

Beyond Atropine and Ortho-K: Contact Lenses for Mitigating Myopia Progression

Myopia is a growing concern among ophthalmologists for good reason. Not only is it one of the world's most common ocular abnormalities, but also its prevalence is increasing at an alarming rate. Researchers have estimated that by 2050, almost half the global population will be myopic. And children with early-onset myopia are at a major risk. The longer the duration of nearsightedness, the greater the danger of pathologic myopia and complications later in life, including retinal detachment, glaucoma, cataract, and optic disc changes.

Despite these epidemic numbers, study results reported as recently as 2011 did not warrant any recommendation for the intervention of myopia progression in patients.¹ But since then, a proliferation of studies—ATOM and LAMP among others—has caught the attention of the ophthalmology community, resulting in a groundswell of action. For example, the Academy's Task Force for Myopia, which assembled in 2019, published its initial report in the December *Ophthalmology*.²

And awareness appears to be increasing among the general public, said Aaron M. Miller, MD, with Houston Eye Associates. "Eye care professionals are seeing more and more young patients whose parents are rightfully concerned about their child's myopia or risk thereof." This in turn has fueled therapeutic strategies for slowing the

development of myopia in at-risk patients, and the results are very promising, he added. "We're seeing more clinical data supporting what we're seeing in our offices: options such as low-concentration atropine, orthokeratology, and now multifocal contact lenses are proving to be effective for both myopic correction and control."

The Pharmacologic First Step

Several recent studies (see "Further Reading") have shown that low-dose atropine in the 0.01% to 0.05% range is efficacious for controlling spherical equivalent change and axial length elongation for up to two years—without the adverse reactions associated with higher doses.

Because it's well tolerated in young children and easily adopted by parents, daily atropine drops are Dr. Miller's first-line recommendation. "There's no scientific consensus as to the exact mechanism by which the drops work," he said. "Nonetheless, the results are clear. I was a skeptic at first, but now I'm in my fifth year of prescribing this treatment, and I'm very pleased." He reported that with consistent and committed use, 90% of his patients are experiencing less than 0.5 D of progression. "And I feel very comfortable saying that I've witnessed hardly any side effects," he said.

Although atropine is approved by the FDA for treatment of amblyopia,



CONTACT LENSES. In a recent study, high-add power lenses produced significant slowing of myopic progression, largely due to their greater ability to focus light in front of the retina.

some parents remain apprehensive about any prescription that's off label, said Dr. Miller. "There's still an obvious concern any time a parent is asked to apply a medication directly to their child's eye. And that's understandable. Will it affect their schoolwork? Will they have trouble focusing on near objects? In these situations, the child might be better suited for contact lens treatment."

Off-Label Orthokeratology

Orthokeratology (Ortho-K) involves the overnight wear of rigid gas-permeable (RGP) contact lenses that reshape the central cornea during sleep for improved vision during the day. These specialty lenses are FDA approved for

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correction of myopia, typically in adults. Any application for myopic control is considered off label. Nonetheless, a growing body of evidence shows that the Ortho-K lenses can effectively reduce axial elongation by as much as 50% in children via the induction of hyperopic defocus on the peripheral retina. A report by VanderVeen et al. shows that efficacy is especially significant in the first and second years of treatment when initiated at an early age (6 to 8 years).³ Another study showed greater efficacy for Ortho-K when it is used in combination with low-dose atropine.⁴

Despite these results, many ophthalmologists are skeptical about Ortho-K, said Deborah S. Jacobs, MD, MSc, at Massachusetts Eye and Ear in Boston. For a variety of reasons, pediatric use of Ortho-K is not widespread. Among them, successful lens fitting requires additional imaging and expertise on the part of the practitioner as well as additional chair time and expenses for the patient, said Dr. Jacobs. “But the biggest concern is that you are asking children to sleep in contact lenses—an environment for developing infectious keratitis that, despite the best hygiene practices, can result in permanent scarring and even vision loss.”

And this risk is not insignificant. At least 170 reports of Ortho-K–induced infection appear in the literature.⁵ One study of infectious keratitis among RGP lens wearers found that nearly 25% of cases were due to Ortho-K.⁶

Other results, however, found keratitis in pediatric Ortho-K patients to be quite rare overall—13.9 cases per 10,000 patient-years.⁷ This leads Dr. Miller to believe that the anti-Ortho-K sensitivities of many ophthalmologists might also be a result of sampling bias. Optometrists fit almost all Ortho-K lenses, he said. “Typically, an ophthalmologist is called in only when there’s a problem. The cases of *Acanthamoeba* and *Pseudomonas* keratitis, for example, always end up with us. We don’t see the hundreds of success stories.”

New Contact Lenses

Ongoing concern about Ortho-K–related infection has been a major driv-

ing force behind the development of a daily-wear soft contact lens for preventing myopia progression, said Dr. Jacobs.

MiSight. In November 2019, the FDA approved the MiSight contact lens (CooperVision) to both correct myopia and slow its progression in children between the ages of 8 and 12 years old who have a refraction of -0.75 to -4.00 D with 0.75 D or less of astigmatism. This soft, single-use lens is discarded at the end of each day and works on a dual-focus property. Similar to multifocal contact lenses for presbyopia, the central portion of the lens corrects the refractive error for distance. Concentric peripheral rings focus light in front of the retina to create a constant myopic defocus that cues the eye to reduce growth.

The FDA approval was based, in part, on a randomized, controlled trial of 144 ethnically diverse children who wore either the MiSight lens or a single-focus contact lens. During the three-year study, the MiSight lenses slowed myopia progression by 59% (as measured by mean cycloplegic spherical equivalent) and 52% (as measured by mean axial elongation)—all without serious adverse effects.⁸ Researchers are currently expanding the scope of this trial to examine five-year outcomes as well as the effects on older children wearing the MiSight lens in their late teens.

“This development could be quite significant,” said Spencer Obie, OD, at Houston Eye Associates. He noted that although eye practitioners have been using multifocal lenses off label to slow myopic progression for the past several years, contact lenses specifically approved for slowing the progression of myopia had not been available in the United States until recently. Compared with Ortho-K, said Dr. Obie, “These new lenses offer a more straightforward approach that may require less chair time while still reducing myopic progression. These factors are helpful for the typical practice and getting patient/parent buy-in.”

Boosting the benefits. A new study published in the *Journal of the American Medical Association* builds on the earlier study results by demonstrating

that the add power of a multifocal lens is a determining factor for slowing the progression of myopia. This provides more evidence that contact lenses will be a major factor in the evolving management of nearsightedness in children, said Dr. Obie. The three-year Bifocal Lenses in Nearsighted Kids (BLINK) trial included 292 children, ages 7 to 11 years, whose multifocal lenses were prescribed off label for myopia control. BLINK researchers examined the effect of both high ($+2.50$ D) and medium ($+1.50$ D) add power on the concentric peripheral ring of the multifocal lenses and compared them with a single-vision contact. Only the high-add power lens produced significant slowing of myopic progression, largely due to its greater ability to focus light in front of the retina.⁹

Despite these developments, said Dr. Jacobs, there is still a way to go before daily multifocal lens use becomes standard of care. A lot of questions remain regarding this strategy, she said. “How long do the results last? When can use be discontinued? Are there similar effects for both low and pathologic myopia?”

She noted that the BLINK results are promising, but the number of subjects is small. “As a cornea specialist, I’m still legitimately concerned about the safety issues of contact lenses worn by very young children. So there’s going to be tension on this topic for some time until we have additional long-term, postmarket studies.” To really understand effectiveness and safety, there could also be funded patient registries for identifying complications, she said.

Asking the Right Questions for the Right Fit

Ultimately these three treatment options mean that eye care professionals can tailor their approach to a variety of young patients. But any treatment decision should be made after a careful review of both the risks and benefits, said Dr. Miller. “Do you have a history with the patient? Based on their current vision, are they candidates for treatment? If so, how much has the child’s myopia progressed over the last two or three years? Typically, I’m comfortable

with a 0.75-D increase over a one-year period. But if I'm seeing 1 or 1.5 D during that time, I might be more aggressive in my approach."

It's also important to remember that the parents are key parts of the treatment equation, said Dr. Obie. "I'll definitely want to know if the parents are currently nearsighted or whether they've had refractive surgery to correct their myopia." Because they'll be active participants in their child's at-home care regimen, it's also good to know if they've had any experience with eye-drops or have any preference for a soft or RGP contact lens, he said.

This type of thorough discussion will provide the practitioner with clues regarding not only the maturity and responsibility level of the child, but also what Dr. Obie considers to be the most important qualifying factor: the parent-child dynamic. "This is a significant investment of time and resources for all parties involved," he said. "If the parents are proactively seeking out my

services, I'll look to see if the child's motivation matches. If everyone's excited, I'm excited, and only then will I proceed with treatment if there are signs of myopic progression." When all parties work together without mismatched motivations, added Dr. Obie, "we can significantly improve the quality of life for children in ways previously unavailable."

Despite growing awareness of the myopia epidemic, too many people don't understand the real-life consequences of severe or extreme myopia, he said, adding that eye care professionals should act earlier and more often whenever possible. "It's not always a matter of instant success, but there's a lot of gratification knowing that an at-risk child can grow up to live a safe and healthy life without the fear of debilitating vision loss," he said.

- 1 Walline JJ et al. *Cochrane Database Syst Rev*. 2011. doi: 10.1002/14651858.CD004916.pub3.
- 2 Modjtahedi BS et al. *Ophthalmology*. Published online Dec. 30, 2020.
- 3 VanderVeen DK et al. *Ophthalmology*. 2019; 126(4):623-636.
- 4 Kinoshita N et al. *Jpn J Ophthalmol*. 2018;62(5): 544-553.
- 5 Kam KW et al. *Infection*. 2017;45(6):727-735.
- 6 Cope JR et al. *Ophthalmology*. 2016;123(7): 1435-1441.
- 7 Bullimore MA et al. *Optom Vis Sci*. 2013;90(9): 937-944.
- 8 Chamberlain P et al. *Optom Vis Sci*. 2019;96(8): 556-567.
- 9 Walline JJ et al. *JAMA*. 2020;324(6):571-580.

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For full disclosures, see this article at www.aao.org/eyenet.

MORE ONLINE. For insights about outdoor activity and myopia, see this article at aao.org/eyenet.

Further Reading

Visit aao.org/journals to read the following articles:

- Modjtahedi BS et al. **Reducing the global burden of myopia by delaying the onset of myopia and reducing myopia progression in children: The Academy's task force on myopia.** *Ophthalmology*. Published online Dec. 30, 2020.
- Yam JC et al. **Two-year clinical trial of the low-concentration atropine for myopia progression (LAMP) study.** *Ophthalmology*. 2020;127(7):910-919.
- VanderVeen DK et al. **Use of orthokeratology for the prevention of myopic progression in children: A report by the American Academy of Ophthalmology.** *Ophthalmology*. 2019;126(4):623-636.
- Pineles SL et al. **Atropine for the prevention of myopia progression in children: A report by the American Academy of Ophthalmology.** *Ophthalmology*. 2017;124(12):1857-1866.



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