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A REVIEW ARTICLE ON MYOPIA PROGRESSION AND TREATMENT EFFECTS OF ORTHO-KERATOLOGY

Ophthalmology

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ABSTRACT

Rapid rise in myopia prevalence can be seen reflected in experiments world-wide, both within the clinic and within the laboratory, with treatments or managements that may slow down the progression of myopia or arrest myopia. The prevalence of myopia and high myopia has significantly increased worldwide and in Asia as well. Myopia is not just a minor inconvenience which needs a simple vision correction with spectacle and contact lenses. It's a thread of diseases that may give rise to severe other vision threatening conditions like retinal detachment, lattice degeneration etc. Not only myopia, but refractive error as a whole is one of the most important cause of avoidable blindness. There are various methods that have been prescribed to slow down the progression of myopia and there are many studies that have been going on to find out the treatment that will be most effective, safe, efficient and convenient for the patient to use and apply. Several well-designed studies have investigated the effects of Ortho-Keratology in school-aged children. We have written this article to better evaluate the existing evidence. This article reviews the clinical treatment effects of Ortho-Keratology to slow the progression of myopia.

KEYWORDS

Myopia, Ortho-K, Axial length, Prevalence, Emmetropization

Introduction

Myopia is a very important cause of vision impairment worldwide. High myopia is also an very important cause of blindness. In Asia, currently there is a high prevalence of myopia, especially among the Chinese and Japanese. In India, myopia is a major eye problem in school children and hence it is important to identify modifiable risk factors associated to its development and should try to develop cost effective interventions(23).The risk factors underlying differences in myopia prevalence between ethnic groups are still uncertain, but the rates of prevalence of myopia in children of East Asian descent are typically higher regardless of where they live(1).The prevention of myopia is increasing worldwide which is viewed as a major public health concern. This increase in prevalence of myopia has driven interest in research into myopia prevention and control in children. Some studies on emmetropization mechanism done on animals reveals that treatments that consider the peripheral retina may be the best effective option compared to others(24). Another experiments done in monkeys has indicated that visual signals from peripheral retina are very much essential for various aspects of regulation of vision dependent ocular growth(25). Again some recent studies have shown that if we include an multifocal image on the eye moving the image to the peripheral retina leaving it myopically defocused, then it may generate a visual stimulus to slow down ocular growth (26,27). There are many strategies that have been developed in the form of optical devices or therapy to treat myopia progression. But amongst all atropine therapy to reduce myopia progression and Ortho-Keratology has been added to the centre of discussion recently. Ortho-K lenses are specially designed gas permeable contact lenses that can be worn overnight while someone is asleep and it helps to reshape the front surface of the cornea so that the wearer can see clearly the following day without wearing any refractive correction. The sole purpose of prescribing Ortho-K lenses is to correct refractive error (primarily myopia, but also astigmatism, hyperopia and sometimes presbyopia) and to slow the progression of childhood myopia.

Prevalence of myopia

In East Asia, the prevalence of myopia is reported higher in Japan(2), South Korea (3,4), Singapore (5), Taiwan (6,7), Hong Kong (8,9), China (10,11,12,13) even though cases reported in India and South Asia (14,15,16,17,18) is much lower than expected. In a study done in AIIMS, New Delhi, India, shows that number of children with presenting vision 6/12 in the better eye were 572(5.8%) among which 455(79.5%) were due to myopia,10.8% children had presenting vision less than equal to 6/12 in the better eye of which nearly 80% of it due to myopia(19). Singaporeans are more prevalent to Myopia (79.3%) and severe myopia (13.1%), with Chinese having higher rates (82.2%) compared with Indians (68.7%) and Malays (65.0%)(20). Education is strongly related to prevalence and severity of myopia(20). A study done in the school children of Southern India states that the prevalence of myopia(8.6%) is significantly higher among children greater than equal to 10 years of age and myopia in adult Indian population is much higher than the similarly aged white populations (21-22). This prevalence of myopia is directly proportional to increasing age (22).

Myopia progression, Axial length changes and clinical treatment effects of Ortho-Keratology (Ortho-K)

The importance of myopia control is to prevent the development of high myopia and to reduce the fast progression in myopia mostly in cases of children. In some studies done in Hon Kong , explain that the average increase in myopia in Chinese children is approximately 0.50 diopter (D) per year(28,29,30)Children who have an average increase of myopia more than 1.00D per year can therefore be regarded as fast progressors (31,32,33). OrthoK has been shown in multiple clinical studies as effective in slowing down myopic progression compared other novel contact lens designs being investigated.(34,35,36). Overnight OrthoK has become one of the most popular choices among children for refractive correction for its unique advantage of providing clear unaided vision during daytime. However with the rapid increase of the applications of Ortho-K, potential complications associated with this treatment, especially used as overnight modality, have become a significant concern (37). Knowing the severity of ocular complications associated with high myopia, lots of efforts have been put into the investigation of interventions that may slow the progression of myopia in children, and thus decreasing the severity of myopia at maturity(38,39,40,41). A meta-analysis shows that ortho-K can slow the progression of myopia in school-aged children. The rate of axial Length elongation was slowed by 0.14mm per year in the Ortho-K group compared to the control group. And this corresponds to early 45%decrease in myopic progression (42). Ortho-K can shift myopia to emmetropia by flattening the cornea within a short period of time after beginning treatment(43). The methods used for measurement of the refractive error do not actually reflect the genuine treatment effects of Ortho-K. The method they have included to measure refractive changes in the identified studies was not comparable, the views on how long treatment was needed was not uniform for all.

Currently, the mechanism of myopia onset and progression is very poorly understood. Various hypotheses for its development have been proposed. However, till date, not even a single theory can fully explain the aetiology of myopia. The presence of optical defocus is a result of the mismatch between the retina and the retinal image plane; hyperopic defocus is induced when the retinal image is focused behind the retina, while myopic defocus is due to the retinal image is focused in front of the retina. The presence of optical defocus, especially hyperopic defocus, has been suggested as one of the potential aetiologies of myopia onset and progression.(53,54). Till date, no consensus has been found and it still remains an active area of research.

The measurement of relative peripheral refraction which is defined as the refractive error difference between the central and peripheral retina, was pioneered by Rempt et al. which examined horizontal

peripheral refraction profiles in adult emmetropes, hyperopes, and myopes using retinoscopy method(54).Several studies have shown consistent results relating relative peripheral refraction in children with hyperopic or myopic status, determining opposing relative peripheral refraction that is present in myopic and hyperopic children . Hyperopic unaided eyes tend to have myopic relative peripheral refraction, whereas myopic unaided eyes tend to show hyperopic relative peripheral refraction in the horizontal meridian.(55,56,57) However, there is controversy over the generality of this finding with respect to other meridians(58, 59,60).

Cheung at el. claimed that the anterior chamber length did not change during the lens wearing period (43).According to Yuansun et al, vitreous chamber depth elongation was slowed by nearly 0.11 mm per year in the Ortho-K group, which corresponded to the change in axial length elongation.(42) Kakita et al. claimed that the rate of axial length elongation in the ortho-k group was only correlated with the spherical equivalent refractive error at baseline in highly myopic children(44). Additionally, Cho at el. Explained and demonstrated that there was a relationship between axial length and the age, but no relationship was found between axial length and gender, initial myopia, initial astigmatism, initial corneal shape, or initial corneal toricity (45,46). Chenet al. claimed that axial length elongation in the ortho-k group was slower for subjects with larger pupil size (47).

Another few studies stated that atropine is one of the best alternative treatment for myopia progression. The effects were dose dependent and varied from 59% to 77%. However, the adverse effects and recurrence has set some limitation in wide use of atropine therapy (48,49,50). However, J.K. Si et al and J. M. Gonz´alez-M´eijome et al claimed that Ortho-K is currently the best possible optical treatment for myopia progression (51,52).

Conclusion

This article has reviewed the papers which have included Asian population in their studies and will help our readers to understand the theories behind myopia progression and clinical treatment effects of Ortho-Keratology in prevention of myopia progression. This article will also help the readers who want to have a quick glimpse of the researches among Asian population on myopia progression and the effects of Ortho-Keratology as a clinical treatment to slow down progression of myopia. Ortho-Keratology is no doubt one of the most effective, efficient and convenient clinical treatment to slow down myopia.

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