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ORIGINAL ARTICLE

HIGH MYOPIA AND ITS LONG-TERM OCULAR COMPLICATIONS: PATHOPHYSIOLOGY, RISK FACTORS, PREVENTION, AND CLINICAL MANAGEMENT

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Abstract

High myopia represents an advanced form of refractive error in which excessive elongation of the eye is associated with substantial changes in ocular anatomy and an increased risk of permanent visual impairment. Unlike uncomplicated low myopia, high myopia may affect the retina, choroid, macula, optic nerve, and other ocular structures. The long-term consequences can include retinal tears and detachment, myopic macular degeneration, myopic macular neovascularization, glaucoma, and progressive loss of visual function. The risk of these complications is closely related to the degree of axial elongation and may remain relevant throughout the patient's lifetime. This article examines the principal structural changes associated with high myopia, the mechanisms underlying ocular complications, major clinical manifestations, diagnostic approaches, preventive measures, and modern management principles. Particular attention is given to the importance of regular retinal examinations, optical coherence tomography, appropriate monitoring of axial length, patient education, and early recognition of warning symptoms. The article also discusses the role of childhood myopia control in reducing the probability of developing severe adult myopia. A comprehensive clinical strategy that combines early intervention, long-term monitoring, appropriate optical correction, and timely treatment of complications can contribute to preservation of visual function and improvement of quality of life in patients with high myopia.

Keywords: high myopia, pathological myopia, axial elongation, retina, retinal detachment, myopic maculopathy, glaucoma, macular degeneration, optical coherence tomography, ocular complications, visual impairment, myopia management.

1. Introduction

Myopia is one of the most common refractive disorders worldwide, but its clinical significance varies considerably according to the severity of refractive error and the structural characteristics of the eye. Mild and moderate myopia can often be corrected effectively with spectacles or contact lenses and may have relatively limited consequences when the condition remains stable. High myopia is different because it is frequently associated with excessive axial elongation and progressive stretching of ocular tissues.

The increasing prevalence of myopia has raised concern about the future number of individuals who may develop high myopia and related ocular complications. Epidemiological projections have indicated that the global number of people with high myopia may increase substantially during the coming decades. This trend is clinically important because high myopia is not simply a stronger version of ordinary refractive error. It represents a state in which structural changes may significantly increase the probability of vision-threatening disease.

The posterior segment of the eye is particularly vulnerable to excessive axial elongation. As the globe becomes longer, the retina and choroid are stretched over a larger surface area. This mechanical process may contribute to retinal thinning, changes in the macular region, alterations of the optic nerve, and progressive degeneration of ocular tissues. Some patients remain visually stable for many years, while others develop complications that can cause irreversible visual loss.

High myopia may therefore be considered both a refractive and structural ocular condition. The patient's current visual acuity does not necessarily reflect the future risk of disease. A person may achieve excellent corrected visual acuity with spectacles while still having an increased lifetime risk of retinal or macular pathology. For this reason, long-term surveillance is an important component of clinical management.

The prevention of high myopia begins during childhood. When myopia develops early and progresses rapidly, the probability of reaching a high refractive level increases. Contemporary myopia-control methods are therefore relevant not only to children's present vision but also to their future risk of pathological ocular changes. Slowing axial elongation during childhood may reduce the severity of myopia reached in adulthood and potentially reduce the associated disease burden.

2. Materials and Methods

This article was developed as a narrative scientific review of literature concerning high myopia, pathological ocular changes, associated complications, diagnostic methods, prevention, and clinical management. Scientific publications from ophthalmological and optometric literature were considered, with emphasis on peer-reviewed studies, systematic reviews, clinical trials, and international professional recommendations.

The literature was organized into several thematic categories: structural consequences of axial elongation, retinal and macular complications, optic nerve and glaucoma-related changes, diagnostic imaging, clinical symptoms, preventive strategies, and treatment of established complications. Particular attention was given to publications addressing pathological myopia and the relationship between axial length and visual prognosis.

Diagnostic methods considered in the review included visual acuity assessment, refraction, dilated fundus examination, optical coherence tomography, fundus photography, optical biometry, and additional retinal imaging when clinically indicated. These techniques provide complementary information about the structural and functional condition of highly myopic eyes.

The analysis also considered the importance of longitudinal observation. Because many complications develop gradually, a single clinical examination may not adequately characterize disease progression. Repeated examinations and comparison of previous imaging studies can help identify subtle changes before significant visual deterioration occurs.

3. Results

The analysis demonstrates that the primary structural factor associated with high myopia is excessive axial elongation. As the eye increases in length, the posterior ocular tissues become increasingly stretched. This may result in changes in the retina, choroid, sclera, and optic nerve. The degree of structural alteration differs among individuals, but the probability of pathological changes generally increases with greater axial length.

One of the major complications associated with high myopia is myopic maculopathy. Degenerative changes in the macular region can affect central vision and may progress from relatively mild alterations to more advanced forms of tissue damage. Patients may initially experience distorted vision, difficulty reading, reduced contrast sensitivity, or gradual deterioration of central visual acuity.

Myopic macular neovascularization is another potentially serious complication. Abnormal blood vessels can develop beneath or within the retinal layers and may leak fluid or blood. When the macular region is involved, central vision can deteriorate rapidly. Early recognition and appropriate ophthalmological treatment are essential for preserving visual function.

Retinal tears and retinal detachment represent additional risks in highly myopic eyes. Excessive axial elongation may produce peripheral retinal thinning and structural abnormalities. Vitreoretinal changes can create traction on vulnerable retinal areas, increasing the possibility of retinal breaks. Sudden flashes of light, a rapid increase in floaters, or the appearance of a dark curtain or shadow in the visual field should therefore be treated as urgent warning signs requiring immediate ophthalmological evaluation.

High myopia is also associated with increased risk of glaucoma and glaucoma-like optic nerve changes. Evaluation may be complicated because the anatomy of a highly myopic optic nerve can make interpretation of the optic disc more difficult. Conventional intraocular pressure measurement alone is not sufficient to exclude glaucoma. Structural and functional assessment, including optic nerve imaging and visual-field testing when appropriate, may be required.

Optical coherence tomography has become an important diagnostic technology in the assessment of high myopia. It provides high-resolution cross-sectional images of retinal structures and can help identify macular abnormalities, retinal thinning, epiretinal changes, fluid accumulation, and other pathological features. Serial OCT examinations can be particularly valuable when monitoring patients at risk of progressive macular disease.

Fundus photography and wide-field retinal imaging provide additional information about peripheral retinal changes. These methods can document the appearance of the retina and allow comparison between examinations. In patients with high myopia, documentation of baseline retinal findings may be useful for identifying subsequent changes.

The results also indicate that high myopia can have significant functional consequences even before severe visual loss develops. Corrected distance vision may remain good, but patients may experience reduced contrast sensitivity, visual distortion, difficulties with night vision, or limitations associated with retinal pathology. These problems can influence education, employment, driving, mobility, and general quality of life.

Another important result concerns the relationship between childhood myopia progression and adult high myopia. Early onset and rapid progression provide a longer period during which the eye can elongate. Consequently, early identification and effective control of myopia progression represent important preventive strategies against future pathological myopia.

4. Discussion

High myopia should be understood as a long-term condition requiring continued observation rather than a refractive error that can be completely resolved by optical correction. Spectacles and contact lenses can restore clear vision, but they cannot reverse established axial elongation or eliminate the structural risks associated with high myopia.

The most important pathological process is progressive stretching of the posterior segment. The retina is a delicate neural tissue and is not designed to expand indefinitely. When the eye becomes excessively elongated, retinal architecture can become thinner and mechanically distorted. These changes help explain why highly myopic patients are more vulnerable to retinal and macular disease.

Myopic maculopathy deserves particular attention because damage to the macula can have a profound effect on central vision. Unlike simple refractive blur, macular degeneration cannot be corrected simply by changing the spectacle prescription. Patients may require specialized imaging and, in selected cases, medical treatment directed at specific pathological processes.

Myopic macular neovascularization illustrates the importance of early diagnosis. New abnormal blood vessels can cause leakage or hemorrhage, resulting in relatively rapid deterioration of central vision. Modern retinal imaging allows clinicians to identify these changes at an earlier stage. When neovascularization is confirmed, appropriate anti-vascular endothelial growth factor treatment may be considered according to established ophthalmological protocols.

Retinal detachment is another serious complication. Patients with high myopia should be educated about its warning symptoms. Sudden onset of numerous floaters, flashes, or a shadow moving across the visual field should not be ignored. Early examination can allow identification and treatment of retinal breaks before a more extensive detachment develops in some cases.

The relationship between high myopia and glaucoma is complex. Highly myopic optic nerves can have unusual shapes, tilted discs, and peripapillary changes that complicate clinical interpretation. Therefore, diagnosis should be based on multiple parameters rather than a single measurement. A combination of intraocular pressure, optic nerve evaluation, OCT findings, and visual-field testing can

provide a more reliable assessment when glaucoma is suspected.
Another important consideration is the role of axial length. Refractive error alone does not completely describe the structural risk of an eye. Two individuals with similar spectacle prescriptions may have different ocular dimensions and different patterns of posterior segment change. Consequently, biometric information can provide useful additional context when evaluating patients with severe myopia.
Preventing high myopia is preferable to treating advanced complications whenever possible. This makes childhood myopia management an important public-health strategy. Interventions that slow progression during childhood may reduce the final degree of myopia and consequently reduce the probability of severe axial elongation. Outdoor activity, appropriate visual habits, and evidence-based clinical interventions can all contribute to this objective.
Patient education should form an integral part of management. Individuals with high myopia should understand that regular eye examinations remain important even when their spectacles provide excellent vision. They should also know the symptoms that require urgent assessment, particularly sudden flashes, new floaters, visual-field defects, or unexplained reduction in central vision.
The psychological and social aspects of high myopia should not be overlooked. Long-term eye disease can produce anxiety regarding future vision, particularly when patients know that their condition is associated with increased ocular risk. Clear communication can help patients understand that increased risk does not mean inevitable blindness. Many highly myopic individuals maintain useful vision throughout life when appropriate monitoring and treatment are provided.
From a public-health perspective, the increasing prevalence of high myopia may place additional demands on ophthalmological services. More patients may require retinal imaging, specialized examinations, long-term monitoring, and treatment of myopia-related complications. Strengthening primary eye care and implementing early myopia-control programs may help reduce this future burden.
Future research should focus on improving prediction of pathological progression. Not every highly myopic eye develops severe complications, and researchers are increasingly interested in determining which anatomical, genetic, and environmental factors identify patients at greatest risk. Artificial intelligence-assisted retinal imaging, advanced OCT technologies, three-dimensional ocular imaging, and longitudinal biometric databases may improve risk assessment in the future.

5. Conclusion

High myopia is a significant ocular condition in which excessive axial elongation can produce structural changes and increase the risk of permanent visual impairment. Its clinical significance extends far beyond the need for stronger spectacles because highly myopic eyes are more susceptible to retinal, macular, optic nerve, and other ocular complications.
Early identification of progressive myopia is essential. Regular examinations, accurate refractive assessment, axial length monitoring, dilated retinal evaluation, and appropriate imaging can help clinicians recognize structural changes at an early stage. Patients with high myopia should receive long-term follow-up even when visual acuity remains stable.
The prevention of high myopia should begin during childhood. Appropriate outdoor activity, healthy visual behavior, regular eye examinations, and evidence-based myopia-control interventions may reduce the rate of progression in susceptible children. These measures can potentially decrease the number of individuals who reach severe levels of myopia later in life.
For patients who already have high myopia, management should focus on maintaining functional vision and detecting complications as early as possible. Optical coherence tomography, retinal imaging, optic nerve assessment, and other diagnostic techniques can provide valuable information about ocular health. When pathological complications occur, timely specialized treatment may prevent or limit further visual deterioration.
Ultimately, high myopia requires a lifelong perspective. Successful management depends on cooperation between patients and eye-care professionals, regular monitoring, early recognition of warning signs, and appropriate treatment of complications. Continued scientific research and wider implementation of preventive strategies are essential for reducing the future burden of pathological myopia and preserving visual health.

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