

MYOPIA CONTROL IN 2021

A summary of recent key research to help optimize myopia management in practice.

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As more practitioners actively practice myopia control with contact lenses, the need for information to optimally treat young patients increases.¹ Keeping up with the myopia control literature is difficult, because new information is released from a variety of sources almost daily.

To help practitioners stay current with the rapid evolution of knowledge related to myopia control, this article summarizes some of the latest research that was published during the past year, providing new information to help optimize the care of young myopia patients.

SPECTACLE MYOPIA CONTROL

Previously, the most effective myopia control with spectacles was reported for executive-top bifocal glasses. They reportedly slowed myopia progression by 39% to 51% over three years, depending on whether or not base-in prism was incorporated.² This was the first study to enroll only patients whose myopia was progressing, which may have enhanced the treatment effect by eliminating the potential for control subjects' myopia to progress during the study. Therefore, it is unknown whether the treatment effect was due to the use of executive-top bifocal spectacles or to the fact that enrollment was limited to patients whose myopia was progressing. All other forms of spectacles, including flat-top bifocals,³ progressive-addition lenses,^{4,5} and eyeglasses specifically designed for myopia control,⁶ failed to produce a clinically meaningful treatment effect.

A new spectacle lens that consists of a central 9mm diameter distance correction zone surrounded by hundreds of 1mm segments that have a +3.50D add slowed myopia progression by 52% (0.55D) and eye growth by 62% (0.32mm) over two years.⁷ Visual acuity and accommodation were similar between the experimental and the single-vision lenses. These lenses are currently marketed and prescribed around the world, but they are not yet available in the United States.

SOFT MULTIFOCAL CONTACT LENSES

To determine whether the add power is important for myopia control with center-distance soft multifocal contact lenses, 294 children were randomly assigned to wear +2.50D add, +1.50D add, or single-vision contact lenses for three years.⁸ The +2.50D add contact lenses slowed myopia progression by 43% (0.46D) and eye growth by 36% (0.23mm) compared with the single-vision contact lenses; there was no significant difference between results achieved with the +1.50D add and with the single-vision lenses. No significant differences were reported among the three groups with respect to adverse events or distance or near visual acuity. Patients wearing the

single-vision contact lenses experienced fewer than two letters of better low-contrast visual acuity compared to those in either of the multifocal groups. When using soft multifocal contact lenses, a higher add power is recommended for optimal myopia control.

ORTHOKERATOLOGY

Contact lens myopia control is believed to result from decreasing hyperopic defocus and/or increasing myopic defocus presented to the peripheral retina, which may act as a signal to slow eye growth. We may be able to alter the peripheral defocus presented to the retina by altering both the back-optic-zone asphericity and diameter as well as by altering the secondary lens curvatures of orthokeratology (ortho-k) contact lenses.

Gifford and colleagues showed that changing these ortho-k lens parameters can reduce the topographic treatment zone, but the changes did not have a meaningful effect on peripheral defocus.⁹ Although the lens design was not longitudinally worn to directly measure eye growth over time, it is less likely that these lens parameter changes would slow myopia progression, as they do not alter the putative cue for myopia control (i.e., peripheral defocus).

LOW-CONCENTRATION ATROPINE

Over one year, 0.05% atropine was previously shown to provide more effective myopia control compared to 0.025% or 0.01% atropine.¹⁰ The two-year results also concluded that 0.05% atropine provided better control of myopia progression and eye growth compared to 0.025% and 0.01% atropine while not causing additional side effects such as reduced accommodative amplitudes, distance visual acuity, or near visual acuity.¹¹ Because 0.05% atropine provides better myopia control without more significant side effects, it may be the concentration of choice for myopia management in young children. There is still no commercially available low-concentration atropine on the market, so all therapies must be prescribed through a compounding pharmacy.

COMBINATION OF ORTHOKERATOLOGY AND LOW-CONCENTRATION ATROPINE

Optical strategies for myopia control, such as ortho-k or soft multifocal contact lenses, may work through different mechanisms compared to pharmacologic strategies, such as low-concentration atropine eye drops. If that is true, then the combined myopia-control effect of an optical and a pharmacologic treatment could be greater compared to the effect of either treatment alone. To date, only the combined effect of orthokeratology and atropine has been investigated.

A study conducted in China showed significant differences in eye growth in each of four subgroups based on the atropine concentration and the baseline myopia.¹² One of the subgroups actually exhibited *faster* eye growth with combination therapy than with monotherapy, and this subgroup exhibited the largest difference. A post hoc sample-size-weighted analysis of the data showed no difference in progression between monotherapy and combination therapy¹² (Figure 1); however, two separate one-year randomized clinical trials each showed slower eye growth with combination therapy than with monotherapy (Figure 1).^{13,14}



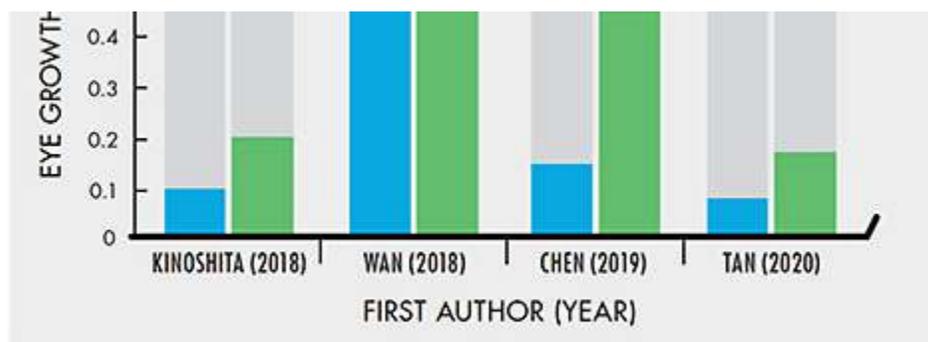


Figure 1.

A case series of myopia patients who exhibited more than 0.25mm of eye growth prior to being fitted with ortho-k contact lenses exhibited 0.46mm of eye growth over one year while wearing ortho-k lenses.¹⁵ They then added low-concentration atropine to the ortho-k contact lens wear, and the eye growth slowed to 0.14mm over one year. Eye growth would be expected to slow naturally, but a historical control group of ortho-k contact lens wearers who had fast-progressing myopia showed a decrease in eye growth from 0.35mm to 0.25mm each over a one-year period. Thus, natural changes in eye growth may account for only about 0.1mm of the 0.32mm decrease experienced when patients switched to combination therapy (Figure 1).

Three of the four studies show that combining ortho-k contact lens wear with low-concentration atropine may provide additional myopia control, and this combination may be used as an adjunctive therapy when either practitioners or parents believe that monotherapy alone does not provide sufficient myopia control.

COMPARISON OF ORTHOKERATOLOGY AND LOW-CONCENTRATION ATROPINE

Low-concentration atropine has been shown to significantly slow myopia progression, but the effect on eye growth is not as meaningful.¹⁶ Because eye length is considered important with regard to the long-term ramifications of myopia, such as retinal detachment and myopic maculopathy, investigators conducted a two-year chart review of 7- to 14-year-old children who were administered 0.02% atropine ($n = 142$) or who wore ortho-k contact lenses ($n = 105$) to compare eye growth between the treatment groups. The eyes in the 0.02% atropine group grew $0.58\text{mm} \pm 0.35\text{mm}$, and the eyes in the ortho-k group grew $0.36\text{mm} \pm 0.30\text{mm}$, controlling for age, baseline myopia, parental myopia, and other important factors ($P = 0.007$). This difference may be clinically meaningful and should be considered when weighing myopia-control treatment options.

HIGH-CONCENTRATION ATROPINE

Several studies have examined a variety of concentrations of atropine to slow myopia progression while minimizing side effects such as mydriasis and cycloplegia.^{10,11,16-18} Taking a different approach, investigators for one study examined the frequency with which 1% atropine needed to be administered to slow myopia progression.¹⁹ Children were randomly assigned to receive one drop of 1% atropine or placebo in one eye on the first day of the month and in the other eye on the sixteenth day of the month; this was repeated every month for two years. Myopia progression was 80% slower ($-0.27\text{D} \pm 0.81\text{D}$ versus $-1.29\text{D} \pm 0.13\text{D}$), and eye growth was 73% slower ($0.11\text{mm} \pm 0.13\text{mm}$ versus $0.41\text{mm} \pm 0.19\text{mm}$), for the 1% atropine group than for the placebo group, respectively.¹⁹ About 20% of the participants in the atropine group stopped therapy; three-fifths of them reported photophobia, and one-fifth reported near blur. This is the only study investigating less frequent administration of 1% atropine for myopia control; it suggests that more affordable treatments may be available to our patients (see sidebar below), as 1% atropine does not need to be compounded and drops are required only monthly.

PREDICTION OF HIGH MYOPIA

One of the primary reasons why myopia control is important is to decrease the risks of sight-threatening complications in adulthood.^{20,21} Bullimore and Brennan showed that for every 1.00D of decreased myopia, the risk of myopic maculopathy decreases by 40%²²; however, we know that the risk increases exponentially for high myopia (more than $-5.00D$).²³

ENSURING ACCESS FOR ECONOMICALLY DISADVANTAGED PATIENTS

As we advance the concept of myopia control, we should do our best to educate all myopic children and their parents about their options. We must keep in mind, however, that refractive treatment is not covered by most insurances. Therefore, myopia control becomes a treatment only for the advantaged.

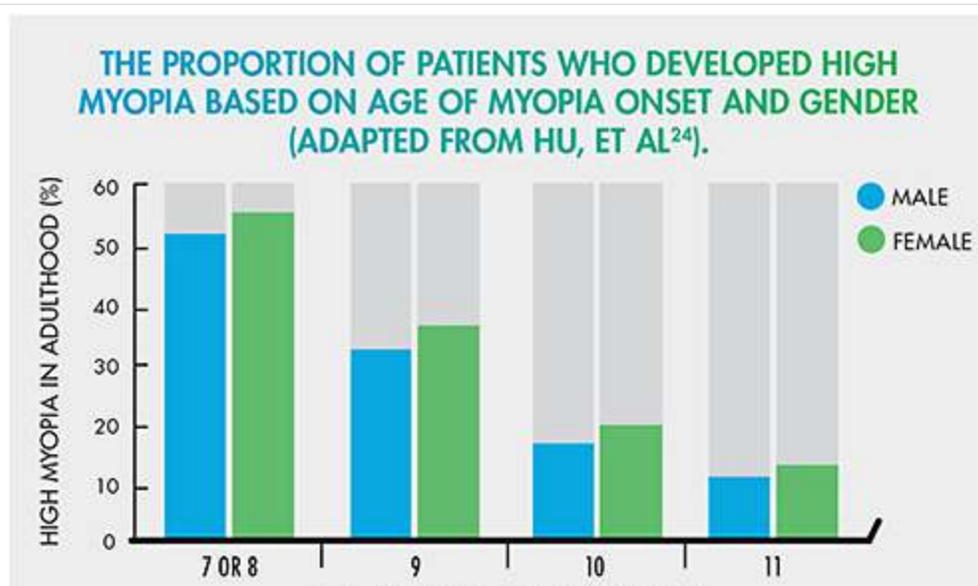
Industry may provide options for free or reduced-cost materials based on the number of prescriptions that a practice writes. Consider using these options for those who are economically disadvantaged.

Also consider a similar program backed by successful myopia control practices. For example, you can promise to provide materials or services to one patient whose parents cannot afford them for every 10 patients whose parents can.

Based on research from Zhu and colleagues,¹⁹ you may be able to provide less expensive treatment for those who cannot afford standard treatments by prescribing 1% atropine on a monthly basis, alternating eyes every two weeks.

While myopia control may provide important protection for all myopes, it may be even more vital for those who are destined to become highly myopic. Being able to predict which patients are most likely to become high myopes is advantageous.

A study of 443 myopic Chinese patients examined longitudinally for 12 years showed that the strongest predictor of high myopia ($-6.00D$ or more) was the age of myopia onset. The younger the onset of myopia, the more likely an individual is to become highly myopic (Figure 2).²⁴ This shows that myopia control is even more important for children who become myopic before 12 years of age.



AGE AT MYOPIA ONSET (YEARS)

Figure 2.

SUMMARY

A brief review of the clinically relevant literature published in 2020 demonstrates how much there is to learn to provide parents with appropriate information about myopia control and optimally treating children. As eye-care providers, we want our knowledge to be current, particularly in an evolving area of science. When practicing myopia control, our goals are far-reaching and have long-term ramifications, chief among them being:

- to decrease the risks of sight-threatening issues related to myopia
- to improve quality of life
- to provide more predictable refractive surgery results
- to provide more treatment options for patients.

We have moved past the days of simply alleviating the symptoms associated with childhood myopia by prescribing eyeglasses to clear distance vision. We are now compelled to educate parents about the potential for myopia control and to offer treatment options when needed.

CONCLUSION

I urge you to use the information presented here as a springboard to help you both prepare for the future (spectacle options) and provide the best care (optical versus pharmacologic or combination therapy) for your patients when the opportunity arises. If you haven't yet begun to provide myopia control options for your patients, what are you waiting for? The treatments are available in your practice right now, and you don't have to measure axial length to practice myopia control. Offer the options that I've discussed here to the next myopic child you see. You both will benefit from the innovations. **CLS**

CLINICAL PEARLS AND TAKEAWAYS

- Spectacle myopia control is on the horizon in the United States.
- Use the highest add power for soft multifocal contact lenses for myopia control.
- Altering ortho-k contact lens parameters does not result in a stronger putative cue for myopia control.
- Combining ortho-k and low-concentration atropine provides better myopia control compared to monotherapy.
- Ortho-k slows eye growth more compared to low-concentration atropine.
- 1% atropine administered just once a month slows myopia progression and eye growth.
- The earlier the age of myopia onset, the greater the chance of high myopia.

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