

## Editorial

# Myopia Control: What we have Learned from Randomized Controlled Trials

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## INTRODUCTION

Myopia is an ophthalmic condition in which the refractive power of the eye is too strong relative to its length. In general, myopia is differentiated into refractive and axial myopia, with the latter being the more common condition. In this situation the eye is axially elongated, which is associated with increased risk of ocular diseases. Worldwide the prevalence rates of myopia are continuously rising. Currently, every 1 out of 3 adults in the United States is myopic [1]. In some Asian countries, 38% schoolchildren are myopic [2]. Since myopia is driven by two factors, a genetic predisposition and a conducive environment, the increase in prevalence may be explained by changes in the everyday visual environment. Since the latter can be manipulated in various ways, efforts to control myopia progression are escalating. Some of myopia control studies show promising results, which can be broken down into two main categories: optical interventions and pharmacologic treatments.

A large number of myopia control studies have been conducted in recent years which include randomized controlled trials (RCT). An RCT is often considered the gold standard to test the efficacy or effectiveness of various types of interventions. A quick review of myopia control RCT results will provide a clear picture on where we are now in the endeavor of retarding myopia progression.

A journal article published in *Ophthalmology* in 2016 analyzed 16 RCT interventions for myopia control and compared their efficacy [3]. The compared RCT studies included both optical (spectacle lenses, contact lenses), pharmacological (atropine, pirenzepine, cyclopentolate, and timolol) and alternative (increased outdoor activities) interventions with a total of 5422 eyes involved in the analysis. The following summaries are based on reviewing of this and other relevant journal articles in the field.

## PHARMACOLOGICAL INTERVENTIONS

Powerful immediate myopia control effects are achieved by using atropine eye drops. The higher the dose of atropine (up to 1%), the stronger and more significant the control effects. As long as the atropine eye drops are administered, this treatment is more potent than any other myopia control intervention,

including most of optical manipulations, which slow down myopia progression at substantially lower rates. On the other hand, with patient safety in mind, the side effects of applying high doses atropine are well documented [4]. In order to be effective, one has to keep in mind that this treatment has to be started early in life and needs to be continued for many years. Furthermore, after ceasing the treatment, a fast myopia rebound is also noticed [5]. These factors make high (0.5% - 1%) or moderate (0.1%) doses of atropine less likely to be considered as top choices for myopia control interventions in clinical patient care. A newer study shows that low dose (0.01%) atropine still has one of the most myopia control effect [6]. And advantages are the reduction in side effects and a remarkably reduced rebound effect after cessation of the treatment [6]. This theoretically makes low dose atropine an attractive intervention for myopia control, however more RCT studies need to be conducted to establish a robust protocol for using this treatment in clinical patient care.

Pirenzepine is a possible alternative to low dose atropine for the control of myopia progression. It demonstrated a moderate effect in slowing down myopia progression, lower than atropine, but still significantly effective. Additionally, pirenzepine has a minimal effect on pupil dilation and is less likely to cause any other atropine like side effects [7]. More RCT studies are needed to investigate pirenzepine's suitability for myopia control.

## OPTICAL INTERVENTIONS

Throughout numerous studies, orthokeratology demonstrated its potential for myopia control [8,9]. With respect to slowing the axial ocular elongation, the method is comparable to low dose atropine treatment. A number of issues limit the widespread use of orthokeratology, such as cost of the lens, discomfort in wearing, a relatively complicated fitting process and lens care regimen, and possible risks of infective keratitis, etc. [10,11]. In addition, the American FDA limits the orthokeratology to a maximum of -6.00 diopters of myopia and -1.75 diopters of cylinder. Application for higher amounts of myopia must be considered off label uses.

Especially designed soft contact lenses, which provide an orthokeratology like effect on the peripheral optics of human eye, can achieve good results for controlling myopia progression. A recent RCT study shows that wearing a soft contact lens, which

provides a peripheral myopic defocus, leads to a moderate but significant slowing of axial ocular elongation, which is comparable to the effect achieved with orthokeratology [12]. Taking into consideration cost, lens fitting complexity, effect on ocular health, and range of available parameters, this treatment option can be a top candidate for myopia control. Similar to treatment with low dose atropine, more RCT studies need to be conducted to confirm its reliability and repeatability in myopia control.

Other optical interventions either showed remarkably weaker myopia control effects (prismatic bifocal spectacle lenses [13], progressive addition spectacle lenses [14,15], bifocal spectacle lenses [16], and spectacle lenses providing peripheral myopic defocus [17]), or were considered ineffective treatment options (single vision rigid gas-permeable contact lenses [18,19], single vision soft contact lenses [20], single vision spectacle lenses [14,15,17], and under correction of myopia with single vision spectacle lenses [21]).

## ALTERNATIVE INTERVENTIONS

Children with more outdoor activities tend to have a lower rate of myopia progression, therefore outdoor activities might be protective for myopia development and progression. According to a number of RCT studies, the protective effect of outdoor activities is weak, which suggests that this intervention alone is insufficient [22].

## CONCLUSION

RCT studies indicate that atropine eye drops provide a myopia control effect that is superior to other interventions. From a clinical perspective however, only low dose atropine is appealing due to minimal clinical side effects and a low rebound effect after cessation of the treatment. Orthokeratology and especially designed soft contact lenses which produce peripheral myopic defocus showed encouraging results from RCT studies. Future research will involve optimizing contact lens designs to provide improved myopia control effects. In addition, more RCT studies are needed to further confirm the myopia control effect of the various interventions.

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