CONTROL OF MYOPIA

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Abstract: Myopia is a refractive error of the eye, where the light rays, when passing through the optical medium during relaxed eye accommodation, converge in front of the retina. In a healthy eye without refractive anomalies, these rays converge onto the retina. Myopia can be classified into three types: axial, when the anterior-posterior axis is longer; refractive, when the eye's refractive power is stronger; secondary, resulting from medication, corneal and lens diseases. In addition to various factors influencing the development of myopia, it can also have a genetic component. In children with at least one myopic parent, the likelihood of developing nearsightedness is significantly higher. Treatment and control of Myopia occur through various methods. Spending more time outdoors, especially for young individuals, reduces the risk by 2%. Experts recommend 7-15 hours of outdoor activity for children weekly. Limiting digital device usage in daily life, combined with prolonged outdoor time, yields better results. Treatment options include glasses with peripheral defocus or progressive/bifocal spectacles, soft contact lenses, rigid gas permeable contact lenses, multifocal soft contact lenses. Ortho K lenses, atropine medication and refractive laser procedures. Research indicates that due to the rapid integration of technology and digital devices into people's daily lives, over 50% of the population by 2050 will experience nearsightedness. It is a leading cause of pathological conditions and a decrease in visual acuity. Myopia is defined as the pandemic of the 21st century. Observations with progressive treatments show positive results in young individuals. Manufactures of dioptric glasses introduce new methods for correction, such as bifocal lenses that address near and far vision or lenses with peripheral defocus to reduce the hyperopic defocus in cases of high myopia. Ortho K lenses, worn overnight, provide clear vision during the day, correcting diopter and reducing eye elongation by 30% to 100%. They are suitable up to the age of 14. Atropine treatment significantly slows myopia progression. Concentrations of 0.5-1% reduce progression by up to 75% and lower concentrations of 0.1-0.01% achieve a 67% reduction with fewer side effects. Control of myopia is a serious issue requiring thorough consideration. Early attention to children and appropriate treatment are crucial. With existing market options, it becomes easy and harmless for them. Timely intervention may prevent the need for surgical procedures. Understanding factors leading to myopia progression and educating people will enhance prevention and control efforts, significantly reducing the percentage of children with high Myopia over time.
Keywords: Myopia, control, treatment, lenses, glasses.

1. INTRODUCTION

Myopia is a global pandemic, with studies showing that it will affect 5 billion people by 2050 (Figs. 1 and 2). In Europe, one in two people will be myopic, resulting in an estimated 416 million people with myopia in less than 30 years (Holden BA, Fricke, 2016). Myopia is a refractive condition in which light rays focus in front of the retina in the absence of accommodation. Thus, a person has reduced vision and blurring when looking at distance. In myopia, we have growth of the eyeball from its interior, not depending on the nervous system and the brain. The retina determines the eye as nearsighted or farsighted (Bullimore and Brennan, 2019). As the eye grows, signals are transmitted to the retinal pigment epithelium through the choroid and then reach the sclera, where remodeling of the intercellular matrix takes place. The enzymes that break down the strength of the scleral tissue weaken structurally and thus the eyeball enlarges. Thus, the internal pressure increases and the eye elongates in myopia (Cruickshank and Logan, 2018; F.E. Cruickshank, N.S. Logan). In the progression of myopia, the axial length of the eye, the anterior-posterior axis, is also important. When the child is born, it is about 17mm. During the first year of development, it has a more intense pace and reaches 21mm, after which the growth of the eye decreases in order to balance the other parts of the body. During adolescence is the other period of increased growth rate of the eye and then it reaches between 22-24mm. Then the axial length remains constant until the end of life. In myopic eyes, however, growth continues and they become longer during this period until the organism completes its full growth. As the eyes continue to grow, children change their optical correction between 6 and 12 months (Fu et al., 2016). The occurrence of myopia is a familial burden with three times the risk when one parent is myopic and up to six times when both parents are myopic. Geographical location is also important, with the highest incidence of myopia being in East and South-East Asia, which is up to twice that of Europe (Cooper and Tkatchenko, 2018).

Figure 1: The number people estimated to have myopia and high myopia for each decade, from the year 2000 through to 2050. Error bars represent the 95% confidenceintervals (from: Holden, 2016).

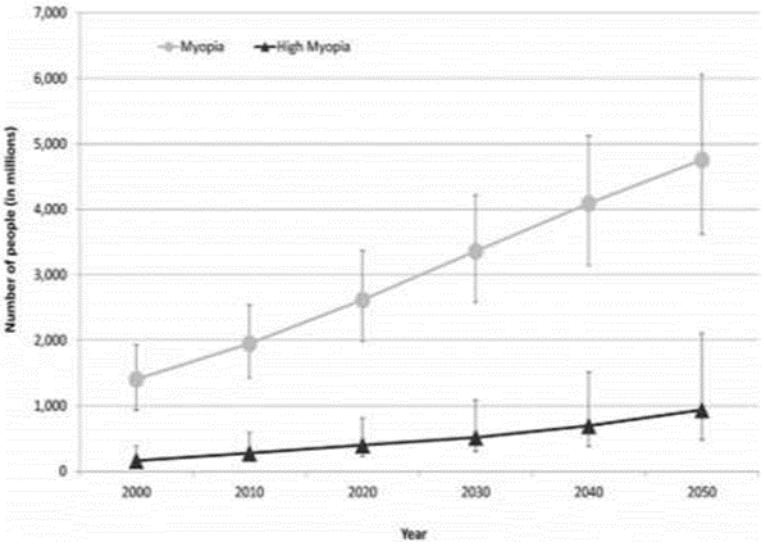
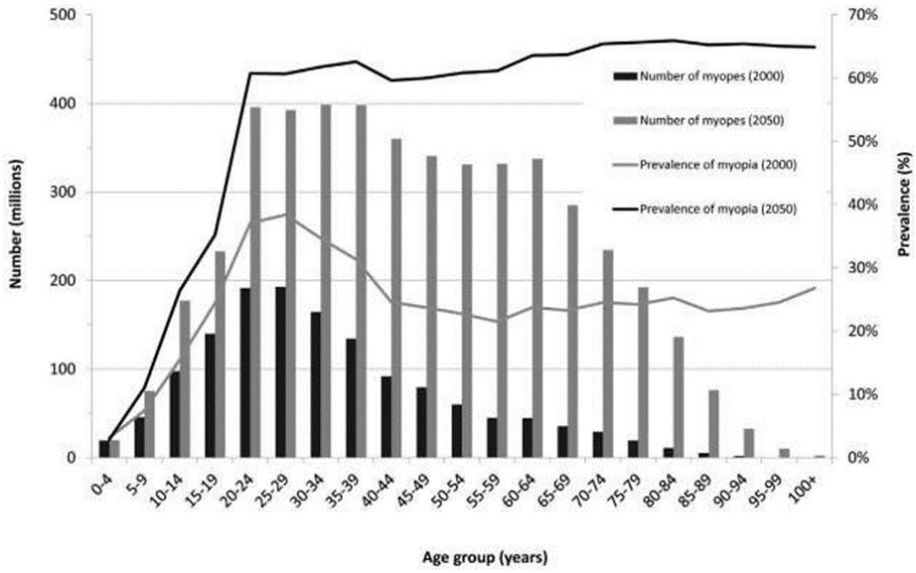


Figure 2: The distribution of people estimated to have myopia across different age groups, in the year 2000 and 2050 (from: Holden, 2016)

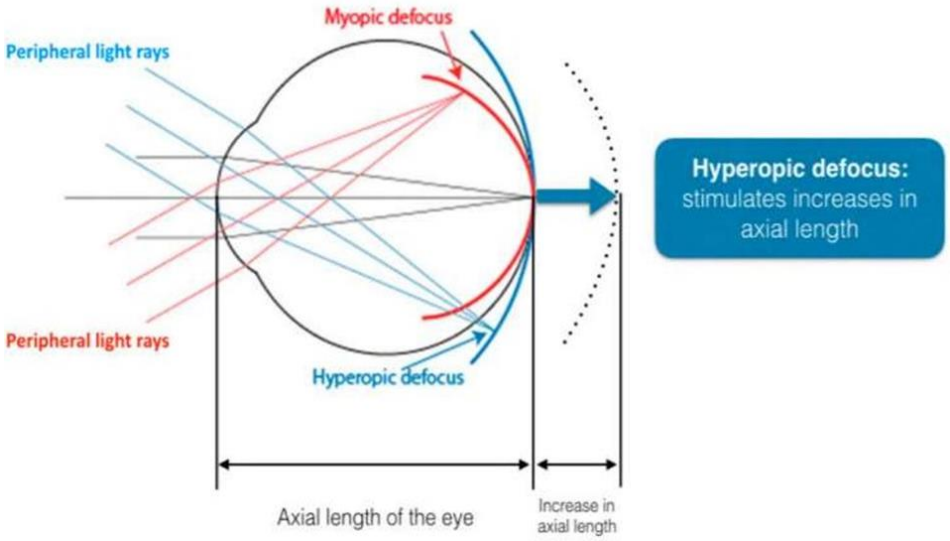


2. MATERIALS AND METHODS

Myopia correction and treatment methods are many and varied. Correction glasses with peripheral defocus or bifocal glasses that support convergence, with them we have a diopter for far and near. These glasses can be with a visible or invisible segment. Studies prove that with this type of corrective lenses they have a positive effect and slow down the growth of myopia (Aller et al., 2016). Almost all prescription lens manufacturers have myopia correction products. With them, we have a clear zone in the middle of the glass and the diopter degresses towards the periphery (Fig. 3). In this way, the resulting image follows the curvature of the retina and thus stops the progression. They are individual lenses with individual parameters - years, interpupillary distance, angle of inclination, pantascopic angle, vertex distance, pupil height, relative to the specific dioptric frame. In this way, the manufacture and installation of the correct product is most accurate. Other ways to correct myopia are through soft, hard and Ortho K lenses. Soft contact lenses can also be combined. In this way, children who do not wish to wear glasses can also undergo correction with lenses. This type of correction is also used in older individuals with high myopia. One of the new and alternative methods of myopia correction is Ortho K lenses. These are gas permeable

contact lenses that can correct from -0.75D to -5D as standard. They are one year old and the child sleeps with them at night, and during the day the lenses are removed and he can walk calmly without them and see clearly without the need for correction. This type of lens can be used up to 14 years of age. They have up to a 100% success rate (Fan et al., 1999). Here, the care of the lenses and their placement is entirely in the hands of the parents. Before purchasing this type of corrective lens, they familiarize themselves with how to use and fit the lenses. Atropine therapy is the next type of myopia treatment. Its exact mechanism of action has not yet been determined. Many experiments show that it is not related to accommodation, but has an effect on the sclera and makes it stiffer so that it does not elongate. Atropine is safe and effective at a concentration of 1.0% as well as at lower concentrations. It is a natural alkaloid and belongs to anticholinergic drugs. Atropine to control myopia is given topically as drops. Its directions are twofold - for the prevention of myopia and the control of myopic progression. The effectiveness of the preparation is great in the age between 5-6 and 11-12 years. After this period, switching to other methods of myopia control is recommended (Chua et al., 2006). The last type of myopia treatment is surgery (Robboy et al., 2018). One of the ways is posterior scleral strengthening, whereby the eyeball is mechanically strengthened in order to slow the progression of myopia. Different materials are used - strips of Tenon's tendons, aorta or donor sclera.

Figure 3: Relative peripheral hyperopic defocus (light focused behind retina), andrelative peripheral myopic defocus (light rays focused in front of the retina) (from: Menicon, 2017).



4. RESULTS AND DISCUSSIONS

With colleagues from the College of Medicine at Trakia University, Stara Zagora, we examined 69 children to check the presence of myopia among the younger generation. The results were not positive, as about 30% (over 20 children) of the examined patients gave a positive presence of already developed myopia, and a part of them had a high diopter level, namely above -4D. After much discussion and re-examination, we were able to conclude that the best types of treatment for these children would be Ortho K lenses as well as low concentration atropine therapy. The use of corrective lenses in children with peripheral defocus or bifocal lenses is also a good solution, but only when the children wear the glasses correctly and consistently. The difference with this correction, compared to the other two, is that the success rate of diopter reduction is high, but the final diopter removal is not 100%. When wearing soft contact lenses, there are also good results, but compliance with hygiene in small children is difficult and is not recommended by smepialists before the age of 12. A study shows how a soft contact lens for myopia control affects the distribution of defocus on the pupil. Aberrometric data of 47 people with normal eyes were used here. Lens decentration reverses myopic defocus, resulting in a clear image. The relationship between the position of the lens and the center of the pupil must be clearly understood and so the performance and design of this type of lens can be presented. (Indiana University). Wearing this type of corrective lenses is a good option. A study aims to compare this type of lens but with different posterior optical axis diameter (BOZD), thus tracking which is the best option for controlling myopia. Children are distributed, some of them wear lenses with a diameter of 5 mm, and others with 6.2 mm. After long examinations, it was found that the growth of the axial length of the eye for lenses with a diameter of 5 mm was 0.16 mm, and for the other variant it was 0.25 mm. After controlling for corneal

refractive power, it has been estimated that wearing orthokeratology lenses with a smaller posterior axis diameter results in a reduction in the axial length of the eye. (Nova Southeastern University College of Optometry, Tianjin Eye Hospital, Tianjin Medical University). Orthokeratology is a treatment that is very popular in the West and the effectiveness is very high. The success rate is maximum and the treatment is relatively short. After a study by the Collaboration Longitudinal and Refractive Error, it was proved that axillary length increases with age and younger organisms are more prone to developing high myopia. This study looked at the axial length of the eye and how it affected the occurrence of progressive myopia over a one-year period. The participating children are not nearsighted and are 6 to 12 years old from the United States. Data were taken from baseline axial length, ethnicity, and gender. It can be seen that in one year the myopic soil does not vary significantly, suggesting that no correction is needed before the axial length can be clearly and accurately assessed. (The Ohio State University College of Optometry).

5. CONCLUSIONS

Myopia control is an important task that eye health professionals must continue to research and find solutions to improve our lifestyle. After the studies and examinations of children, we were able to conclude that when people have a desire to change and listen to the advice of the persons taking care of their health, treatment is possible. However, it should be known that with each method there are risks. As when wearing lenses, high hygiene must be observed in order to avoid adverse reactions and inflammatory processes. Before using any method to control myopia, it is very important that informed consent is obtained and that people know exactly what they need to do and what the possible results will be. Globally, the development of progressive myopia is pandemicly more widespread in East Asian latitudes than in European latitudes, although significant progress is also observed in Europe. The control of progressive myopia is described in the study of many reports. Risk factors due to high myopia such as: maculopathy 58%, retinal detachment 30%, cataract 21% and glaucoma 20% increase with each increased diopter of myopia. Numerous articles, reports and studies in recent years on progressive myopia as an epidemic, prevention and risk factors have been published in PubMed. Only in 2019 there are 1401, in 2020 - 1686 and in 2021 there are 1994. A large part of the publications are related to methods and methods for controlling, delaying and treating myopia. Asian studies prove that low doses of atropine lead to ineffective treatment. This leads more and more to the wearing of soft contact lenses, but with less rapid therapy. This option becomes an alternative to orthokeratogy.

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