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Current challenges in studying myopia & convergence insufficiency - a literature review

RANITA RAY,
Ph.D Scholar, Lincoln University College, Malaysia
Mail id: rray@lincoln.edu.my

Dr. Regidor III Poblete Dioso*
Principal Supervisor, Lincoln University College, Malaysia.

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*** Corresponding author**

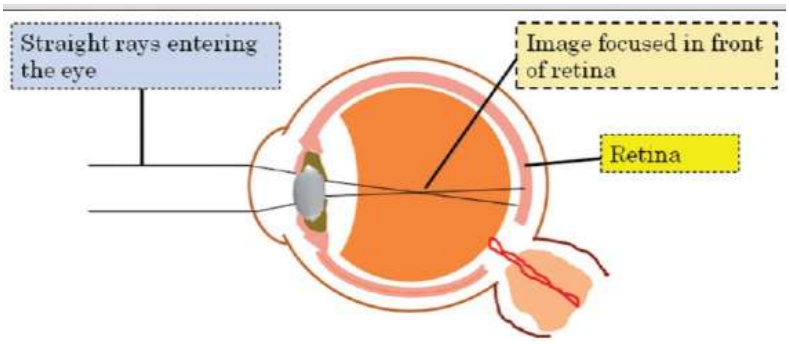
Abstract

In youngsters, the most prevalent reason for refractive error is myopia. It is the most prevalent eye condition in the world. In addition to genetic variables, age and environmental factors have also been discovered to be strongly connected with the development of myopia. A thorough literature search was conducted on internet platforms using the phrases myopia review, onset, progression, treatment, control, updates, bifocals, atropine, and orthokeratology. All of the pertinent papers that were published in English during the last ten years were examined and included. Excessive near work and continuous screen use have been confirmed as denite risk factors aside from genetics. The role of vitamin D and outdoor activities continues to be a topic of debate. Treatment for myopia has improved significantly from glasses and contact lenses to more modern options such as femtosecond-assisted operations and tiny incision lenticule extraction, which are minimally invasive refractive treatments. Controlling the development of myopia continues to be a significant concern due to the rapid advancement of technology and the growing reliance on digital gadgets. “There has been a lot of research on the use of bifocals, progressive glasses, stiff contact lenses, and soft bifocal lenses. All of these approaches seem to be successful in the early years, but the long-term outcomes are not promising. The outcomes of low-dose atropine have been promising, but we are still waiting for the long-term follow-up data.

Keywords: Atropine, myopia control, orthokeratology, progressive glasses

Introduction

Refractive error is the most often documented cause of decreased vision in children, affecting 2% to 11% of the population under the age of 16. It is also responsible for 60% to 80% of vision impairment in youngsters. Myopia is the most frequent eye problem in the world when considered as a single condition. There is a lot of evidence that shows that the development of myopia is influenced by both inherited and environmental factors. Myopia is often characterized by family clustering. A research conducted on preschoolers of Chinese descent in Singapore found that the largest risk factor for myopia in children was a family history of the condition. There is considerable evidence that environmental risk factors such as spending a lot of time doing close-up work, receiving extensive schooling, and spending little time outside are associated with the condition.



Source: *Myopia: Current Concepts and Review of Literature tnoa Journal of*

Ophthalmic Science and Research58(4):280-287

Children are exposed to screens for lengthy periods of time from a very early age, and they get reliant on devices such as tablets, smartphones, TVs, laptops, and PCs. This might be connected to the fact that electronics are simple to purchase in today's environment. Therefore, it is essential to have a solid understanding of the epidemiology, etiology, relationships, evolving ideas, and therapy choices for myopia.

Myopia

Short-sightedness is the term that is most often used to refer to myopia. When light rays reach the eye, they are concentrated in front of the retina instead than directly on it. This causes things that are far away to look blurry. This is seen in.

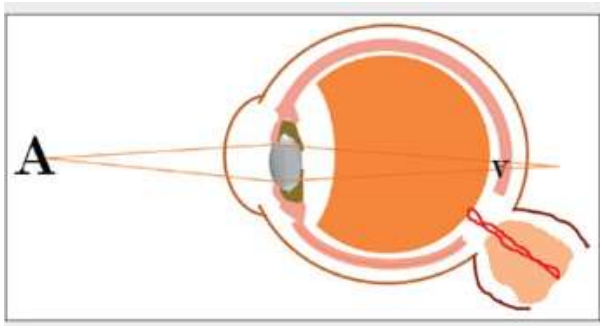
Theories of myopia progression

There are a number of ideas that have been put up to explain the cause of the development of myopia. The following are included:

1. Lag of accommodation
2. Mechanical tension
3. Peripheral refraction.

Lag of accommodation

The idea is based on the concept that foveal hyperopic retinal blur is caused by a large lag of accommodation that occurs during close work in myopic eyes". This causes the eye to develop abnormally along the axis, which results in myopia, as seen in the illustration.

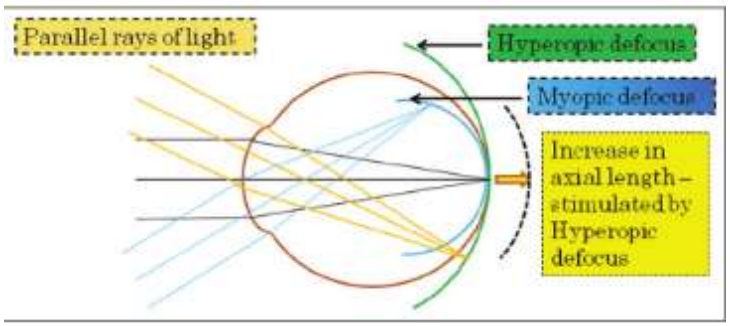


Foveal hyperopic retinal blur resulting from reduced accommodative response at near

Various forms of myopia have been described as:

• Congenital myopia is characterized by an increase in the axial length and total globe size of the eye. This is more often seen in children who are born prematurely or have birth abnormalities such Marfan syndrome or homocystinuria.

- Simple myopia is often referred to as school myopia. Myopia often starts between the ages of 8 and 12. This is the most prevalent kind of myopia, and it usually falls between 4.00 and 6.00 diopters.
- Degenerative myopia, sometimes referred to as pathological myopia or progressive myopia, is a kind of myopia. "It is distinguished by significant alterations in the fundus, such as posterior staphyloma, and is linked to a high refractive error and subnormal visual acuity following correction. This kind of nearsightedness becomes more severe as time goes on. This begins in infancy, between the ages of 5 and 10, and leads to extreme myopia (more than 6 diopters).
- Myopia that was developed: Pseudo myopia is a condition in which the ability to see things at a distance becomes blurry due to spasms in the accommodation system.
- Nocturnal myopia: The transition from photopic vision to scotopic vision at dusk is linked to an increased sensitivity to shorter wavelengths of light. As a result, the emmetropic becomes a little bit myopic when it comes to shorter wavelengths.



- close work-induced transient myopia (NITM) is a temporary shift in the far point of vision that occurs after a prolonged period of close visual activity. Certain writers claim that there is a connection between NITM and the onset of persistent myopia.

Schematic representation of the peripheral theory

- Drug-induced myopia is caused by a variety of drugs, changes in glucose levels, oxygen toxicity (for example, from diving or oxygen and hyperbaric treatment), or other unusual situations. Ciliary body edema, which may occur as a consequence of sulfonamide medication, can cause the lens to move forward, making the eye seem out of focus.Accommodative spasm, which is responsible for myopia, is caused by cholinergic medications like pilocarpine and echothiopate. When sorbitol builds up in the lens, it may cause the crystalline lens to enlarge (edema) as a consequence of an increase in blood glucose levels. This edema often leads to temporary nearsightedness.
- Iatrogenic myopia: Scleral buckles, which are used to repair retinal detachments, may cause myopia by increasing the axial length of the eye.
- Index myopia: This condition is caused by differences in the index of refraction of one or more of the ocular media. Index myopia may be caused by cataracts.

Control of myopia

1. Control of myopia progression
2. Control of myopia onset.

Control of myopia progression

Spectacles

In the past, it was thought that undercorrecting myopia would slow down the evolution of the condition since it would lower the amount of accommodation. However, this has been dismissed since we now know that blur has an impact on the eye's capacity to become emmetropic". Two recent investigations have shown that undercorrection actually leads to a little increase in the speed at which myopia progresses. As a result, undercorrection should not be utilized to slow down the advancement of myopia.

Bifocal/multifocal glasses

The most studied glasses for controlling myopia are bifocal or multifocal lenses. The therapy using these glasses is predicated on the idea that myopia is a result of prolonged accommodation. "Wearing bifocal or multifocal glasses would lessen the amount of effort needed to focus and hence slow down the onset of myopia. Cheng et al. conducted a study to investigate the impact of high fitting bifocals and base in prismatic bifocal spectacles on the advancement of myopia, in comparison to single vision (SV) glasses. According to their research, these spectacles reduced the advancement of myopia by 40%.

Progressive glasses

The Correction of Myopia Evaluation Trial research evaluated whether a +2.00 D progressive additional lenses (PAL) delayed the development of myopia as compared to SV complete corrective lens. This prospective, multicenter trial showed that in the first year, PALs delayed the advancement of myopia by 20%. The net decrease was 0.2 D, which was statistically significant. The PALs were most successful; when both the parents were myopic, there was a considerable lag of adjustment or the kid developed esophoria at near.

Contact lenses

For many years, it was thought that gas permeable contact lenses may slow down the development of myopia. On the other hand, gas permeable contact lenses are usually recommended when myopia starts to slow down (around age 12 or older). A number of well-controlled clinical investigations have shown that neither traditional soft contact lenses nor gas permeable contact lenses have an effect on the development of myopia.

Soft bifocal contact lenses

Contact lenses that have been evaluated for myopia management are the center distance (increase power in the peripheral region) lenses. On average, these contact lenses reduce the development of myopia by 46%.was out a randomized controlled experiment on children aged 8 to 13 who had myopia with a spherical equivalent between -1.00 and -5.00. Over the course of two years, the myopia of those who used bifocal contact lenses advanced by an average of -0.59 ± 0.49 D, whereas the myopia of those who wore single-vision contact lenses progressed by an average of -0.79 ± 0.56 D (P = 0.03). This indicates that the advancement of myopia was slowed by 25%. The soft bifocal contact lens users had slower axial length elongation (0.25 ± 0.23 mm) compared to the SV contact lens wearers (0.37 ± 0.24 mm, P = 0.009).

Prevention of myopia onset

Limit screen time

There may be a connection between greater screen time and a higher incidence of myopia in preschool-aged children. It is suggested that the closer the viewing distance, the more focusing faults there are and the greater the lag of accommodation. Research has been carried all over the globe on the relationship between screen exposure and myopia. According to a study conducted by Harrington et al., children in Ireland who used screens for more than three hours a day had a higher risk of developing myopia. In addition, a study involving primary and middle school students in six provinces of China found that children whose parents did not limit their screen time were also at a higher risk of developing myopia". In a similar vein, a research conducted in North India indicated that screen watching was a major risk factor for the advancement of myopia in children aged 5 to 15 years. According to the most recent recommendations from the "American Academy of Pediatrics, children under the age of 2 should not be allowed to use electronic media at all, and children over the age of 2 should be limited to less than 2 hours per day.

Increased outdoor

initially documented the connection between spending time outside and the chances of acquiring myopic refractive defect. Several investigations that came after this one have revealed a similar impact. Indoor activities cause greater hyperopic defocus (which leads to myopia) throughout the full surface of the retina than outdoor activities do. Outdoor activities virtually prevent any defocus over the whole visual field, which acts as a stop signal for the eye growth and inhibits the development of myopia. When the light is brighter, the pupils contract and the depth of focus rises. This lowers optical blur and boosts contrast. Changes in contrast would impact the activity of amacrine cells, which may explain the involvement of dopamine in the development of myopia in animal models". There have been very few research that have attempted to identify a link between the amount of time spent outside, levels of Vitamin D, and myopia. The findings have not been uniform; some people support this relationship while others do not. It is obvious that spending more time outside has a significant therapeutic impact on the beginning of myopia and potentially its progression. "As a result, it is advisable for children, particularly those with two myopic parents or those who show indications of developing or progressing myopia, to spend more time outside in order to avoid the development of myopia.

Low concentration atropine

A research was done in which children aged 6 to 12 years with a cycloplegic refractive error of +1.00 D and -1.00 D spherical equivalent were followed for at least 12 months. The children were then included in a retrospective comparison of those who took 0.025% atropine and those who did not. Of the children that received atropine, only 21% were myopic, whereas 54% of the youngsters who did not get atropine became myopic (P = 0.016). The development of refractive error was similarly lower for individuals who were on atropine (-0.14 ± 0.24 D/year) compared to those who were not on atropine (-0.58 ± 0.34 D/year, P = 0.0001). None of the children in either group reported having hazy vision while looking at things up close. Additionally, there was no difference in the number of children who reported having photophobia, with 16% of those on atropine and 8% of those not on atropine reporting this symptom (P = 0.41).

It is important to keep in mind that, for clinical practice, atropine 0.01% eye drops are likely the most effective method of slowing development at this time. However, it is also important to note that this medication is not reimbursable and is considered off-label in Germany. It is not known how long atropine eye drop therapy should be maintained, the ideal duration of treatment, or how the condition will evolve after treatment has ended. It has not yet been shown whether or whether atropine therapy is effective as a preventative intervention against future myopia, as has been demonstrated for exposure to sunshine.

Future prospects

The number of people with myopia across the globe is growing rapidly. The waves of the pandemic may also be seen in emerging countries such as India. In addition, there is a significant rise in the rates of progression to pathological myopia. It is important to understand the causes that cause myopic waves in each nation on a unique basis. Large-scale clinical studies are necessary to limit the development of myopia. A thorough examination of risk factors, lifestyle changes that may help avoid myopia, and an investigation of various methods to prevent the advancement of the condition to pathological myopia will contribute to a better knowledge of the disease". These will also assist politicians in making sure that school curriculums and teachings are adjusted in a manner that will help to manage the myopia epidemic. The family-based strategy has to be adjusted since it would be best to identify the individual risk factors. Taking action before the development of myopia will be advantageous. Implementing treatments sooner will also greatly lower the likelihood of developing pathological myopia.

Conclusion

Excessive close work and continuous screen use have been confirmed as clear risk factors aside from heredity. The role of vitamin D and outdoor activities continues to be a topic of debate. Treatment for myopia has improved significantly, moving from spectacles and contact lenses to sophisticated minimally invasive refractive treatments including femtosecond-assisted operations and tiny incision lenticule extraction.Controlling the advancement of myopia continues to be a significant difficulty, even with the remarkable improvement in technology and the growing reliance on digital gadgets. There has been a lot of research on the use of bifocals, progressive glasses, stiff contact lenses, and soft bifocal lenses. All of these interventions seem to be effective in the early years, but the long-term outcomes are not promising. The use of low-dose atropine has been allowed, but the long-term outcomes are still pending.

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