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State of accommodation and life expectancy: is there a relationship?

Abstract

The work of the visual analyzer is very energy-intensive forthe brain. Accommodation (the ability to scan for hazards at differentdistances) takes up a significant portion of brain resources. In the life expectancy curve, periods of increased risk of death coincide with periods of farsightedness during the development of the normal (emmetropic) eye - the first years of life and after 40 years.

In case of farsightedness, the load on the accommodative apparatus is maximum (compared to other types of refraction), which exhausts the brain and the body as a whole. Therefore, after 40 years of age, in the conditions of body aging, the brain gradually turns off near accommodation (the lens loses its elasticity, the ciliary muscle - its efficiency). Excessively weakened accommodation is a trigger for age-related eye diseases (cataracts, glaucoma, macular degeneration). New surgical approaches to the treatment of these ophthalmopathologies based on the restoration of accommodation have been proposed. These surgeries may affect not only the quality of vision but also the life expectancy of patients.

Keywords: eye, brain, accommodation, hyperopia, laser mydriasis, supraciliary sclerectomies, simple direct myopic astigmatism up to 1.5 diopters

The days of our years are seventy years old, and in good health - eighty years. Psalm 90:10

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Introduction

The visual analyzer, which provides 90% of the information about the world around us, is very energy-intensive for the brain. Its work is serviced by half of the 12 pairs of cranial nerves (about 50% of the brain's energy resources are spent on it). One of the most energy-consuming muscles is the accommodation muscle.

Accommodation is the ability of the eye to see clearly both far and near. The accommodation apparatus consists of the lens, ciliary bodyand ciliary ligaments. The sympathetic nervous system provides distance accommodation, while the parasympathetic system provides near accommodation. There is also a resting state of accommodation - in a reference-free space, the eye becomes myopic at 1.5 diopters and is adjusted to a distance of 60-70 cm. This corresponds to the length of a person's arm (so that in the dark it is ready to react instantly to danger). That is, evolutionarily, accommodation was created to scan for danger atdifferent distances and played an important role in the survival of humans as a species.[1]

From this perspective, it is interesting to look at the lifeexpectancy curve.[2] The chance of dying in a given year gives a slight spike at birth, because some children die shortly after birth, but if a child survives the first few years, he or she is likely to live for decades. Then, around the age of 40, our chances of dying begin to increase and peak at 82. Life expectancy follows a normal distribution curve (Gaussian distribution).

This curve coincides very well with the development of the human accommodative function. At birth, most full-term infants are farsighted at 4.0 diopters, and the burden of accommodation is very high (in the context of an incompletely formed visual system - its sensory and motor parts). Duringthis period, the brain spends a significant portion of energy resources on maintenance of the accommodation device, so in general, the body's resistance to diseases is reduced, and mortality in early childhood is quite high.

Eye emmetropization is completed by the age of 5-7 years. The working conditions of the adaptive device become more physiological, the brain works more ergonomically, and most childhood diseases are left behind. After the age of 40, age-related farsightedness - presbyopia - develops and mortality begins to increase. Presbyopia is similar to farsightedness, which begins in childhood and shows similar signs of blurred vision of close objects. We believe that as the body ages, the brain gradually turns off near accommodation (minimum at 80 years of age) to "make life easier" for itself, as organs and systems begin to fail and require more attention (accommodation weakens due to decreased elasticity of the lens and reduced efficiency of the ciliary muscle). Or perhaps weakening accommodation is one of the factors that triggers the aging process itself?

Ancient Indian treatises say that after the age of 40, a person begins to see poorly up close, so that he or she stops being disturbed by all the vain things, and looks up to Heaven more often and thinks about Eternity.

The Bible says: "Moreover, my son, be careful: to keep many books is to have no end, and to study much is to torment the body" (Ecclesiastes 12:12).[3,4]

Therefore, after the age of 40, when accommodation is progressively weakening, visual loads in the vicinity (even with proper presbyopia correction) should be dosed so that the brain is not excessively distracted by the functioning of the visual analyzer to the detriment of other vital organs and systems. The fact that the visual analyzer is very energy-consuming for the brain is confirmed by the partial blocking of its sensory and/or motor parts in serious somatic diseases (macular edema, central retinal vein thrombosis, mydriasis, ophthalmoplegia, etc. develop).[5] There is also afeedback loop: with excessive visual load, IT workers' overall health deteriorates.

A few words about accommodative asthenopia (visual fatigue). It occurs not only in uncorrected refractive errors (farsightedness, astigmatism, presbyopia), but also in case of general fatigue, debilitating

diseases, contusions, chronic stress, infections, intoxication, etc. Symptoms of visual fatigue (weakness of accommodation): "blurring" of letters when reading, details of small objects; cutting and aching in the eyes, pain in the temples, between the brow bones, photophobia.

One of the natural ways to solve the problem of weakened accommodation is myopization of the eye (myopia reduces the cost of accommodation at close range).

Cases from practice. Example 1: Boy M., 9 years old. Since the beginning of the war in Ukraine, he has been under chronic stress (his father is at the front). According to his mother, the child is irritable, tearful, and does not sleep well. They came for a preventive visit. Objectively: eyes arecalm, optical media and fundus are normal.

Visual acuity of both eyes is

1.0. Mydriasis refractometer: simple myopic astigmatism of direct type -

0.75 diopters in both eyes. There is no discomfort when working at close distances. The volume of accommodation is 14 diopters (normal). The formation of myopic astigmatism expanded the focal area of theeyes, which compensated for the load on accommodation.

Recommendations: consultation with a pediatric neurologist, sports,limiting the use of gadgets, and a healthy lifestyle.

Example 2: Woman D., 43 years old. Two years in chronic stress (illnessof relatives). Takes sedatives (prescribed by a family doctor). She is asthenic. Complaints of redness, burning, discomfort when working up close. Objectively: both eyes - anterior compartments: signs of dry eye syndrome, deeper media without pathology. Visual acuity of the right eye: 0.8/1.0 with cyl-1.0D ax 10; visual acuity of the left eye: 0.7/1.0 with cyl-1.25D ax 165. Refractometer: simple myopic astigmatism of the direct type of 1.25 diopters and 1.5 diopters, respectively. The volume ofaccommodation is 3.0 diopters (slightly below normal). Intraocular pressure and visual field of both eyes are normal. The formation of simple myopic astigmatism of the direct type expandedthe focal area of the eyes, reduced the load on accommodation, but did not completely solve the problem (as evidenced by the addition of the dry eye syndrome).

Recommended: trophic therapy, short-distance glasses, limiting visual load, healthy lifestyle. The above examples show that in case of chronic stress (as well as other debilitating pathologies), it is necessary to check the ophthalmic status and state of accommodation. The treatment of weakened accommodation should be comprehensive: optical correction plus a healthy lifestyle (rational nutrition, adequate drinking, good sleep, physical activity, positive thinking). The total myopization of our youth is nature's response to a sedentary lifestyle and excessive use of gadgets, which depletes theciliary muscle and weakens accommodation.

Another compensatory reaction of the body to excessive weakening of accommodation (more than presbyopic) is age-related eye diseases (cataracts, glaucoma, macular degeneration)[4]. Why are age-related eye diseases so difficult to treat and often lead to vision loss? Because globally, the brain is not interested in a significant load onitself from actively working eyes in the context of aging of the whole body.

We offer step-by-step methods of treating age-related ophthalmopathology aimed at restoring the weakened adaptive capacityof the eyes:[4,6]

Laser mydriasis. (In old age, the pupil is narrow, respectively, the distance "ciliary body - crystalline lens equator" is smaller, the influence of the ciliary muscle on the lens decreases, and accommodation is weakened. Given the synergistic innervation of the iris and ciliary muscles, moderate laser dilation of the pupil (the diameter is determined experimentally) should cause the ciliary ring to dilate and, accordingly, increase the volume of accommodation).

Formation of rounded supraciliary non-penetrating sclerectomies (imitation of anterior scleral staphyloma in neglected myopia and glaucoma, which will expand the ciliary body ring and, accordingly, increase the volume of accommodation. The diameter, number and location of sclerectomies are determined experimentally).

Phacoemulsification of the lens with IOL implantation (the optical power of the IOL should be calculated so that the final refraction of the artificial eye is simple myopic astigmatism of the direct type up to 1.5 diopters - this refraction provides the maximum amount of pseudo-accommodation).[3]

It is possible that these surgeries, by restoring accommodation in old age,will affect not only the quality of people's vision, but also their life expectancy.

But the question arises: will the body, unbalanced by old age, like the fact that the brain will again have to devote a significant part of its resources to the actively working visual analyzer, neglecting the needs ofother organs and systems? Therefore, in our opinion, the effect of these operations will be short-lived.

God has encoded age-related eye diseases in the accommodative apparatus, which is so complex and jewel-like that it is unlikely to interfere with its structure and radically change its functioning.

The Bible says: "And remember in the days of your youth your Creator...the years will come of which you will speak: "They are unpleasant to me!"... and those who look out of the window will become dark..." (Ecclesiastes 12:1,3).

Therefore, faith in God, good deeds, professional employment, proper correction of refractive errors, healthy lifestyle, family warmth, traveling are the best prevention of early eye diseases and the body as a whole. And death will be defeated in Eternity.

Conclusion

1. The work of the visual analyzer is very energy-consuming for the brain.
2. Accommodation (the ability to scan for danger at different distances) takes up a significant portion of brain resources.
3. In the life expectancy curve, periods of increased risk of death coincide with periods of farsightedness during the development of the normal (emmetropic) eye - the first years of life and after 40 years.
4. In case of farsightedness, the load on the accommodative apparatus ismaximum (compared to other types of refraction), which exhausts the brain and the body as a whole. Therefore, after the age of 40, in the conditions of body aging, the brain gradually turns off near accommodation (the lens loses its elasticity, the ciliary muscle - its efficiency).
5. Excessively weakened accommodation is a trigger for age-related eye diseases (cataracts, glaucoma, macular degeneration).
6. New surgical approaches to the treatment of these ophthalmopathologies based on the restoration of accommodation have been proposed. These surgeries may affect not only the quality of vision but also the life expectancy of patients.

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Conflicts of interest

The authors declare no conflicts of interest.

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