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MYOPIA: MODERN METHODS OF TREATMENT

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Abstract
Myopia, which is widely known as a nearsightedness, is a condition that affects millions of people worldwide and is expected to reach almost half of the total population by 2050, according to the forecasts. Research results suggest that low-dose atropine is very effective in retarding the progression of myopia, and besides it, orthokeratology and peripheral defocus lenses are also good options for children. On the other hand, surgical procedures such as LASIK and the insertion of collamer lenses can achieve the complete correction of myopia in adults with stable refractive error.

Keywords: Myopia, refractive error, atropine therapy, orthokeratology, LASIK, myopia control, progressive myopia, optical correction

Аннотация
Миопия, широко известная как близорукость, представляет собой одно из наиболее распространённых заболеваний органа зрения, поражающих население всего мира, при этом прогнозы указывают на то, что к 2050 году почти половина населения планеты будет страдать миопией. Результаты исследований свидетельствуют о том, что низкие дозы атропина демонстрируют значительную эффективность в замедлении прогрессирования миопии, тогда как ортокератология и линзы с периферическим дефокусом предлагают перспективные альтернативы для пациентов младшего возраста. Хирургические вмешательства, включая LASIK и имплантируемые коллагеновые линзы, обеспечивают эффективную коррекцию стабильной миопии у взрослых.

Ключевые слова: миопия, аномалия рефракции, атропиновая терапия, ортокератология, LASIK, контроль миопии, прогрессирующая миопия, оптическая коррекция

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Annotatsiya
Miopiya, odatda yaqindan ko'rmaslik deb ataluvchi holat, dunyo aholisiga ta'sir ko'rsatuvchi eng keng tarqalgan ko'z kasalliklaridan birini ifodalaydi, bunda prognozlarga ko'ra 2050-yilga kelib dunyo aholisining deyarli yarmi miopiyaga chalinadi. Natijalar shuni ko'rsatadiki, past dozadagi atropin miopiya rivojlanishini sekinlashtirishda sezilarli samaradorlik namoyish etadi, ortokeratologiya va periferik defokus linzalari esa yosh bemorlar uchun istiqbolli muqobil usullarni taklif etadi. LASIK va implantatsiya qilinadigan kollamer linzalarini o'z ichiga olgan jarrohlik aralashuvlari kattalar orasidagi barqaror miopiyani samarali tuzatishni ta'minlaydi.

Kalit so'zlar: miopiya, refraksiya anomaliyasi, atropin terapiyasi, ortokeratologiya, LASIK, miopiyani nazorat qilish, progressiv miopiya, optik korreksiya

INTRODUCTION

Myopia is a refractive defect that occurs when the eye's focus is set in front of the retina and consequently, it leads to the blurring of distant objects while the vision for the close range is quite clear. This ocular disorder has become a major public health issue, as the results of various studies conducted in different regions and among diverse populations have indicated a steady rise in the number of cases [1]. The development of myopia is linked to a pathological mechanism involving the pointing of the eyeball. This results in the inability of the cornea and lens to accommodate for the eye's physical length and power. Modern studies in the field of ophthalmology have pointed to a variety of factors as being responsible for the initiation and development of myopia amongst which are genetic predisposition, environmental factors like excessive near work and lack of outdoor activity, along with the educational requirement of continuous visual attention at close distances [2]. The economic impact of myopia is not only limited to direct healthcare costs but also includes loss of productivity, decreased quality of life, and an increased risk of eye-threatening complications such as retinal detachment, myopic maculopathy, glaucoma, and cataracts. All these concerns have led to the

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intensification of the research efforts aimed at the development of the treatment methods that would not only correct the existing refractive errors but also prevent or slow down the progressive myopic changes, especially in children, where the intervention is likely to have the most significant effect [3].

METHODOLOGY AND LITERATURE ANALYSIS

The methodological approach used in this review consisted of a systematic review of the peer-reviewed literature of the last ten years, such as clinical studies, meta-analyses, and trusted guidelines from the most recognized ophthalmological organizations. The analysis of the literature points out that he modern treatment of myopia is made up of three main groups: optical correction, pharmacological and surgical procedures, each of which has its own action mechanism and clinical application [4]. Optical correction methods have long since expanded from the traditional single-vision glasses and contact lenses to the inclusion of special designs that change the characteristics of retinal areas with different defocuses. Orthokeratology has become overnight wear of rigid gas-permeable contact lenses to temporarily reshape the cornea to an extent where this method is considered both corrective and myopia control, with a reduction rate of the axial length of about forty to sixty percent compared to conventional methods indicated by studies [5].

The spectacle lenses with peripheral defocus modifications that include the defocus incorporated multiple segments technology and highly aspherical lenslet designs are the most recent methods to produce myopic defocus in the peripheral retina while keeping clear central vision. Atropine eye drops have been one of the most frequently researched ways to treat myopia, and studies have shown that the effects on the progression rates are dependent on the dosage. The Atropine for the Treatment of Myopia trials in Asian populations indicated that low-dose atropine concentrations, especially at the level of zero point zero one percent, can lead to significant reductions in myopia progression with a reduction in the occurrence of side effects such as photophobia and accommodation loss which are associated with higher concentrations [6]. Further studies have looked at different

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concentration protocols and combinations of therapies, but the agreement on the best dosing regimens is still changing as more longitudinal data become available. Myopia surgical treatments have made an enormous benefit in technology, and now laser-assisted procedures like laser-assisted in situ keratomileusis and photorefractive keratectomy are considered to be normal and already established treatments for suitable adult patients. The ablation of corneal tissue is done very precisely, and the eye's optical power is changed, which is what these procedures do for refractive correction. The modern platforms for these procedures engage wavefront-guided and topography-guided treatment profiles to enhance visual results [7]. Moreover, for those patients who have very high myopia or corneal patterns unsuitable for ablative treatment, phakic intraocular lens also known as implantable collamer lenses is an alternative surgical method that not only provides correction of the refractive status but also keeps the cornea intact and achieves quite a bit of correction [8].

RESULTS AND DISCUSSION

Modern myopia treatment has gone through a change in the measures taken which now consist of both refractive correction and management of progression control. That change was supported by strong evidence base for the therapy of low-dose atropine; indeed, there were numerous randomized controlled trials in different parts of the world that confirmed its efficacy in cutting down annual myopia progression by about fifty percent in comparison to placebo groups [6]. However, the studies also report that there is a large variability among the patients in terms of their responses to the treatment, so some will hardly benefit at all whereas others will manage to get great reduction in progression; hence, it is suggested that factors like the initial refractive error, age at the start of treatment and possibly even genetic traits should be considered as determinants of the outcome of the treatment. One of the treatments for myopia that is orthokeratology shows a very high likelihood of success in the children population management; this is inferred from the meta-analyses indicating that the reductions in axial elongation caused by the treatment are very consistent when compared to the cases where conventional contact lens or spectacles play the main role [5].

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The way this protective effect works seems to be linked to the peripheral myopic defocus that was brought about by the corneal profile after the treatment. This peripheral myopic defocus may send out signals that influence eye growth. Nevertheless, there is a possibility of developing infectious keratitis during overnight contact lens wear which requires careful selection of patients, strict adherence to hygiene practices, and regular professional monitoring. Myopia control glasses have been clinically proven to be only moderately effective but they do offer the advantages of being a safer and more comfortable option than lenses or drug treatments [9]. The design of the lens that incorporates defocus in multiple segments has been able to reduce myopia progression by about sixty percent when initial studies were done. Similarly, highly aspherical lenslet technology was proven to be as effective as the former in the following studies confirming the use of spectacles-based interventions as possible options in myopia control techniques.

So far, the long-term outcome data for laser-assisted surgeries have shown excellent stability and patient satisfaction in properly selected patients, confirming the use of modern platforms for myopia corrections up to about ten diopters with predictable results [7]. The implantable collamer lens technology aids in the performance of surgical corrections in the high myopia range along with the advantage of being reversible, which is not the case with ablative treatments [8]. Even though corneal refractive surgery is associated with a lesser incidence of complications including cataract formation, the outcomes of phakic lens implantation in terms of visual quality have been the same or superior in the case of high myopia and thus require careful benefit-risk assessment. The use of different treatment methods is becoming the new trend in myopia management, with some doctors coupling low-dose atropine with optical interventions to get better control over the progression [10]. The first result shows that there are indeed additive effects from such combining approaches, but till the ongoing prospective studies evaluating the best combination protocols are completed, no conclusive statements can be made.

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CONCLUSION

The contemporary landscape of myopia treatment encompasses a diverse array of interventions capable of addressing both refractive correction and disease progression across the patient age spectrum. The synthesis of current literature supports the efficacy of low-dose atropine therapy, orthokeratology, and peripheral defocus spectacle designs for myopia control in children and adolescents, while laser-assisted and lens-based surgical procedures provide effective correction options for adults with stable refractive errors. The evidence reviewed indicates that treatment selection should be individualized based on patient age, myopia severity, progression rate, lifestyle factors, and risk tolerance, with regular monitoring essential regardless of the chosen intervention. Future research directions include refinement of pharmacological dosing protocols, development of novel optical designs with enhanced efficacy, and investigation of genetic and environmental factors that may predict treatment response. The ultimate objective of myopia management extends beyond achieving clear vision to preserving long-term ocular health by minimizing the pathological changes associated with progressive axial elongation, thereby reducing the substantial personal and societal burden imposed by this increasingly prevalent condition.

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