



# Optimization Diagnosis of Spasm of Accommodation among Students in the Osh State University

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## Abstract

The paper focuses on the optimization of the spasm of accommodation diagnosis. The authors examined 320 schoolchildren from Zirek, Yiman, Bilim, and Kara-Kuldzha lyceum in the Kara-Suu and Nookat regions and 698 students from KMOP, STEM, MIT, BM, PhysMat, and other faculties of the Osh State University based on complaints and clinical examination, diagnosed with spasm of accommodation. A spasm of accommodation, called false myopia or tired eye syndrome, is very common among students and schoolchildren who use cell phones. This research aims to optimize the diagnosis of the spasm of accommodation among students of Osh State University and schoolchildren. The research shows that increased visual load caused by cell phones and computer technology has become the primary cause of ciliary muscle dysfunction in ocular accommodation, leading to an increase in the number of patients with prolonged spasms of accommodation from visual tension. Schoolchildren, students, and young people of working age are most susceptible to this disease. Spasm of accommodation was found to reduce performance due to visual impairment as a factor in the progression of myopia at Osh State University.

## Keywords

Optimization diagnosis · Accommodation spasm · Students · Schoolchildren · Osh State University

## JEL Codes

I12 · I15 · I18 · I19

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## 1 Introduction

Many people who work at a computer complain of rapid fatigue during long visual work at close range, pain in the eyeballs, temples, and frontal area. Ophthalmologists call this condition spasm of accommodation of the eye. Translated from Russian, accommodation means “adaptation.” Some experts call it “false myopia” because the loss of vision characteristic of this disease is temporary (Agarwal et al., 2020). This pathology is equally common in people with excellent vision and in those who wear glasses or contact lenses. This phenomenon can be explained quite simply from a medical point of view. In normal conditions, the eye muscles are relaxed, and the lens is flattened; vision focuses on distant objects. If a person focuses on one or another object located in the immediate vicinity for a long time, the muscles contract, causing the lens to acquire a convex shape. Statistically, this vision disorder occurs in 15% of the population. Schoolchildren and those whose work requires prolonged visual loads (programmers, jewelers, tailors, all people working at a computer, etc.) are subject to this disease more than others (Asabina, 1971). The following factors contribute to the contraction of the muscles that regulate the curvature of the lens:

- Insufficient level of lighting in the workplace;
- Long stay in front of the monitor or TV;
- Weakness of the neck and back muscles;
- Impaired blood supply in the vertebrobasilar region;
- Vitamin deficiency;
- Sedentary lifestyle.

It is not difficult for a specialist to recognize an accommodation spasm in time. As a rule, conservative treatment is chosen to stop involuntary muscle contraction. For this purpose, the ophthalmologist prescribes eye drops for fatigue, dilating the pupil. The duration of treatment depends on the severity of visual impairment and can vary from a few days to

a month. The ophthalmologist may advise the patient to buy glasses as one of the correction methods.

If the spasm is caused by a neck, back, or spine muscle disease, a doctor may prescribe physiotherapeutic procedures, including electrophoresis, magneto therapy, a massage course of the cervical-collar zone, acupuncture, and physiotherapy exercises. An excellent remedy for eye fatigue is the performance of special exercises, the essence of which is to develop the ability of the eye lens to change its configuration through training quickly. If students and schoolchildren have to spend much time at the computer, it is enough to blink quickly for a couple of minutes to rest the eyes. Eyes should be closed for a minute and eyelids lightly massaged, after which eyes should be closed tightly and then opened. Doing this exercise for about ten times will significantly improve eye function.

Weakness of the accommodative apparatus of the eye due to hereditary structural deficiencies of the ciliary muscle and its insufficient training affect the outcome of the ciliary muscle in the body. Reduced regulation in ciliary muscle generates an even greater deterioration in the eye hemodynamics. Insufficient blood supply is the reason for the weakening of accommodation. The main role in accommodation and deaccommodation belongs to the ciliary body muscles, composed of different types of muscle fibers conjugation, such as cholinergic meridional fibers (Brucke's muscle) and circular (Muller's muscle) and radial (Ivanov's muscle) adrenergic fibers. The last two muscles are disaccommodative because they contribute to the relaxation of accommodation. When the Brucke's muscle contracts, the tension of the Zinn ligaments is weakened, which is immediately compensated by a change in the shape of the lens due to its elastic properties. Weaker circular and radial fibers of the ciliary muscle cannot fully deaccommodate during a spasm of accommodation (Ananin, 1989), which leads to permanent contraction of the ciliary body, characteristic accommodation spasm, blood squeezing, and suprachoroidal space enlargement, accompanied by a nutrition failure of the ciliary body and posterior sclera. Due to all of the above reasons, it is necessary to stimulate deaccommodative muscles of the ciliary body, which is immediately compensated by a change in the shape of the lens due to its elastic properties.

In a myopic eye, the image formed in front of the retina is called axial myopia, in which the distance from the top of the retina cornea or eye axis is increased. In refractive myopia, the radius of the cornea curvature is small, and light rays are more refracted, causing spasm of accommodation or false myopia (Dashevsky, 1973), in which the fixed contraction of the ciliary muscle makes the myopic eye, leading to an increase in the thickness of the lens to form myopic refraction. Increased visual work at close range becomes difficult for the eyes in case of weakened accommodation. Under such conditions, the body needs to change the optical arrangement

of the eyes to adjust them to work at close distances without straining the accommodation. This is achieved largely by lengthening the anteroposterior axis of the eye throughout its growth and refraction. An unfavorable hygienic environment of visual work affects myopia progression only in the area that impedes accommodation and contributes to excessive visual contact with the object of visual work.

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## 2 Materials and Method

The range of examinations includes ophthalmic analysis of central corrected visual acuity, biomicroscopy of the anterior and posterior segments of the eye, ophthalmoscopy, and refractometry (Chetyz, 2007). The authors examined a group of 420 students from Osh State University and schoolchildren aged 7–25 diagnosed with the spasm of accommodation. High visual load associated with professional duties, reading, and computer work was found in all patients with the following complaints: decreased visual acuity, eye sensitivity, eye redness, and lacrimation. The examination of all patients included visometry, refractometry, and determination of accommodation reserves (Samatova, 2011).

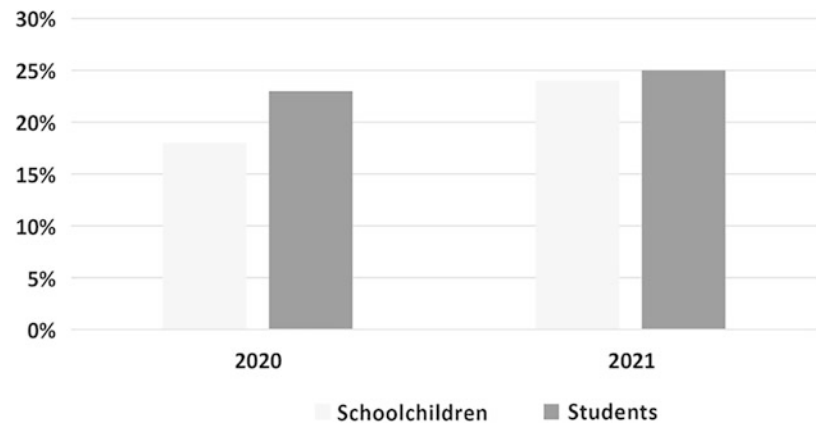
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## 3 Results

Patients' complaints were of the same kind, distinctly related to the presence of visual load. Most of the daily visual workload was examined in people who work about eight hours a day for all their working hours, as shown in Fig. 1. According to the Sivtsev-Golovin table, when examining the central visual acuity, there is a decrease in vision from 0.5 to 0.6 (Ossenblok et al., 1994). Correction with negative lenses (from 0.5 to 1.5 diopters) provided visual acuity of 1.0. Next, refractometry was performed. The average refractometry values were  $-1.25 \pm 0.05$  diopters.

Dry eye syndrome (DES) is currently found in adolescents and children. The main reason for the development of DES in this age is mainly the long-term use of various gadgets, including cell phones and computers. As a rule, an ophthalmologist detects students with DES during professional examinations. Increasing the accessibility of medical care for this category of patients allows them to be monitored to prevent complications and reduces difficulties in the care provided by ophthalmologists. DES is a multifactorial ocular surface disease characterized by impaired tear film homeostasis and ophthalmic symptoms accomplishment, in the progression of which the etiological function belongs to impaired tear film stability, hyperosmolarity, ocular surface damage and inflammation, and neurosensory changes. Damage to the ocular fundus ranges from minor/red eye syndrome to corneal ulcers and loss of the eyeball.

**Fig. 1** Difference in the results of the examination of students and schoolchildren for spasm of accommodation. *Source:* Developed by authors



## 4 Discussion

The occurrence of systemic diseases (hormonal disorders, autoimmune diseases, metabolic diseases, etc.) that cause the impaired production of the water component of the tear film was considered a primary cause of DES. The risk factors for the progression of DES include external (climatic and environmental conditions, occupational hazards, cell phones, computers, and halogen lighting) and internal risks (functional and pathological conditions and eye diseases, including lacrimal glands and Meibomian glands diseases).

Additionally, risk factors for the development of DES include older age, being a student, female gender, smoking, low androgen levels, exposure to weather conditions (heat, cold, low humidity), work with video terminals and monitors, refractive surgery, wearing contact lenses, use of a number of drugs including antidepressants, beta-blockers, etc., systemic diseases such as diabetes mellitus, Sjögren's syndrome, and rheumatoid arthritis.

Based on the above definition of DES, the pathogenesis is based on impaired tear film stability. There are three layers in the tear film structure: lipid, mucin, and aqueous. The exterior lipid layer is derived from the secretion of the Meibomian glands on the eyelids and prevents evaporation of fluid from the cornea surface and conjunctiva. The aqueous layer in the center is secreted by lacrimal glands, making up the largest part of the tear film. The inner mucin layer is secreted by the conjunctiva goblet cells, the main function of which is to provide and maintain the hydrophilic properties of corneal epithelium, which allow the tear film to retain. The tear film performs the following functions:

- Prevention from dehydration and provision of antimicrobial protection, including participation in the immune response protective;
- Facilitation of the sliding of the eyelids over the external side of the eye, separation of unknown particles, and desquamation of epithelial cells;

- Flushing and nourishing the cornea and conjunctiva;
- Light refraction by ensuring the cornea transparency and clarity of vision or optical functions.

Damaged tear film may result in the impaired production of tears, mucins, and lipids, as well as increased tear fluid evaporation.

The glands actively involved in the formation of the lipid layer are called Meibomian glands. They have a definite function in the formation of the tear film. Various diseases of organs and systems, as well as the tension of visual apparatus, can lower the quality of Meibomian glands secretion or lead to blockage of excretory ducts.

Let us discuss dysfunctions considered the leading cause of DES. Tear film becomes hyperosmolar by losing its functions, including protective, metabolic, and others, which leads to inflammation of eye tissues and damage to peripheral nerves, including mechano- and thermoreceptors, resulting in the development of clinical symptoms such as dryness, damage to the eye surface, and eye pain. Against inflammatory reaction conditions, the lacrimal fluid composition changes, and the vicious circle closes.

There are objective and subjective symptoms in the clinical signs of DES. Adhesion of eyelids edges in the morning, dry eyes, burning, a feeling of sand or a foreign body behind eyelids, photophobia, itching in the eyes, pain or discomfort in the eyes, and lacrimation are included in subjective symptoms. Objective symptoms include conjunctival hyperemia, mucous discharge in the form of threads; bulbar conjunctiva folds parallel to the edge of the eyelid, blepharitis, and SDC complications (corneal erosion and punctate keratitis). Additionally, DES is confirmed by data from additional studies, including biochemical studies, the presence of conjunctiva inflammatory markers, and staining with vital stains. Based on the presence of complications and severity of the disease, mild, moderate, severe, and especially severe degrees of DES are distinguished.

When monitoring patients with a mild form of DES, if there are no complications, a general practitioner is

competent to make a timely diagnosis; patients with severe complications are referred to an ophthalmologist.

DES can reduce the quality of a patient's life, in addition to subjective and objective manifestations with problems in reading, watching TV, or driving. A Long DES period causes the emergence of psycho-emotional disorders and depression.

The collection of anamnesis is the first stage in the diagnostic examination of a patient with risk factors in the progress of DES, the identification of conditions and diseases that can lead to secondary DES, and signs (subjective and objective) of corneal-conjunctival xerosis.

The following methods of DES diagnosing are recognized as the main ones:

1. Assessment of the stability of the peroneal tear film;
2. Study of osmolarity of the tear film (salt content in tear fluid);
3. The severity of the determination of xerotic changes in the ocular surface; in practice, fluorescein-staining tests are more commonly used (Strakhov et al., 1998).

The condition of the cornea and conjunctiva can be assessed on a slit lamp using a cobalt light filter. Damaged areas of epithelium in the cornea are stained in a yellow-greenish color. Pathology is considered as such if the number of points of diffuse or dot staining exceeds ten. With DES, these erosions are first localized in the region of the lower third of the cornea and then spread to its entire area and conjunctiva.

A break time test is performed to assess the stability of the tear film. One drop of 0.5% fluorescein solution is injected into the conjunctival fornix of each eye. The patient closes their eyes to remove excess dye. Two minutes after the injection of the solution, the patient blinks and then keeps their eyes open. Tear break-up time is the appearance of a dry spot on the cornea in the absence of blinking. If the tear break-up time is longer than the interval between blinks but less than ten seconds, then the tear film is unstable. The instability of the tear film contributes to local drying and hyperosmolarity of the ocular surface, damage to the surface epithelium, and disruption of the glycocalyx and goblet cell mucin (Xu et al., 2001).

To reduce the evaporation of tears into the environment, active humidification of the room, especially in dry climates, and avoiding aggravating factors are recommended. An important component of the prevention of DES is the application of tear replacements, which are prescribed individually based on the condition of the visual apparatus and aggravating factors with concomitant diseases. Prevention of computer vision syndrome and treatment consists in the organization of the workplace, adjustment of working distances, optimization of the work process, and the proper

use of moisturizing drops or artificial tear preparations, if possible, not protective, corresponding to the correct ametropia and astigmatism, to reduce the symptoms of dryness.

The number of therapeutic measures in DES depends on the etiology, severity of the disease, and the presence of complications and comorbidities. A doctor prescribes medications and separately controls the patient during the initial period of disease without complications and with mild manifestations of the disease and a fairly approving prognosis. The first stage includes all preventive measures and prescription of tear substitute drugs. Low-viscosity preparations are used in mild clinical forms of DES; gel forms are used in moderate and severe forms of the disease. In extremely severe xerosis, low-viscosity preparations without a preservative are indicated.

The first drugs proposed for the correction of DES were saline solutions. Their obvious drawback is the narrow area of influence (tear film aqueous layer) and very short contact time with the eye surface. Synthetic and natural polymers act primarily by replacing the tear film's aqueous layer.

Eye drops with moisturizing properties depend on the drug's viscosity. The higher the drug viscosity, the longer the period of contact of the eye surface with the drug and hydration and preservation of the tear film. Moderate administration of drugs over the eye exterior prevents blinking problems. Viscosity can be increased in a higher concentration of drugs. The high amount of hyaluronic acid in gels (Chang et al., 2021; Salzillo et al., 2016; Vasvani et al., 2020; Zhang et al., 2014) is worse for patients and can cause discomfort and irritation when blinking.

In mild clinical forms of DES, low-viscosity preparations are used in the form of solutions. The concentration of active substance from 0.1% to 0.3% is considered optimal. According to some authors, the protective properties of drugs, such as binding, moisture retention, and recovery, are not mainly characterized by the drug's viscosity but by the product's viscosity and concentration with molecular weight.

Another important property of hyaluronic acid preparations is the presence of additives to ensure the safety of the main active ingredient. Simultaneously, additives can cause some complications and severe complicated forms of DES. The use of eye drops with additives is inappropriate or contraindicated.

Certain artificial tear preparations can contain vital ingredients:

- Dexpanthenol, basic mucopolysaccharides, polyvinyl alcohol, or vitamins are needed to speed up metabolic processes in the outer eye membranes;
- Levocarnitine, glycerol, and erythritol are important for the osmoprotection of corneal and conjunctival epithelial cells;

- Resistance to dehydration;
- Endogenous interferon production, refreshed by polyvinylpyrrolidone, etc.

All hyaluronic acid preparations can restore the lipid mucous layer.

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## 5 Conclusion

The main task of our professional examination of the Osh State University students is the timely diagnosis of DES in the early stages, before the development of complications, as well as the identification of the cause of this disease. It is necessary to supervise students with mild forms of DES, prescribe tear substitutes, and take preventive measures when diagnosing DES (or its high probability). It is important to share the observation of professional examinations of the medical clinic of Osh State University among schoolchildren and students of Osh State University.

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