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MANAGING MYOPIA CONTROL: A REVIEW OF PROVEN STRATEGIES

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ABSTRACT

Myopia control is a significant concern for parents of myopic children, and clinical research is expanding strategies to decrease myopia progression. This article reviews peer-reviewed research on a range of strategies for slowing down the progression of myopia, such as wearing bifocal or multifocal glasses, aligning gas-permeable contact lenses, going outside, and under-correcting myopic refractive error. Numerous interventions have proven ineffective, such as myopic refractive error under-correction, gas-permeable contact lens alignment, time spent outdoors, and bifocal or multifocal glasses. The review found that myopia management measures, especially in children and teenagers, are an efficient strategy to delay myopia growth and lower the chances of excessive myopia, leading to significant eye issues later in life.

Keywords: Myopia control, multifocal lenses, orthokeratology, antimuscarinic drugs, atropine

INTRODUCTION

An eye with an excessive amount of refractive power relative to its axial length is said to have myopia, a refractive defect. This may be because of the comparatively long axial length of the eye or because one or more refractive elements have a higher dioptric power. A deficiency in pneuma reduces the ability to perceive distant objects, resulting in myopia. Myopia can be classified into axial and refractive types, physiological and pathological myopia, hereditary and environmentally induced myopia, theory of myopic development, and age of myopia onset[1].

Possible risk factors for myopia development include family history of myopia, presence of myopia on noncycloplegic retinoscopy in infancy, decreasing to emmetropia before entering school, refractive error of emmetropia to 0.50 D of hyperopia, Against-the-rule astigmatism, decreased accommodative function or near point esophoria, substantial amount of near work regularly, steep corneal curvature or high axial length to corneal radius ratio, and conditions temporarily obscuring the retina from explicit imagery during infancy[2].

Myopia is the most frequent refractive defect and a primary cause of reversible vision impairment and blindness worldwide. The "myopia boom" has sparked widespread international alarm, particularly in East Asia, where 80-90% of 18-year-olds are myopic and 10-20% are severely myopic. Preventing the beginning and advancement of myopia is crucial, as it can be compounded by vision-compromising disorders like myopic maculopathy and glaucoma.

Many therapies have been recommended to decrease myopia progression successfully, including spectacles, novel contact lenses and glasses, low-dose atropine eye drops, and orthokeratology. Clinical selection of treatment alternatives should be made on an individual basis, with accurate myopia prediction aiding in the identification of high-risk children for prompt and effective management, reducing myopia development or progression and improving visual outcomes and quality of life[3].

NEED FOR MYOPIA PROGRESSION CONTROL

Myopia progression control is crucial due to its high prevalence and potential serious vision problems. It reduces the risk of serious vision issues like retinal detachment, glaucoma, and macular degeneration, improves vision for school and sports, and reduces frequent prescription changes. This leads to a better quality of life for those with myopia, thereby enhancing their overall quality of life.

CONTROL OF MYOPIA PROGRESSION

1. Under correction of myopia

Under correction of myopia is a controversial topic, with some studies suggesting it may slow myopia progression, while others suggest no benefit or even increase it[4]. One theory suggests it reduces eyeball growth and stimulates retina growth to prevent myopia. Another suggests it can lead to faster progression of myopia[5], as it causes strain on the eyes, eye fatigue, and further elongation of the eyeball. The evidence on under-correction for myopia control is mixed, and further research is needed to determine its safety and effectiveness. Overall, the evidence on under-correction for myopia control is mixed[4].

When considering under-correction for your child's myopia, it's crucial to consult with an eye doctor to discuss the risks and benefits. They can help determine the best treatment for your child's individual needs[7]. Two studies found that 72 under-corrected children advanced more than 70 SVL users, and the development of myopia from baseline for the under-correction group was 0.02 D compared to the complete correction group at two years. The confidence of evidence for refractive error is low, with deductions for imprecision and bias risk[5].

2. Gas-Permeable Contact Lens Wear

Gas permeable (GP) contact lenses are a type of rigid contact lens used to control the progression of myopia, or nearsightedness. These lenses allow oxygen to pass through the lens to the cornea, which helps maintain the cornea's health and slows the progression of myopia[4]. GP lenses are more effective than soft contact lenses but can be more difficult to wear and more expensive[8]. It is crucial to consult an eye doctor to determine if GP lenses are suitable for you and to learn proper care[9].

The benefits of GP lenses include their effectiveness in controlling myopia, maintaining cornea health, durability, and providing clear vision. However, they can also be more difficult to wear than soft lenses, more expensive, cause discomfort and dryness, and increase the risk of eye infections. It is essential to consult an eye doctor to determine if GP lenses are suitable for you and to learn proper care [2].

3. Bifocal or Multifocal Spectacles and Soft Bifocal Contact Lenses

Although bifocal lenses were first created for individuals with near vision focus problems, some children may require them for issues related to eye muscle coordination. Studies have indicated that the use of executive bifocals can impede the advancement of myopia in children. With near focus power at the bottom and distance focus power at the top of the lens, executive bifocals feature a clear demarcation line[4]. One study showed that executive bifocals can have a good result for slowing myopia progression in children aged 8-13 years compared to single-vision glasses[7]. Addition done gradually, the power of spectacle lenses gradually changes from the distance vision zone at the top of the lens to the close-up or reading power zone at the bottom. They have only been shown to have a very small effect on slowing myopia progression in children[8].

The Essilor Stellest spectacle lens uses Highly Aspherical Lenslet Target (HALT) Technology, featuring 11 concentric rings of highly aspherical lenslets. The Hoya MiYOSMART spectacle lens uses Defocus Incorporated Multiple Segments (DIMS) Technology, with lenslets of the same power and not touching. The new Sight Glass Vision Diffusion Optics Technology (DOT) spectacle lenses use microscopic diffusers and a smaller central clear zone, creating a diffusion or blur of light around the edges of the lens[9].

4. Orthokeratology

Orthokeratology is a procedure that involves the use of contact lenses to flatten the cornea and reduce myopia[10]. In certain patients, it can lead to a reduction of up to 3.00 D; the majority of this reduction happens in the first 4-6 months of the orthokeratology program. Significant peripheral flattening of the cornea increases the likelihood of successful central flattening, which reduces myopia through orthokeratology. Orthokeratology is safe and effective when followed up appropriately. However, research indicates that in patients who discontinue wearing contact lenses, refractive error returns to baseline[4]. To maintain the improved refractive state, retainer lenses are typically worn for several hours daily. Orthokeratology steepens the peripheral cornea as it

flattens the central cornea, with some contact lenses designed to maximize these changes. The mean myopia reduction with such lenses is about 2D, resulting in a uniform corneal surface. Orthokeratology is typically performed only on adults, with some control in children possibly due to orthokeratology-like effects[9].

5. Antimuscarinic Agents

The potential of antimuscarinic agents to treat myopia-a condition in which light focuses in front of the retina rather than on it-is being studied. Myopia is caused by an overly long eye or a curved cornea. These agents work by blocking the action of acetylcholine, a neurotransmitter that causes muscles to contract. By relaxing the ciliary muscle, antimuscarinic agents can slow the growth of the eye, which can help control myopia. Research has indicated that antimuscarinic medications may be useful in delaying the development of myopia. For example, children who used atropine 0.01% once daily for two years had significantly slower myopia progression than those who did not use atropine. Another study found that pirenzepine, another antimuscarinic agent, was also influential in slowing myopia progression[11]. Although antimuscarinic agents are generally safe and well-tolerated, some people may experience side effects such as blurred vision, dry eyes, and difficulty focusing on near objects. Overall, antimuscarinic agents offer a promising new treatment for myopia control, but more studies are needed to confirm their long-term safety and efficacy[12].

6. Outdoor Time

Outdoor time is an effective way to prevent and control myopia, the most common refractive error in the world (4). Dopamine is released when exposed to strong sun-light; this neurotransmitter aids in controlling the growth of the eyeball. Outdoor activities also reduce the amount of time children spend doing near work, such as reading or using electronic devices, which is a risk factor for myopia development[5]. Children who spend more time outside are less likely to develop myopia, according to research. For example, one study found that children who spent at least two hours per day outdoors had a 50% lower risk of developing myopia than those who spent less than one hour per day outdoors[4].

Every extra hour spent outside each week decreased the incidence of myopia by 2%, according to a meta-analysis. The mechanism of increasing outside time as a myopia management strategy is unclear[8]. Spending time outside, rather than engaging in physical activities outside, has been proposed as a protective factor. Patterns of defocus on the retina caused by three dimensional environmental features have also been hypothesized as a possible echnique of protection during outdoor activities[9].

The American Academy of Ophthalmology recommends that children spend at least two hours per day outdoors through various activities, such as playing sports, riding a bike, or walking[2]. To increase your child's outdoor time, make outdoor time a part of your family's daily routine, encourage them to participate in enjoyable outdoor activities, make outdoor time fun and engaging, and limit screen time. If you are concerned about your child's risk of developing myopia or if they already have it, talk to your eye doctor for more information on how to protect their vision[10].

7. Low-Concentration Atropine

Low-concentration atropine eye drops are a safe and effective treatment for myopia control in children. Atropine blocks the action of the neurotransmitter acetylcholine in the eye, causing the pupil to dilate and the eye to focus less on near objects[2]. Research indicates that atropine eye drops at low concentrations can halt the progression of myopia by 30% to 50% when compared to a placebo. Most children are well-tolerated by atropine, with common side effects being mild blurring of near vision and light sensitivity[13].

Low-concentration atropine eye drops are typically used once a day at bedtime and are most effective starting at a young age before myopia has progressed too far[14]. A randomized controlled trial published in the Chinese Journal of Medical Genetics in 2022 found that the average change in axial length over the 2-year study period was significantly less in the atropine group (-0.37 mm) than in the placebo group (-0.75 mm). Atropine was also effective in reducing the rate of myopic progression, with the atropine group showing a 50% reduction in myopia progression compared to the placebo group[15].

The benefits of using low-concentration atropine eye drops for myopia control include their effectiveness, well -tolerance by most children, ease of use, and the ability to be continued as long as necessary. Talking to an eye doctor is recommended when considering using atropine eye drops for your child[14].

8. Vision therapy

While myopia does not appear to decrease, vision therapy can help myopia patients' unassisted visual acuity. Proposed procedures for reducing myopic progression rates haven't been tested, and pseudomyopia is often treated with vision therapy to reduce accommodative response. Auditory biofeedback has also been successful[2].

FUTURE ASPECTS OF MYOPIA CONTROL

Myopia, a progressive eye condition, can lead to serious eye health issues like retinal detachment and glaucoma. Reducing myopia progression by one diopter can significantly reduce these complications[16,17]. Ortho-k and low-dose atropine are effective in slowing myopia progression, but more long-term studies are needed to assess their safety and efficacy[16,18]. A 2023 article discusses the challenges and opportunities of designing and conducting clinical trials for myopia control, arguing for more collaborative trials involving multiple countries and research centers and developing new outcome measures to better assess long-term effects[19].

New and emerging treatments, such as soft contact lenses and spectacle lenses designed to create optical defocus, are in development, offering patients more options and flexibility. Personalised myopia control treatments are also being developed, potentially using genetic testing or artificial intelligence to identify patients at high risk of developing myopia. These treatments aim to provide more options and flexibility for patients with myopia.

CONCLUSION

Myopia control techniques can lessen the likelihood of developing high myopia and subsequent eye issues by slowing the progression of myopia, especially in children and adolescents. Orthokeratology, soft bifocal contact lenses, and antimuscarinic agents are effective options, but the best choice depends on the patient's age, risk factors, and lifestyle.

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