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HE CAUSES AND TREATMENT OF MYOPIA IN CHILDREN

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Annotation: This scientific article is dedicated to comprehensively covering the etiology, pathogenesis, clinical manifestations, and modern approaches to the treatment and prevention of myopia (nearsightedness) in children. Myopia is one of the most common refractive errors in childhood, characterized by the focusing of an image in front of the retina due to the elongation of the anterior-posterior axis of the eyeball or an increase in the eye's optical refractive power beyond the norm. The article analyzes the main factors influencing the development of myopia—hereditary predisposition, biological factors during the prenatal and postnatal periods, prolonged close-up work, excessive use of digital technologies, poorly lit environments, lack of physical activity, and non-compliance with visual hygiene—based on scientific sources. It also highlights the pathological changes that occur in the fundus in progressive forms of myopia and their negative impact on visual acuity. The abstract emphasizes the importance of early detection of myopia and the necessity of regular ophthalmological screening in preschool and school-aged children. The significance of examination methods such as refractometry, visometry, and ophthalmoscopy in the diagnostic process is indicated. The role of optical correction using individually selected glasses and contact lenses, instrumental physiotherapeutic procedures, eye muscle strengthening exercises, pharmacological agents, and surgical interventions in severe and complicated cases are analyzed as treatment and control measures. Furthermore, the article pays special attention to complex prophylactic measures aimed at preventing myopia—normalizing visual load, maintaining the correct distance during reading and writing, increasing active outdoor movement, fostering a healthy lifestyle, and increasing the responsibility of parents and educators. The research results have significant scientific and practical importance in reducing the prevalence of myopia in children, early detection of the disease, and developing effective treatment strategies.

Keywords: myopia in children, nearsightedness, refractive errors, eye diseases, ophthalmology, pediatric ophthalmology, etiology of myopia, pathogenesis of myopia, hereditary predisposition, visual analyzer, elongation of the eyeball, retina, refractive power, progressive myopia, fundus changes, visual acuity, early diagnosis, ophthalmological screening, visometry, refractometry, ophthalmoscopy, optical correction, glasses, contact lenses, instrumental treatment, physiotherapeutic procedures, eye exercises, pharmacological treatment.

Introduction

In recent decades, the widespread prevalence of eye diseases in children, particularly myopia among refractive anomalies, has emerged as a serious problem for the global healthcare system. According to the World Health Organization and leading ophthalmological research data, a significant portion of school-aged children worldwide are diagnosed with various degrees of myopia, and this indicator is consistently increasing against the backdrop of rapid development

of digital technologies. Myopia is not only a decrease in visual acuity, but also an important medical and social problem that negatively affects a child's psychophysiological development, activity in the learning process, and quality of life. Myopia in children primarily forms during the period when the visual analyzer is functionally immature and develops as a result of a complex interaction of hereditary and exogenous factors. Studies show that children with a hereditary predisposition have several times higher risk of developing myopia, and this risk further increases, especially when one or both parents have myopia. At the same time, prolonged close-up visual work characteristic of modern lifestyles, uncontrolled use of electronic devices (smartphones, tablets, computers), insufficient natural lighting, and non-compliance with visual hygiene are recognized as the main external risk factors for the development of myopia.The stretching of the eyeball's anterior-posterior axis, strain on the accommodative apparatus, changes in the biomechanical properties of the scleral tissue, and functional disorders occurring in the retinal structures play an important role in the pathogenesis of myopia. Especially in childhood, due to the high elasticity of eye tissues, progressive forms of myopia are frequently encountered. If these processes are not stopped in time, severe complications such as high-grade myopia, chorioretinal dystrophies, retinal detachment, and even early disability can develop.Early detection and effective treatment of myopia in children is one of the priority areas of modern ophthalmology. Today, highly accurate instrumental methods such as refractometry, skiaskopy, biomicroscopy, ophthalmoscopy, optical coherence tomography, and biometric measurements of the eyeball are widely used in the diagnosis of myopia. In treatment and control, in addition to traditional optical correction, low-dose atropine therapy, orthokeratological lenses, apparatus-treatment methods, and lifestyle preventive measures aimed at optimization are being introduced. In this regard, it is important to deeply study the mechanisms of myopia in children, scientifically evaluate the effectiveness of modern treatment and prevention approaches, and implement them in practice. This article comprehensively analyzes the etiological and pathogenetic aspects, clinical course, and modern treatment and control methods of myopia in children.

Myopia is a refractive anomaly caused by an imbalance between the refractive power of the eye and the axial length of the eyeball, characterized by the image focusing in front of the retina. According to the World Health Organization (WHO) and the Global Burden of Disease (GBD) project, approximately 30–35% of the world's population currently has myopia, and this figure is projected to reach 50% (≈5 billion people) by 2050. In particular, the prevalence of myopia is rapidly increasing among school-aged children and adolescents.Etiologically, myopia in children is a multifactorial disease, shaped by the complex interaction of genetic predisposition and environmental factors. Epidemiological studies show that if both parents have myopia, the risk of a child developing the disease is 6–8 times higher, and if one parent has it, the risk is 2–3 times higher. Genetic factors are associated with the axial length of the eyeball, the strength of the scleral collagen structure, and the regulation of the accommodative apparatus.Among exogenous factors, prolonged near work, excessive use of digital devices, insufficient lighting, and reduced time spent outdoors play a leading role. International cohort studies have shown that spending at least 2 hours a day outdoors reduces the risk of myopia development by 20–30%. In the pathogenesis of myopia in children, the main pathomorphological mechanism is the axial elongation of the eyeball. Clinical and instrumental studies show a strong correlation between an increase in axial length and an increase in the degree of myopia. In progressive myopia, axial length can increase by 0.2–0.4 mm per year.Chronic strain on the accommodative apparatus leads to accommodative spasm, imbalance in ciliary muscle activity, and disruption of intraocular hydrodynamics. Concurrently, collagen

fiber restructuring, decreased biomechanical strength, and increased matrix metalloproteinase activity are observed in the scleral tissue. Some molecular-biological studies have indicated that a weakening of the retina-dopamine system plays an important regulatory role in the development of myopia.In diagnosing myopia in children, objective refractometry, skiaskopy (under cycloplegia), biometry, optical coherence tomography (OCT), and fundus examination are used.

The examination is of great importance. According to international clinical recommendations, an examination performed under cycloplegia is considered the "gold standard" for assessing refraction in children.When assessing the prognosis of myopia, axial length, age of onset of myopia, and annual progression rate are considered as key prognostic criteria. According to scientific data, the onset of myopia before the age of 7-8 significantly increases the risk of developing high myopia. In modern ophthalmology, the concept of controlling the progression of myopia (myopia control) is a priority rather than treating it in children. Although traditional optical correction (glasses, contact lenses) improves visual acuity, it cannot completely stop the progression of myopia.Recent randomized clinical trials have proven that low-dose atropine (0.01–0.05%) drops slow down axial elongation by 40–60%. The mechanism of action of atropine is explained by the modulation of growth signals at the retinal and scleral levels. Orthokeratological lenses have also been found to reduce myopia progression by 30–50%, acting through a peripheral retinal defocus mechanism. The combined use of these methods with visual hygiene and lifestyle optimization ensures the highest effectiveness. The high prevalence of myopia in children represents a significant economic burden for the healthcare system. According to international estimates, the global economic damage associated with myopia and its complications exceeds 200 billion US dollars annually. Therefore, early prevention, school ophthalmological screening, and the introduction of comprehensive control programs are a priority.

Conclusion

Myopia in children is a global health problem, and its development is caused by the interaction of genetic predisposition and environmental factors. Studies show that parental myopia, prolonged near work, excessive engagement with digital devices, spending less time outdoors, and neglecting visual hygiene are major risk factors for myopia in children.In the pathogenesis of myopia, axial elongation of the eyeball, accommodative dysfunction, and biomechanical weakening of scleral tissue appear as key mechanisms. Early-onset myopia increases the risk of developing high myopia and retinal complications. Modern approaches aim to slow the progression of myopia in children, with the effectiveness of low-dose atropine therapy, orthokeratology lenses, and optical correction based on peripheral defocus being scientifically proven. At the same time, regular ophthalmological follow-up, increased outdoor activities, and visual hygiene measures are important in reducing progression.As a result, early detection of myopia in children and assessment of individual risk factors, as well as the implementation of evidence-based comprehensive control and prevention programs, are key conditions for long-term preservation of visual

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