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REVIEW OF CORNEA & CONTACT LENSES

Slowing Myopia Progression
with Multifocal Lenses, p. 12

Seeing Multifocal Optics
More Clearly, p. 16

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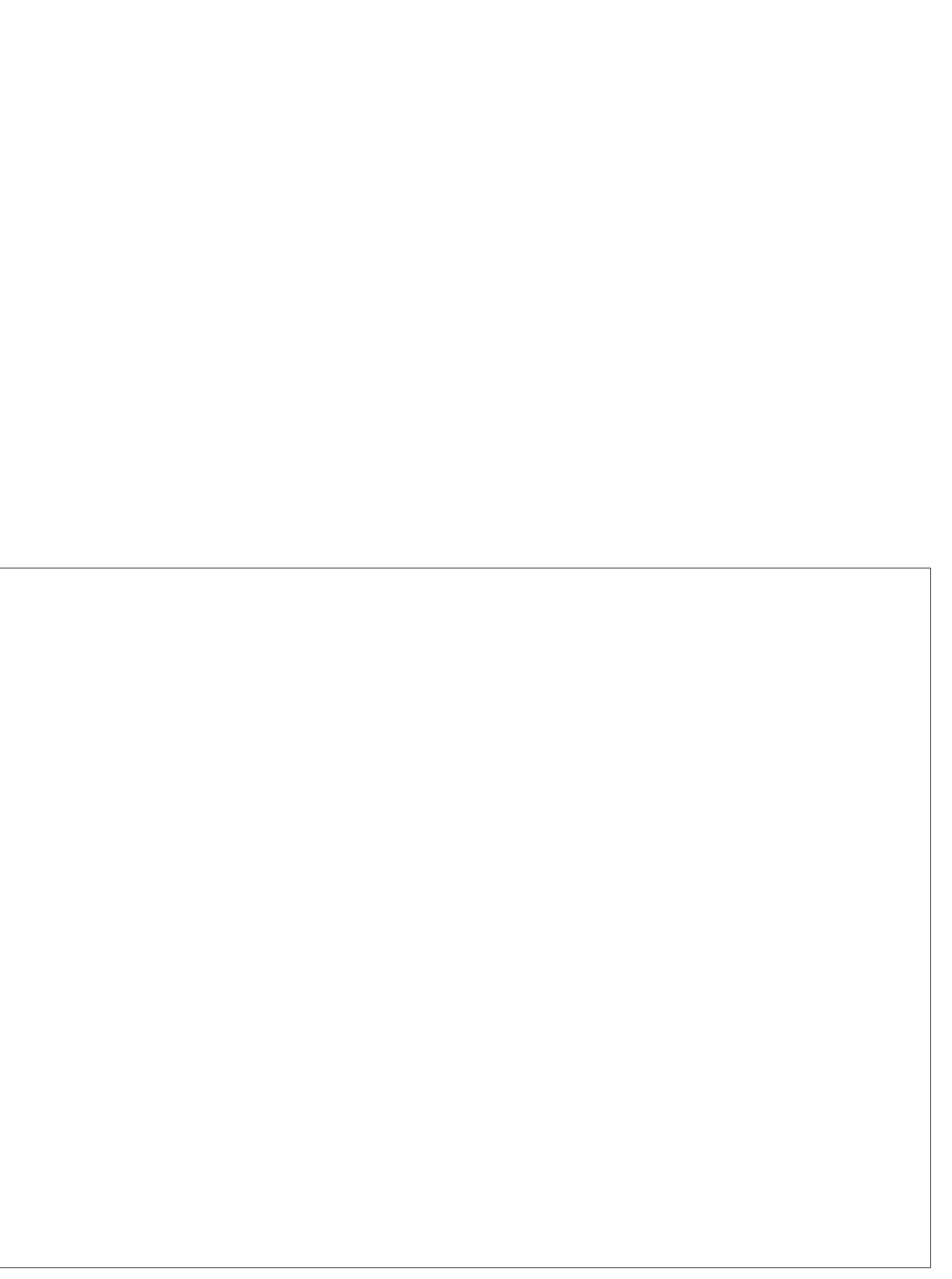
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IN BRIEF

■ Investigators in Turkey have found a **relationship between obsessive-compulsive disorder (OCD) and dry eye** based on tear film parameters and subjective dry eye symptoms. In 30 patients with newly diagnosed OCD who were not using any psychiatric drug alongside 30 healthy controls, the study noted an increase in Ocular Surface Disease Index (OSDI) and corneal staining scores along with a decrease in tear break-up time and Schirmer test in the patients with OCD.

Eroglu FC, Gediz BS, Ozturk M, et al. Association between dry eye disease and newly diagnosed obsessive-compulsive disorder. *Cornea*. April 9, 2021. [Epub ahead of print].

■ A **“game-changing” surgical procedure—corneal neurotization (CN)—could restore corneal sensitivity in all stages of neurotrophic keratopathy (NK)**, regardless of the denervation mechanism. Researchers analyzed the two main surgical approaches to NK—direct and indirect CN—in the literature, including *ex vivo* studies with histopathology of neurotized cornea. They reported that **corneal sensitivity improves after both types of CN approaches**. CN is still limited to a few research groups, however, largely because of the long surgical time and need for a multidisciplinary team involving maxillofacial/plastic surgeons.

Giannaccare G, Bolognesi G, Pellegrini M, et al. Corneal neurotization: a game-changing surgical procedure for neurotrophic keratopathy. *Cornea*. April 14, 2021. [Epub ahead of print].

■ Children with amblyopia who are lost to follow-up after their initial visit appear to be older, non-white and lack insurance. **Individuals were also more likely to be lost to follow-up if they had undergone previous amblyopia treatment or had longer requested intervals between visits**, the investigative team suggested. More children with amblyopia returned as scheduled when their follow-ups were six weeks or two months after the initial visit, as opposed to between six and 12 months later.

Shoshany TN, Chinn RN, Staffa SJ, et al. Identifying characteristics predictive of lost-to-follow-up (LTFU) status in amblyopia. *Am J Ophthalmol*. May 13, 2021. [Epub ahead of print].

Study Affirms CXL as a First-line Therapy in Kids

A recent study found that corneal crosslinking (CXL) is able to stop keratoconus progression in the majority of young patients. Rigid contact lenses can help affected eyes, but more advanced disease may devolve into opacification, requiring a transplant. CXL, on the other hand, strengthens the cornea by increasing its biomechanical rigidity.

The study aimed to examine the efficacy and safety of CXL for stabilizing progressive keratoconus in young patients. The observer-masked, randomized, controlled, parallel group superiority trial included one eye of each of the 60 patients, who were 10 to 16 years old. Patients were randomized to receive CXL + standard care (n=30) or standard care alone (n=30), with spectacle or contact lens correction as necessary. Keratoconus progression was defined as 1.50D increase in K2.

The researchers analyzed 30 patients in the CXL group and 28 in the standard care group. They found the mean K2 in the study eye at 18 months was 49.70D in the CXL group and 53.40D in the standard care group. The adjusted mean difference significantly favored CXL, with a K2 of -3.00D.

Eyes that received CXL achieved better uncorrected and corrected vision than standard care at 18 months. Differences between the two groups were significant, at -0.31logMAR and -0.30logMAR, respectively.

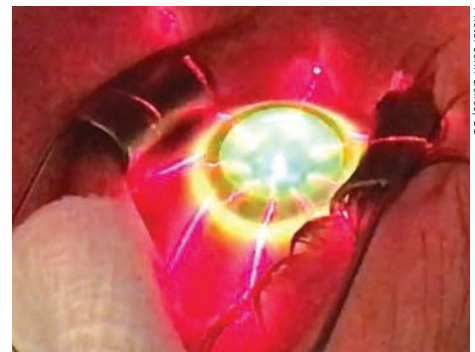
The researchers reported keratoconus progression in two patients (7%) in the CXL group and in 12 patients

(43%) in the standard care group. Based on the adjusted odds ratio, the researchers found that patients in the CXL group had a 90% lower chance of progression than in the standard care group. They reported that quality of life outcomes were similar.

“On average at 18 months post-randomization, patients receiving CXL in the study eye had corneal power in the steepest meridian 3.00D lower than those receiving standard care, a statistically significant difference,” they wrote. “We found no adverse events associated with CXL, suggesting that this is a relatively safe intervention.”

“These data suggest that CXL should be considered as a first-line treatment in progressive disease,” the researchers concluded. “If the arrest of keratoconus progression induced by CXL is sustained in longer follow-up, there may be particular benefit in avoiding a later requirement for contact lens wear or corneal transplant.”

Chen AM, Erzurum SA, Chandler DL, et al. Overminus lens therapy for children three to 10 years of age with intermittent exotropia: a randomized clinical trial. *JAMA Ophthalmol*. March 4, 2021. [Epub ahead of print].



Children aged 10 to 16 who received CXL for keratoconus had a 90% lower chance of progression than standard care.

Photo: John Gelles, MD

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Rapid Myopia Progression Kids Bound to be High Myopia Teens

High myopia in young adults is reaching epidemic proportions in East and Southeast Asia with prevalence rates reported to range between 8% and approximately 22% from childhood to young adulthood.¹⁻⁶ Looking into this association, new research found children with initial rapid myopia progression may need closer monitoring, follow-up and possible clinical treatment interventions, since they are more likely to develop high myopia by their teenage years.¹

The study found three-year myopia progression rates in childhood, combined with their baseline spherical equivalent (SE) or axial length (AL), were good predictors of teenage high myopia.

The investigation included 928 Singapore Cohort of Risk Factors for Myopia Study children between the ages of six and 11 who were followed up for about seven years until they became teenagers (12 to 19 years old). During the follow-up visits, researchers performed cycloplegic autorefractometry and AL measurements, and evaluated SE and AL outcomes at three years. Myopia was defined as SE of $-0.50D$ or less and high myopia was considered $-5.00D$ or less. The study's outcomes of interest were teenage high myopia and AL of 25mm or greater, in addition to teenage SE and AL measurements at the final follow-up.¹

During the last visit, approximately 10% of teenagers developed high myopia, and roughly 23% had AL of 25mm or greater. In multivariate regression analyses, every $-0.3D$ /year increase in three-year

SE progression and every 0.2mm/year increase in three-year AL progression was linked with a $-1.14D$ greater teenage SE and 0.52mm greater teenage AL.

The area under the curve of a combination of three-year SE progression and baseline SE for teenage high myopia was 0.97, and the area under the curve of three-year AL progression and baseline AL for teenage AL of 25mm or more was 0.91.

The study results may be useful to risk-stratify and guide clinical decisions in terms of myopia control management for children, the researchers said. For children at higher risk, they suggest more aggressive treatment, including a higher frequency or concentration of atropine eye drops or combination treatment, such as atropine with multi-zone contact lenses, may be necessary for myopia control.¹

The study received support from several groups, including the Singapore Government under the Industry Alignment Fund Industry Collaboration Projects Grant, the National Medical Research Council Individual Research Grant and Johnson & Johnson Vision. **RCCL**

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Vaccinations and the Susceptible Cornea

Prepare patients who have had a graft in the past on what to expect.

All of us have patients who have had a successful full-thickness corneal transplant or a lamellar procedure. Immunization for SARS/CoV-2 (COVID-19) is certainly front and center, so what exactly do you tell these patients regarding it? Does the risk for a vaccine-related rejection (or risk for adverse reaction and vaccine-derived disease) outweigh any benefit in reducing the risk for getting infected?

We just don't know for certain how often corneal rejection episodes occur (if at all) after any vaccination, SARS-CoV-2 vaccination included. Causation hasn't been proven. Large studies, including a meta-analysis, have shown no evidence that influenza vaccines cause rejection in solid organ transplant recipients, but anecdotal reports of adverse events have been shared on various forums suggesting causation or association.¹ Registries and audits for these patients are sorely needed in order to make timely and meaningful recommendations.

ASSESS THE RISK

A recent survey of cornea surgeons investigated attitudes and practices regarding added risk for rejection in transplanted patients following immunization.¹ This manuscript reports the clinical attitudes of 142 current corneal specialists and their specific responses to 18 clinical scenarios. Decision-making scenarios for early and late time points were explored regarding both shingles and influenza vaccinations in grafted patients. Either not recommending vaccination for young, recently grafted (or other high-risk patients) or treating

patients with an increase in topical steroids prior to and following vaccination for 10 days to two weeks seems prudent. But, nearly half of those surveyed recommended no change in ocular management with immunization since most of these patients used a low-dose, chronic topical steroid.¹

Of those surveyed, 19.7% stated they have personally observed a rejection episode associated with a recent vaccination even though only four papers totaling 12 cases of rejection following recent vaccination were identified in published literature the past three decades.¹ Should actual rejection be suspected, clinicians should question patients about any recent immunization and treat with an increase in topical steroids.^{1,2} Most of these reported cases are fortunately reversed, and patients seem to recover totally with prompt topical steroid use.² Treatment for rejection in some cases may require both topical and systemic steroid use.

DEALING WITH REJECTION

Several anecdotal cases of rejection episodes following SARS-CoV-2 vaccination have been reported. Most occurred within two weeks of receiving the first or second dose of vaccine. To effectively prevent or mitigate possible vaccination-related rejection, we must first be aware of vaccination schedules to highlight any concerns.¹ Educate patients on what to look for and not hesitate to call should they have any concerns.

With a worldwide vaccination program underway, we have a unique opportunity to record and assess cases of rejection that happen following recent vaccination. Timelines,

management of such rejections and success in any recovery would be important data. Still, more research is required regarding possible causation or association in order to provide guidance necessary in making meaningful recommendations.

Clinicians are encouraged to publish any suspected case of vaccine-associated rejection episodes, but making this available in a public forum might just frighten those who are still considering vaccination.¹ Until we have solid evidence-based recommendations, consult your cornea specialist. Don't be surprised if recommendations vary greatly among experts and may depend on the type of graft and age of the patient. But, recommending against getting vaccinated doesn't seem wise since treating a graft rejection sure beats being on a respirator. However, I realize a young, healthy graft patient at low risk for COVID-19 complications may elect to not be vaccinated after being fully informed.

In the meantime, take time to ask when patients plan on getting vaccinated and discuss with them about the potential risks. Should they experience any discomfort, change in vision or any other signs of rejection after immunization, treat appropriately for possible vaccine-related rejection to minimize any potential for losing the graft. [RCCU](#)

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CLEAR: What's in it for GPs?

This report details everything you need to know about GPs and why it's a viable option for several patients.

The British Contact Lens Association (BCLA) recently published its long-awaited Contact Lens Evidence-based Academic Reports (CLEAR) in *Contact Lens and Anterior Eye*. Conceived by James Wolffsohn in June 2019, CLEAR brought together over 100 multidisciplinary experts in contact lenses to review and summarize the literature on contact lenses in a set of 10 articles covering topics including effect of contact lens materials and designs on the anatomy and physiology of the eye, contact lens optics, medical use of contact lenses, evidence-based contact lens practice, and contact lens technologies of the future.

I dove into the two reports dedicated to gas permeable (GP) lenses and materials to see what pearls we could take away.

The report on medical use of contact lenses was authored by Deborah S. Jacobs, MD, of the cornea and refractive surgery service at Massachusetts Eye and Ear and Harvard Medical School along with 11 optometric colleagues active in practice and research across the United Kingdom, Spain, Australia and the United States.¹

The authors do an excellent job detailing the current lack of a field-wide, universally accepted definition of what constitutes “medical contact lenses.” Their consensus determined that medical contact lenses are those worn primarily to treat an underlying disease state or complicated refractive status; that is, for a reason other than cosmesis, or eliminating the need for spectacles.

THERAPEUTIC OR REHABILITATIVE?

Beyond their consensus definition of medical contact lenses, this esteemed group additionally recommended two clinical definitions for medical use of lenses:

(1) As therapeutic (or bandage) contact lenses “for the treatment of ocular discomfort, to support the cornea after surgery, or when the cornea is being treated for an underlying disease state or to protect the cornea from the environment or mechanical interaction with the lids.”

(2) As a rehabilitative contact lens “prescribed for conditions that prevent a patient from achieving adequate visual function with spectacles because of high, irregular or asymmetric refractive error.” They add that “partially or completely occlusive lenses that improve function or cosmesis after trauma, surgery or stroke also fall into this category.”

Therapeutic lenses are used to treat, support or protect the cornea. Examples include a soft contact lens worn after refractive surgery or a scleral lens worn in exposure keratopathy. Rehabilitative lenses are used to treat high, irregular or asymmetric refractive error or worn as a partial or complete occluder.

Examples include custom-tinted black occluder lenses worn for amblyopia, large diameter custom soft lenses, custom soft toric hydrogel or silicone hydrogel contact lenses, or standard or custom lenses to correct anisometropia (asymmetry in refractive error between the two eyes).

When discussing contact lenses for medical purposes, the group

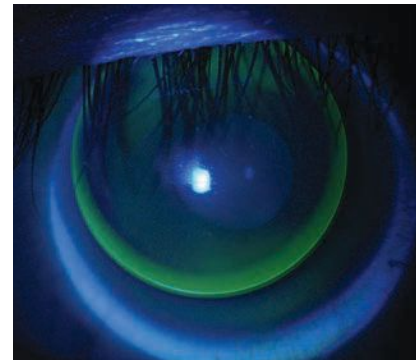


Fig 1. Lid-attached corneal GP lens fit on a patient with myopic astigmatism.

identifies bandage lenses, stating that “while any CL might be used medically or as a therapeutic or bandage contact lens, some contact lenses are labeled for use as a bandage lens or with a therapeutic indication for use.” However, they note “the literature currently lacks well-controlled studies related to [soft] lens materials being used specifically for medical purposes.”

The report also outlines the medical purposes for which practitioners may fit contact lenses, including “treating patients with corneal ectasia, ocular surface disease, after ocular surgery and in the setting of high refractive error,” which is a definition borne out of the Scleral Lenses in Current Ophthalmic Practice study group’s 2018 publication on the prescribing patterns of scleral lens fitters.²

REHABILITATIVE CORNEAL GP LENSES

When specifically discussing corneal GP lenses, the authors outline suitability for two distinct conditions: aphakia and high



refractive error. While the report also includes an assessment of the use of corneal GP lenses in the management of keratoconus, this falls more into the category of a therapeutic GP lens. In all cases, corneal GPs offer “superior visual correction provided by the rigid, regular front surface of the lens,” which can be most useful in high refractive error and corneal irregularity.

With the more widespread adoption of corneal GP lenses as the 20th century progressed, it became clear these lenses were useful in the correction of high ametropia. Contact lenses provide better acuity than spectacles for highly myopic refractive errors.³ In patients with high astigmatism, empirical fitting of either soft or corneal GP lenses can provide results that meet or exceed the vision achieved with spectacles. This is attributed to the increase in magnification of high minus corneal GP lenses when compared with spectacles.⁴ When considering anisometropia, good results can also be achieved in treating myopic anisometropic amblyopia with contact lenses.

CHALLENGES AND COMPLICATIONS

One of the challenges of GP lens fitting for rehabilitative purposes in aphakia is unilateral aphakia, where aniseikonia can be the limiting factor in successful wear of spectacles. The report outlines cases where contact lenses of varying types have been shown to provide some level of binocular vision. In addition, for patients with traumatic aphakia,

there is often accompanying corneal irregularity and scarring, which can benefit from GP lens correction.

In cases of aphakia, much attention has been paid to the benefits of overnight contact lens wear to improve the patient experience. The reasoning is that our aphakic patients tend to be elderly and may face challenges with daily lens routines. The authors cite multiple studies that evaluated the risks/benefits of overnight wear in aphakia and found that while there are benefits in lens experience with GP and silicone elastomer lenses, there is also a high risk of adverse events including risk of microbial keratitis and vision loss.¹

In cases of both aphakia and high refractive error, there can be corneal neovascularization that arises from poor oxygen transmission associated with lens thickness, lens material or overnight wear. In addition, simply achieving an optimal fit due to the lens thickness and fit dynamics can be a challenge. The report also reminds us of the challenges associated with fitting GP lenses in patients with ectopia lentis and Marfan syndrome, as these corneas tend to be flat with larger corneal diameters and higher levels of myopic and astigmatic refractive error.

Furthermore, corneal GP lens correction of highly myopic refractive error is associated with the development of ptosis, and the degree correlates to the degree of refractive error and duration of GP lens wear.⁵ This creates a potential issue in either unilateral lens wear or anisometropia, and given the utility of corneal GPs for treating these

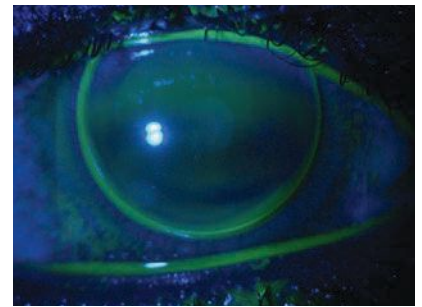


Fig 2. Corneal GP fit on a myopic patient with neovascularization due to previous overwear of a hydrogel soft lens.

conditions, it is certainly something we should monitor if developing in our patients.

Whether you are fitting a “normal” refractive error or a more complex case with co-existing aphakia, anisometropia or amblyopia, corneal GP lenses can be an option for optimal vision correction and give the opportunity for long-term patient satisfaction, binocularity and even vision improvement when compared with spectacle lens wear. CLEAR gives us a well-referenced, well-thought-out, evidence-based summary of contact lenses that is going to be a resource in our industry for years to come. **RCCL**

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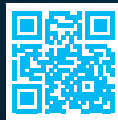
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SLOWING MYOPIA PROGRESSION WITH MULTIFOCAL LENSES

Integrating this service into practice is beneficial for both patients and ODs. Here's a primer.

By Catlin Nalley, Contributing Writer

There's been an increased focus on myopia management in recent years and, as primary eye care providers, optometrists are positioned at the forefront of this effort. The shift is largely due to the growing prevalence of myopia as well as new research breakthroughs. In North America alone, cases grew by 6.2% between 2000 (28.3%) and 2010 (34.5%) and are expected to reach 58.4% by 2050. Worldwide, it's projected that the prevalence will be 49.8% by 2050, meaning five billion people will be myopic and nearly one billion of those individuals will develop high myopia.¹

“In the past three decades, we have witnessed an increasing global prevalence of myopia that trends suggest will continue,” notes Kevin Chan, OD, senior clinical director at Treehouse Eyes of Vienna, VA. “We are also expecting to see a surge of myopia in children, which is why it is so important to engage in myopia management when patients are still young, and we actually have the best chance to slow progression.”

Current myopia control options include atropine drops, soft multifo-

cal contact lenses and orthokeratology lenses. Multifocals for myopia management, a relatively new area of care, is seeing increased interest, but has not yet been widely adopted. This article will explore this service and not only how ODs can integrate it into their practice, but how to do so successfully.

MULTIFOCALS FOR MYOPIA

A number of studies have explored multifocal contact lens and their role in myopia management. One of the most recent, the Bifocal Lenses in Nearsighted Kids (BLINK) randomized clinical trial, sought to determine if center-distance soft multifocal contact lenses slow myopia progression in children when compared to single-vision lenses. It also examined whether high add power (+2.50D) slows myopia progression more than medium add power (+1.50D).² The Biofinity lens from CooperVision was used in the study.

The BLINK study, a three-year clinical trial, recruited 294 school-aged myopes without any signs of pathological myopia.³ Throughout the course of the study, the children wore contact lenses daily and had



Pervasive digital device use among kids—and their consequent reduction in time outdoors—is accelerating myopia onset in younger populations.

yearly exams. Findings showed that high add power multifocal contact lenses significantly reduced the rate of myopia progression when compared to single vision contact lenses of the same power and medium add power multifocal lenses. The BLINK study is now in second phase and participants will wear the +2.50D add for the next two years followed by single vision lenses for the final year of the study.³

Given the evidence supporting this approach as well as a growing need among patients, optometrists must be prepared to navigate myopia

management. “As the primary eye care provider, optometrists must take the lead when managing these patients,” notes Maria Walker, OD, PhD, an instructor at the University of Houston College of Optometry. “It is well within our scope of practice and something that we as a profession should take ownership of.”

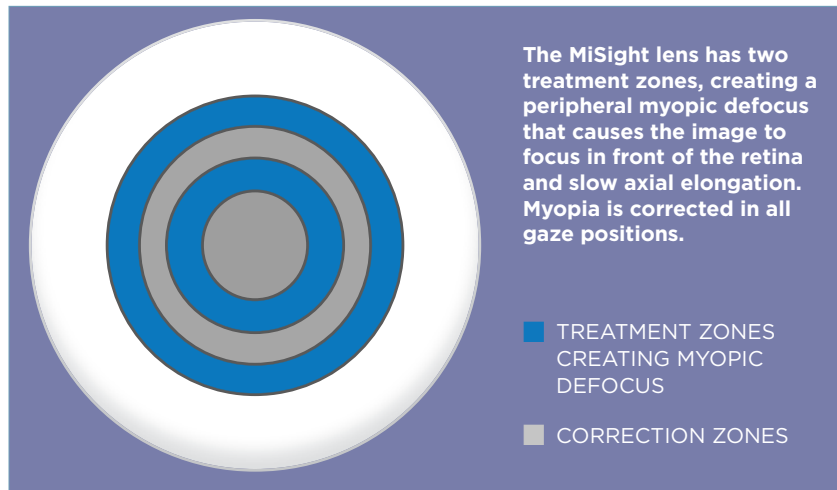
“Using multifocal contact lenses in this way is becoming more mainstream but, like anything new, it takes time to integrate,” she continues. “However, given the overwhelming data and an increasing number of optometrists tackling this aspect of patient care, this is something that everyone can learn to do with confidence.”

SUCCESSFUL INTEGRATION

Incorporating this service into your practice begins with the basics: learning more about the various products currently on the market. This starts with education and familiarizing yourself with your options as well as reaching out to representatives of different contact lens manufacturers.

“Doctors need to be more proactive when it comes to doing research, connecting with brands and learning about different products,” says Dr. Chan. “Because just like in other areas of care, there are a variety of new lenses that can be used for myopia control that could offer better vision quality for young patients.”

A thorough understanding of different lens properties and designs is crucial, notes Chris Browning, OD, of Indianapolis, who suggests making a list of the pros and cons of different lenses as well as which children might benefit from which type of design. “ODs should also become familiar with the consulting services of different manufacturers,” he adds. “It is really beneficial to take advantage of consults, especially when integrating this service into your practice.”



Research suggests the most effective lens design for myopia control is a center-distance multifocal. To date, the only FDA-approved lens for myopia control is MiSight from CooperVision, a single-use, disposable lens is indicated to slow the progression of myopia.⁴ To get certified to prescribe this lens, ODs must participate in CooperVision’s Brilliant Futures Myopia Management Program, which offers training for physicians as well as tools to support children and their parents.

There are also a variety of lenses that can be used off-label for myopia management, including the Biofinity lens (CooperVision), a one-month replacement daily wear silicone hydrogel lens. It is typically prescribed in both eyes with a +2.50D dominant (center-distance design) add power, according to Andrew Pucker, OD, an assistant professor at the University of Alabama at Birmingham.⁵ If the patient finds it difficult to adjust to the higher add, a +2.00D dominant add power is sometimes used. “This power seems warranted since the MiSight has been shown to have a meaningful reduction in growth with a +2.00D add,” he notes. Another available option is the NaturalVue multifocal (Visioneering Technologies)—a daily disposable hydrogel contact lens.

There are a number of reasons to select an off-label option, says Dr. Walker, which is why ODs must stay current on the available products. “Cost is often a factor,” she explains. “Also, one lens may fit a patient’s eye better than another. Material, water content, diameter and base curve can all play a role in choosing the right lens.”

The lens modality is also an important consideration, according to Dr. Walker. “Some parents may be more comfortable with a monthly lens rather than a daily lens,” she says. “Certain lenses may match a patient’s lifestyle more than others.”

Once you have determined which option best meets the needs of your patient, ensuring you have the training and tools to properly fit these lenses is paramount to your success. When it comes to selecting power, Dr. Walker suggests that ODs shouldn’t be afraid to put more minus power in the lens than may be predicted based on spherical lens fitting. “Remember, it’s complex optics,” she notes. “Optometrists should feel comfortable using a different power than you would use spherically, as this has been done in clinical trials and the efficacy of the modality is still evident.”

Since MiSight is approved for myopia management, the fitting

SLOWING MYOPIA PROGRESSION WITH MULTIFOCAL LENSES

guide will be an important part of your toolbox. However, off-label lenses will not provide a fitting guide specific to myopia management, notes Dr. Walker. “In those cases, I would encourage you to fit until you are happy with the results. Don’t be afraid, within reason, to go outside the expected parameters. Fit the parameters that allow a patient to see comfortably.” However, Dr. Walker did present a caveat to this—when patients have visually significant residual astigmatism—and discussed consideration of multifocal toric lenses for these patients. When needed, ODs shouldn’t hesitate to prescribe this type of lens, she notes. “There are currently two available options for commercially available soft toric multifocals (CooperVision’s Biofinity toric multifocal and the Ultra Multifocal for Astigmatism from Bausch + Lomb), and of course custom soft lenses are available at most specialty lens manufacturers.”

Practitioners should be mindful that the goal of prescribing multifocal lenses for children “is more than vision correction only; it is largely for managing their myopia progression,” adds Dr. Chan. “At times, some patients may be symptomatic with residual astigmatism at night. Practitioners may need to provide a pair of glasses at a lower prescription as a ‘booster.’”

After an OD has laid the foundation for this new service, the next step is marketing. How are you going to make patients as well as colleagues aware that you now offer multifocal contact lenses for myopia management? Educating current patients is a crucial step. Other marketing tools include social media as well as displaying your services prominently on your website.

“Initially, I think one of the most powerful tools at your disposal is word of mouth,” suggests Dr.

Walker. “You don’t have to market loudly. Just start talking about it with your patients. They, in turn, will start discussing it with their friends and family. And as the service grows within your practice, so will your confidence.”

It is never too soon to start the conversation about this service and why it is beneficial to initiate myopia management at an early age, emphasizes Dr. Browning, who makes a point to review the schedule a week in advance and identify patients who have family members who might benefit from this service. “Talk about it with every patient that comes into your practice,” he says. “That includes parents and grandparents. I’ll bring it up with myopic patients who have babies or very young children and even expecting parents, if their child is at an increased risk of developing myopia.”

Making this service stand out is another way to highlight its value. “I think that it is important to treat multifocal lenses for myopia management like a referral service,” suggests Dr. Pucker. “You are providing care that goes beyond a standard visit. I would avoid just adding it on to a primary care day; that’s not a good message. Scheduling a standalone visit is important from both a patient perception and billing standpoint.”

Success also depends on a strong support staff, notes Dr. Browning. They are integral to not only building this new service and managing logistics, but also marketing and patient education. “Your staff is key,” he says. “You have to have a team that understands what you’re trying to do and why it is important so they can help execute it effectively.”

Staff buy-in must be a top priority, emphasizes Dr. Walker. “You have to take the time to make sure everyone is on board and is ready

to invest their time and energy into this new service. And don’t rush,” she urges. “Take your time to learn what’s working and what’s not working for your practice, then grow from there.”

PATIENT BUY-IN

Another key component of offering any new service is strong patient communication and education, especially in regards to a long-term intervention that comes with a higher price tag.

However, before an OD can effectively communicate the importance of this service to patients and parents, they have to feel comfortable with their own knowledge of myopia management. “We have to step out of our comfort zone and tackle this new area of care,” says Dr. Chan, while suggesting ODs engage in peer-to-peer education and CE opportunities to deepen their understanding of myopia management. “We have to increase awareness and common grounds of knowledge within the eye care community first, before we even have a chance to successfully educate parents.”

When talking to parents, ODs must take the time to thoroughly explain the service and its value. “Patients often think that all soft contact lenses are the same,” explains Dr. Pucker. “You have to help them understand that multifocal contact lenses aim to slow eye growth in addition to correcting distance vision. Fully informing the patient, of what you’re doing and why, is incredibly important.”

Help them understand why this approach is so valuable for their child’s vision and overall well-being. This can be especially useful for the parent who is nervous about a new approach or hesitant due to the cost. Dr. Pucker suggests showing pictures and emphasizing potential outcomes. “The long-term benefit

is more than just having less glasses prescriptions in the future,” he says. “It’s also decreasing the risk for vision-threatening conditions, such as retinal detachment, glaucoma and cataracts, in the future.”

Focusing on the long-term benefit also helps parents understand the cost behind this service. “When I talk to parents, I emphasize that this is an investment in their child’s future,” Dr. Browning explains, while noting that his practice works with vendors who allow him to bill patients monthly, which can help ease the financial burden. “We found that patients were much more willing to listen to us when we’re able to break payment down on a monthly basis.”

Taking the time to connect with the child on a personal level can build trust with the patient as well as their parents. It also ensures the child is prescribed the right approach for their personality and lifestyle. “Being able to read the parents as well as the child is very important,” says Dr. Browning. “This requires taking the time to talk to the child. Ask them about their day, their favorite classes and hobbies. Not only does this help you get to know your patient better, it also goes a long way with the parents. They want to feel reassured that you understand their child and their individual needs.”

This can be an intimidating process for the child as well as their parents. By not just jumping into clinical discussions and price points, you are putting them at ease, and they will be more likely to listen to your recommendations with an open mind.

TAKE-HOME MESSAGE

Integrating multifocal contact lenses for myopia management into the services you provide is an opportunity to grow your skills and practice exponentially. It is a way to attract new patients while also building a

Clinical Pearls for Myopia Management⁶

- Multifocal soft contact lens parameters, such as wear time, add power and pupil size, vary with each patient.
- The suggested wear time for adequate myopia control is eight or more hours a day.
- Initial lens selection should be based on cycloplegic spherical equivalent refractive error, appropriately adjusted for vertex distance, with an additional -0.25 to -0.50 added to the sphere power (a practice not described in FDA trials but shown effective in clinical practice).
- Research shows that higher add powers improve myopia control ($\geq +2.50$); however, add powers need to be balanced with visual quality.
- The pupil size and behavior may have an effect on treatment but need not be strongly considered when fitting soft multifocal lenses.
- Educate both children and patients on how to correctly handle and clean the lenses—with written and verbal resources (consider virtual resources, too).
- Train and excite your staff about myopia management.
- Aim for 20/happy visual acuity that meets your patient’s daily needs.
- Cater the application of multifocal lens not only based on clinical assessment, but also patients’ lifestyle and preference individually.

deeper connection with the ones you currently have.

However, to find true success, you have to be prepared to make the commitment, says Dr. Chan. “Invest in education and practice management. Prepare not only yourself as a doctor, but also your staff and practice as a whole,” he notes. “Fully embrace this new specialty if you want to be able to succeed.”

With the growing prevalence of myopia and a greater emphasis on its management, optometrists must take the lead not only for their patients, but also their profession. “The myopia epidemic isn’t going anywhere, so we can either pick up the mantle or wait until ophthalmology takes on the burden,” notes Dr. Walker. “If you want to practice to your full scope as an optometrist, you need to be providing this service. And, if you don’t, you could potentially lose a patient (or family) to another provider.”

As primary eye care providers, optometrists are in the perfect position to offer this important service, which can provide lifelong benefits to patients. And so, the profession as a whole must change their mentality when it comes to myopia management, notes Dr. Browning.

“There is no primary care OD in this country who doesn’t see a myopic child in their practice every day,” says Dr. Browning. “And it’s just too easy to do what we’ve always done—give them a pair of glasses and send them out the door.

“If you aren’t treating the myopia then you need to send them to somebody that is because we now have the knowledge and tools to help these children,” he concludes. “They’re in your chair on a daily basis and we have the chance to change these children’s lives forever. We just have to take it.” **RCCL**

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SEEING MULTIFOCAL OPTICS MORE CLEARLY

As the presbyopia population grows, so does the number of multifocal contact lenses. That gives you more options—but also more to master. Here's an overview.

By Robert L. Davis, OD, and Mosche Schwartz, OD

The process of fitting presbyopia patients with multifocal contact lenses is often fraught with challenges. Some are hesitant to wear them, others are on board with the idea but the choices seem endless. Still more have unrealistic expectations that almost doom the endeavor from the start. And it's not just the patient who feels overwhelmed; some ODs feel the same way, as there are many anatomical features, optical advantages and patient-specific alternatives to be aware of.

Prospective patients for multifocal lens wear need to have clear optical media, ideally with minimal aberrations or deviations from the norm, given the complexity of the visual correction being attempted in a single design. Anatomical factors impacting the performance of the lens optics include corneal shape (e.g., prolate, elliptical), any dystrophies, pupil size (in scotopic, mesopic and photopic settings), lens crystalline clarity, aberrations and misalignment with the visual axis. Individual patient characteristics include total ocular system spherical aberration, centration and the ability

to neuroadapt.¹ Posterior segment concerns like epiretinal membrane or any macular disorders also raise the degree of difficulty in fitting multifocals.

Contact lens correction for presbyopia accounts for up to 25 to 35% of contact lens fittings in some countries, though adoption in the United States tends to lag international markets.² Here, we'll look at the options, impediments and decision-making process to help improve your odds of success in meeting the needs of presbyopes with a contact lens option.

Practitioners investigate the advantages and disadvantages of presbyopic lens designs through patient experience, discussing outcomes with colleagues, reading articles and listening to clinical pearls from speakers. We thought asking the 1,700 members of the American Academy of Optometry's Cornea, Contact Lens and Refractive Technologies Section for their viewpoints on presbyopia contact lens fitting might give additional insight. The questionnaire's goal was to examine whether the practitioner's prescribing habits in correcting

presbyopia change with its severity or age. This survey did not look at the different methodologies of fitting advanced cases of post refractive surgeries, corneal anomalies/dystrophies or dry eyes. The questions are shown in the table and answers are discussed below.

PROGRESSIVE MULTIFOCALS

The majority of the responding clinicians' first lens of choice for the initial diagnosis of presbyopia was a progressive multifocal design. This is due to advancements in the fabricating technology that "eases" the fitting process. Most simultaneous vision multifocal contact lens designs

ABOUT THE AUTHORS



Dr. Davis is medical director at the Contact Lens Clinic at Davis EyeCare in Oak Lawn, IL. He is also co-founder of EyeVis, Eye and Vision Research Institute developing novel contact lens designs.



Dr. Schwartz, a CCRT Diplomate, has a specialty contact lens practice in Owings Mills, MD. He has received lecture, travel or authorship honoraria from Truform Optics and SpecialEyes.

1. What is your lens of choice when fitting a presbyope?

	Emerging	45-year-old	55-year-old	65-year-old
Distance contacts and reading glasses	9.5%	5.1%	4.0%	10.1%
Modified Monovision	15.3%	13.1%	17.8%	19.2%
Monovision	12.4%	9.8%	4.7%	6.2%
Progressive Multifocals	56.0%	65.1%	63.0%	49.6%
Annular Bifocals	3.6%	4.4%	5.8%	5.1%
Translating Bifocals	0.4%	0.7%	2.7%	5.1%
Custom Design Multifocals	2.9%	1.8%	2.5%	4.7%

incorporate multiple add powers. The majority of the responding practitioners prefer soft lens designs over hybrid and gas permeable options, owing to patient comfort concerns.

However, even with recent advancements in multifocal lens design, the success rate is still questionable. Only 62.8% of practitioners reported a success rate of 70% in transitioning patients from single vision to multifocal design. Typical reasons why multifocal lenses may have a lower chance of success include relatively restricted lens choices (compared to spherical options), anatomical limitations and visual demands due to lifestyle. While some of the reasons are generally age-related discomfort and problems with handling lenses, dissatisfaction with the performance of multifocal soft lenses due to unwarranted visual compromise does not make it an appealing choice for the presbyopic lens wearer.⁷

It should be noted that only 29% of contact lens dropouts are presented with other designs and modalities to try.³ Visual change related to advancing age is another factor that causes patients to drop out of contact lenses.⁴

The advancement of lens production, lens materials and improved understanding of scleral anatomy and physiology have increased the indications for scleral lenses prescribing. Scleral contact lenses designs are regarded as one of the improved correcting solutions for eyes that

have failed with traditional lens modalities.⁵ However, only 5% of respondents' lens wearers make use of this modality.⁶ Correcting presbyopia in a scleral lens design is not impossible but may be impractical for mainstream use. While corneal gas permeable refits were prescribed only 8% of the time in our findings, it is still higher than the reported trend of 4%.⁷

MONOVISION AND MODIFIED MONOVISION

These choices collectively comprised the second-most selected approach to presbyopic correction in our survey. An interesting pattern resulted with the highest percentage of fits with the emerging presbyopes and patients over 65 years of age. This fitting approach for the emerging presbyope correcting distance vision with the dominant eye and near vision with the non-dominant eye was selected approximately 25% of the time by practitioners. Monovision is advantageous in the early stages of presbyopia, with a prescription gap up to +1.75D between the two eyes in instances when multifocal contact lenses do not achieve ideal vision at both distance and near. Patients over 65 using modified monovision multifocal approach enhanced visual performance, as the dominant eye is corrected for distance with a lower add multifocal power, while

the non-dominant eye is corrected with a higher add power.

Practitioners fitting presbyopic patients should select the design with the best visual effect and lens comfort that attributes to improved outcomes. Our questionnaire found an interesting trend among practitioners, with 64% paying attention to the replacement category (daily vs. monthly) when fitting presbyopia. This statistic, coupled with almost 14% who define success by the wearing schedule, reveal that practitioners are more concerned with wear schedules than finding a successful lens design—no matter the replacement cycle. To improve contact lens success, the resultant acuity and comfort attributes should be the priority.

Multifocal lens designs are constructed into several categories: center-near aspheric, center-distance aspheric, concentric ring or segmented. The easiest for patients to process information is the segmented design. When they look straight ahead, the visual axis goes through the distance zone; looking down shifts the axis to the reading zone.

In a gas permeable (GP) lens, the lower lid acts as a ledge barrier holding the lens in place as the eyes traverse through the lower reading portion. In the soft version, a new lens to the market incorporates a bump in the upper portion of the lens and uses the upper lid to hold the lens in place as the eyes traverse to the lower bifocal portion of the lens. These lens designs—like

2. When troubleshooting an unsuccessful multifocal fit, which do you change?

Design Type	43.1%
Distance Lens Power	18.5%
Near Lens Power	19.9%
Fabricator	2.7%
Material	0%
Other	16.3%

SEEING MULTIFOCAL OPTICS MORE CLEARLY

3. To achieve optimal soft multifocal outcomes, do you pay attention to the replacement category (daily vs. monthly)?

Yes	64.1%
No	35.9%

spectacles—have the visual system looking through distance in primary gaze and the near portion of the lens when looking through the lower portion of the lens.

BIFOCALS

In annular bifocal or aspheric multifocal simultaneous-image correction lenses, light rays pass through the pupil to form the retinal image incorporating distance and near corrections (annular design) or a smooth transition in power between distance and near corrections (aspheric multifocal design). The image on the retina receives both in-focus and out-of-focus images.

One negative outcome of these simultaneous optical lens designs is a reduction of contrast.^{8,9} The retinal image is degraded by the induced spherical aberration in these designs, but this is countered by the increase in the vergence range over which there is no apparent deterioration in retinal image quality because depth of focus is increased.¹⁰⁻¹³ The one factor that cannot be controlled is the difference between individual patients in their tolerance of blur, which may be attributed to inherent optical factors, such as pupil size, higher-order ocular aberrations and binocular summation.¹⁴⁻¹⁸

The simultaneous vision category divides the pupil area designated for near and distance zones. It is this balance that will determine patient acceptance to the lens design. Pupil size controls the amount of the two images focusing on the retina, and power only controls where the image is focused or working distance.

PROGRESSIVE LENS MULTIFOCALS

The progressive center-near design has most plus in the center and gradually reduces plus to the periphery; these lenses tend to be more successful with higher add requirements.

The progressive distance center lens has most minus in the center and gradually increases in plus in the periphery. Patients with lower add prescriptions adapt to these lens designs quickly because of their similarity to distance-only lens designs.

The concentric ring design alternates near and distance zones within the pupil area. The power distribution across the lens is highly dependent on pupil size variations, line of sight and lens centration to provide a positive visual effect for presbyopia; patients take a little more time to adapt to this design.

An additional multifocal lens design uses the annular concept in the center zone and periphery zone while incorporating the progressive design as the transition between the two annular zones, and creates a customized multifocal. A problem inherent to all multifocals: as the power distribution is divided between near and far, visual range contrast sensitivity is reduced. The goal is to provide a balance between the defocused image without compromising the focused image. As patients age and pupils become smaller, depth of field increases, which will improve multifocal contact lens performance.¹⁹

THE BEST FIT

Fitting multifocal/bifocal lenses can be broken up into distinct stages. The first is deciding the power configuration, the second is creating a perfect centered-lens

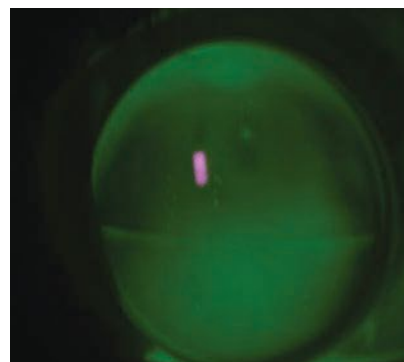


Fig. 1. Bifocal GP lenses offer crisper vision than soft lenses but many patients find adaptation difficult.

design and the third is neutralizing ocular aberration and aligning the image onto the fovea. Once these factors are engineered into a lens design, the patient will respond with real-world feedback, giving additional insight that can lead the practitioner toward a successful outcome.

The total power configuration (near, intermediate and distance) has to reside within the pupil. If any portion of the power zone falls outside the pupil, clarity will be affected. This visual aperture is also changing determined by the amount of illumination. The outcome is dependent on the percentage of distance vs. near power within pupillary area, whether it is center-near or center-distance design.

All power zones must reside within the space designated by the pupil. In either a distance-centered or a near-centered lens, the surrounding power always has a negative effect on visual outcome, reducing contrast sensitivity. As the power of the surround increases, the effect is magnified.

4. Typically, how many lens “try ons” do you encounter to reach a successful multifocal fit?

One	16%
Three	78.6%
Five	5.1%
Seven	0.4%

5. How do you define a successful multifocal contact lens fit?

Acuities	39.3%
Wearing schedule	13.8%
Other	46.9%

6. What percentage of your presbyopes are in the following modalities?

Dailies	38%
Bi-weekly	11%
Monthlies	42%
Customized soft/hybrid	6%
Corneal GP	11%
Scleral contact lenses	5%

If a patient has a 4.0mm pupil under photopic conditions and the lens design incorporates 2.2mm near center zone, then 1.8mm is left for the distance zone. To improve near vision, the only alternative is to increase the space of the near zone to 2.5mm—leaving 1.5mm for distance. The doctor-patient relationship entails trying to partner and balance these zones to arrive at a mutually successful result. Increasing the near prescription only reduces the working distance and does not improve vision quality. Patients with small pupils require a smaller central optical zone in order to incorporate the surround.²⁰ These patients tend to perform better with a distance-centered optics. Using a smaller central optical zone will minimize the visual deterioration from spherical aberration while improving extended depth of focus (EDOF). These can be fabricated akin to a variety of optical philosophies seen in the IOL market.

EDOF and diffractive concepts use spherical aberration and chromatic aberration to enhance the multifocality and contrast sensitivity of these designs. Positive spherical aberration focuses marginal rays in front of the retina and paraxial central rays are focused on the retina, while negative spherical aberration focuses marginal rays behind the retina and central

rays on the retina. It is the difference between these foci that result in depth of field.

By manipulating the degree of positive and negative spherical aberration, a superior lens design is created; whereas the diffractive design uses a wavelength of color to create different foci.²¹ These different foci create a diffractive lens design to minimize chromatic aberrations, resulting in an improvement in contrast sensitivity and quality of vision.²²⁻²³ Both of these optical techniques are affected by pupil size, which is why multifocal contact lenses perform differently during changes in illumination between patients.

CUSTOM DESIGN MULTIFOCALS

Correcting the visual system for higher-order aberrations is contingent on perfect centration and non-rotating lens designs. Manipulating the lens parameters and at times decentering the optics creates the optimal system. In order to successfully develop the necessary fitting parameters at times, custom lens designs are necessary to accomplish the task. Using corneal topography can help in the determination of centration and accurate optical alignment of the contact lens. Integrating this technology into routine contact lens care will help ma-

nipulate lens parameters to eliminate some potential optical inaccuracies and improve visual outcomes.

One of the most difficult challenges that clinicians face when transitioning from single vision contact lenses to multifocal designs is patients' willingness (or unwillingness) to consider a temporary reduction in their quality of vision. Therefore, early intervention is critical to "easing" them into a new reality of simultaneous vision. This must be presented to emerging presbyopes with a design that has a center-distance prescription. These emerging patients require only a low add, so the power shift will not overwhelm their visual system.

The center-distance design works best with an add power up to +1.75, which corresponds to patients in their late forties. As the add power need increases, so does the gap between their distance and near

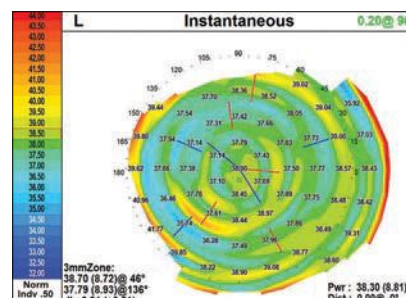


Fig. 2. Corneal topography performed over a multifocal.

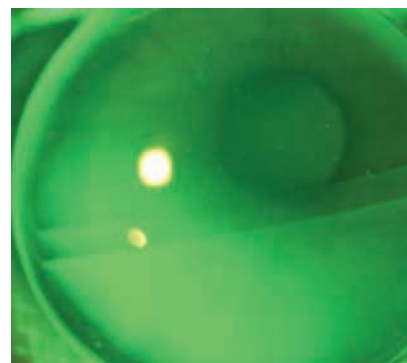
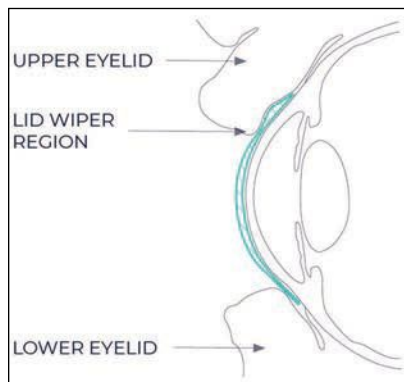


Fig. 3. Anterior segment image of a fluorescein pattern of a trifocal GP contact lens.

SEEING MULTIFOCAL OPTICS MORE CLEARLY

7. What percentage of your patients transitioned successfully from single vision contact lenses wear to multifocal?

Category	Share of respondents
Over 70%	62.8%
50-70%	22.8%
Less than 50%	14.7%

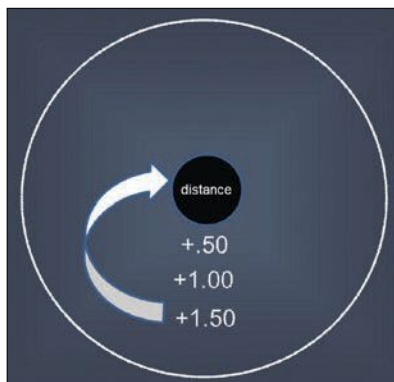


Thickened superior area for stabilizing a translating soft lens.

powers. A progressive multifocal center-near design encompasses a softer transition for those who require increased add powers. At times we have to modify the transition phase from center-distance to center-near correcting the dominant eye with center-distance and non-dominant eye with center-near. It is critical to match visual demands with different multifocal designs; patients who use desktop computers would require a larger intermediate zone whereas those with high near demands would require a larger near zone diameter.

As clinicians, we cannot lose sight of the realization that many presbyopes would like to have the flexibility to use contact lenses for certain tasks and glasses for others. However, this growing population is increasingly active and benefits from the visual freedom of being spectacle-free for many of their activities.

According to the United Nations Department of Economic and Social Affairs, the global presbyopic population is increasing, with



The surround powers always have a negative effect on central vision.

more than two billion people over the age of 60 expected by 2050.²⁴ Therefore, the prescribing process should not be approached as all-or-nothing situation. This demographic is significantly more engaged and will benefit from the visual freedom of not wearing spectacles nearly as much. Clinicians may help their patients find relief through presbyopia correction by holding thorough discussions before lens fittings, recognizing the different lens designs and being prepared to troubleshoot when patients struggle with adaptation and anatomical or lifestyle challenges. **RCCL**

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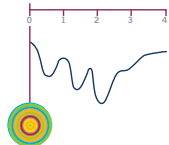
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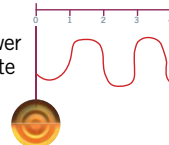
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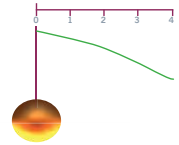


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“

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– Michael M., OD

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“Simple and accurate from the first lens.”

– Neil H., OD

”

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1. Bakaraju et al 2018a JOptom Extended Depth of Focus contact lenses vs. two commercial multifocals.
2. Sha et al 2018, ECL. 3. OD and patient feedback; over 300 MF EDOF patients fit. Data on file.
* Adjustment primarily for power.

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KEEP PRESBYOPES SOLD ON MULTIFOCALS

Experts offer pearls on combating comfort, vision and price concerns to reduce lens dropout.

By Jane Cole, Contributing Editor

Contact lenses remain one of the top choices for presbyopes when it comes to vision correction, especially considering the evolution of the multifocal contact lens. This modality has made significant strides in recent years, including better optics, improved materials, additional parameters and enhanced wearing schedules.

Still, once a patient is fit into a multifocal, retention often remains a hurdle.

“Vision and comfort are the two main challenges that I have in keeping presbyopes in contact lenses,” says optometrist Vince Zingaro of Malvern, PA. “Presbyopes tend to have dryer eyes than younger patients, so lens material and modality are important. I know if patients aren’t comfortable in their contact lenses, then there’s a good chance they’ll eventually drop out and become full-time glasses wearers.”

Here, contact lens experts offer guidance on how to tackle the three main challenges they see in multifocal dropout: vision, comfort and cost.

ISSUE #1: VISION

Good visual outcomes are of utmost importance when fitting presbyopes in multifocal contacts, explains Jennifer A. Dattolo, OD, of Woodstock, GA.

A recent study published in *Optometry & Vision Science* found poor vision was the main reason patients dropped out of multifocal lens wear.¹ Another investigation found visual problems were most common among new multifocal contact lens wearers.²

Here are a few ways to optimize vision from start to finish:

Set expectations. Vision is the most important aspect in retaining contact lens wearers, Dr. Zingaro says. His method is as follows: “I explain to each presbyopic contact lens wearer that the technology is always getting better. If they were unsuccessful in a multifocal in



Photo: Alex Nixon, OD, MS, and Erin Rueff, OD, PhD

Soft multifocal contact lenses have made significant strides in recent years.

the past, they may do better with today’s lenses.”

Dr. Zingaro also ensures the goal of a multifocal lens is clear to patients: get them through most of the day without the need for reading glasses. He notes that these lenses provide “softer” vision compared with glasses. He then reinforces to patients that they will still be able to see well without having

to rely on readers, except when viewing small print or reading in dimly lit environments, for example. He focuses on the positives.

“With so many patients working on the computer for their job, I explain that they will no longer need to worry about tilting their head up and down to find the sweet spot in their vision as they often need to do with progressive glasses,” Dr. Zingaro says. “This is a great advantage to many patients, especially now with so many people working remotely on a computer all day.”

Setting realistic vision expectations from the beginning is essential, confirms David Anderson, OD, of Miamisburg, OH.

Dr. Anderson first asks a patient how they prioritize their daily activities. “I find out their pain points, visual challenges and areas of focus,” he says. Sometimes a multifocal doesn’t check every box, but using such a lens to give a patient freedom from glasses during an activity they enjoy, such as hiking or exercising, is a great start. “One pair of glasses isn’t always going to satisfy every visual need, and neither will one pair of contact lenses, so you may need to have different options for different activities,” he notes.

Be transparent with patients that multifocals aren’t perfect, but that there is usually—but not always—a way to achieve working vision at all distances, Dr. Dattolo follows up with.

“I believe if you tell patients the truth and set expectations from the beginning, they will be much more successful,” she explains.

Optimize the fit. Any practitioner who fits multifocals can affirm it’s often a step-by-step process, with several different lens parameters attempted before dispensing the final fit.

To ensure best visual outcomes, Dr. Zingaro always follows the manufacturer’s fitting guide. “I used to ‘wing it’ and try to fit multifocal contact lenses my own way, but I wasn’t very successful. I think using your resources wisely is important for the long-term success of the patient because they may be so desperate to not have to wear glasses in the short-term that they give up some vision in contacts just to have freedom from glasses,” he says.

Unfortunately, problems are also due to occur down the road when the presbyopia worsens, and the patient may opt to wear reading glasses and drop out of contact lens wear entirely since they no longer see value in the lenses.

“I’ve had patients tell me they used to wear monovision contacts or multifocal contacts but they ‘stopped working,’” Dr. Zingaro explains. “Rather than talk with their doctor about it, they just stopped wearing the lenses. If you follow the fit guide each time you examine the patient, you’re constantly optimizing their vision, which will keep them happy and reduce the chance of them giving up on contacts or, worse, finding a new doctor to help them.”

Adapt to changes. Flexibility is key in the multifocal process, especially if a patient’s visual needs change.

Dr. Anderson recently saw a patient who traded in her multifocal contacts for a pair of readers. Due to the pandemic, the patient was working in front of the

computer more than she was driving, which was the initial reason for her distance multifocal lenses. With the switch-up in her daily routine, Dr. Anderson changed her multifocal lens to a center-near design.

For patients who don’t gain crisp and clear vision from standard soft multifocals, gas permeable multifocals tend to offer a higher quality of vision, says optometrist Andrew Fischer of Jasper, IN. There can be a steep learning curve associated with the adaptation period, so he suggests guiding patients through the process.

“It’s important that we listen, ask the right questions and find solutions to solve patients’ problems,” Dr. Anderson says. “There are many different multifocal lens designs, and we shouldn’t get stuck fitting the same lens on every patient. While that may work for a large percentage of individuals, this approach won’t work on everyone, and it will open the door for more dropouts.”

ISSUE #2: COMFORT

Studies have reported that changes to the tear film and ocular surface can exacerbate lens discomfort—a key factor in lens dropout.³⁻⁵



Photo: Erin Rueff, OD, PhD

Vision, comfort and cost remain barriers to multifocal contact lens wear in presbyopes.

Another leading cause of drop-out is contact lens dryness. It is vital to address these issues with all contact lens patients, including presbyopes, at every visit, Dr. Fischer says.

Ocular surface health. “At times, despite wearing a well-fitting, highly breathable lens, patients just can’t seem to get comfortable. When this happens, I often hit pause on the contact lens fitting process and shift the focus to improving the ocular surface,” Dr. Fischer explains.

Part of this process involves a dry eye screening, which includes corneal and lissamine green staining, meibomian gland expression, lid margin evaluation and blink assessment. This can highlight problem areas that require improvement for optimum contact lens comfort.

“Sometimes even the best daily disposable contacts won’t provide all-day comfort because the problem isn’t with the contact, but instead with the ocular surface. When these issues are mitigated, comfortable contact lens wear can be achieved again,” Dr. Fischer suggests.

Studies have shown that early treatment for underlying comfort issues caused by dry eye may promote additional years of comfortable contact lens use.⁵

Replacement schedule. Dr. Fischer also considers lens modality if comfort issues arise. “If the patient is wearing a monthly or another frequent-replacement contact lens, switching to a high-quality daily disposable can help tremendously,” Dr. Fischer suggests.

Screen usage. If the patient is in a good contact lens and has no clear evidence of dry eye or ocular surface disease but is still experiencing discomfort, their work en-

Coming Soon: Presbyopia-masking Drops

Poised to enter the presbyopia-correcting market are half a dozen drops currently making their way through FDA approval. One of the more novel drops works to change the composition of the lens, while others are miotic in nature and constrict the pupil, creating a pinhole effect.

Dr. Fischer believes these new drop options will offer an exciting alternative for presbyopes. “I think this will allow patients who don’t want to wear glasses or transition into multifocal contacts the opportunity to have clear near vision without correction,” he says. “I would imagine these drops would compete with presbyopia-correcting contact lenses. I am excited to get first-hand experience with these drops to see how patients respond to them.”

Here’s what’s on deck:

- UNR844-CI (Novartis) breaks disulfide bonds, which helps the lens become more elastic and regain some functionality.¹ This drop, formerly known as EV06, is in Phase II clinical trials.¹
- Allergan’s AGN-199201 and AGN-190584 are both miotic-based drops that work by constricting the pupil.² In February 2021, Allergan submitted a New Drug Application (NDA) to the FDA for AGN-190584 for the treatment of presbyopia. The FDA is expected to act on the NDA by the end of 2021.¹
- Yolia’s True Vision Treatment combines customized contact lenses and specially formulated eye drops to provide a noninvasive, binocular treatment for presbyopia.²
- The Liquid Vision PRX-100 (Presbyopia Therapies) drop contains aceclidine and low-dose tropicamide to create a miotic pupil without the accommodative effect.^{2,3}
- The CSF-1 drop (Orasis) is a parasymphomimetic agent with a nonsteroidal anti-inflammatory in an oil-based formulation that causes a miotic pupil and increases the eye’s depth of focus.²
- FOV Tears affects the ciliary muscle, which causes a physiological accommodation and a dynamic pseudoaccommodation.^{2,3}

These drops, once approved, may be ideal for patients who have difficulty with inserting and removing lenses, have prescriptions that don’t allow for ideal presbyopic multifocal wear or had laser vision correction and aren’t interested in wearing glasses or contacts again, Dr. Zagaro says.

He believes the drops will compete with multifocals only if they are able to deliver the same visual outcomes.

Still, not all doctors are sold.

“I honestly don’t think I’ll be one of the first on board to try them with my patients,” Dr. Dattolo says. Many lens wearers cringe at the sight of eye drops, and for those who work long days, the question is whether the drops will be able to provide near vision for the entire duration, she notes.

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3. Cole J. Can an eye drop eliminate presbyopia? *Rev Optom.* 2017;154(6):42-6.

vironment is often the culprit, Dr. Fischer says. “I find that patients who are on screens a majority of the day tend to have more comfort issues with contact lenses.” This may be due to a decreased blink rate or more incomplete blinks while on the computer, he explains. Other considerations include fans, drafty rooms and dirty or dusty environments.

“Changing the work environment can make all the difference,” Dr. Fischer says.

Patient meds. In addition to heavy screen use, Dr. Dattolo suggests another cause of discomfort: the dry eye—causing medications many presbyopic contact lens wearers take for conditions such as hypertension, high cholesterol, diabetes and thyroid issues.

In these cases, Dr. Dattolo instructs patients to make a conscious effort to blink while in front of electronic devices, hydrate throughout the day, take fish oils and maintain proper eyelid hygiene. She also recommends daily disposable contacts for patients who suffer from dry eye, as wearing fresh lenses every day helps lessen the role dry eye plays.

ISSUE #3: COST

The out-of-pocket expense for multifocal wearers can be a factor for some patients, especially if the lens isn’t meeting their expectations, Dr. Anderson says. “If the lens is working and the individual is free from glasses, then cost becomes less of a factor. But, truthfully, the cost is reasonable for what the lens is expected to do.” And a little bit of education and reassurance goes a long way.

To mitigate patients’ initial cost concerns, Dr. Zingaro lets his patients test drive a trial lens. He also explains the how and the why behind his selection of a particular

lens specific to the patient and their individual needs. He believes this helps the patient realize the lens is a necessary medical device and not an arbitrary commodity.

Additionally, Dr. Zingaro takes time during the exam to explain insurance coverage and manufacturer rebates, both of which can bring down the cost.

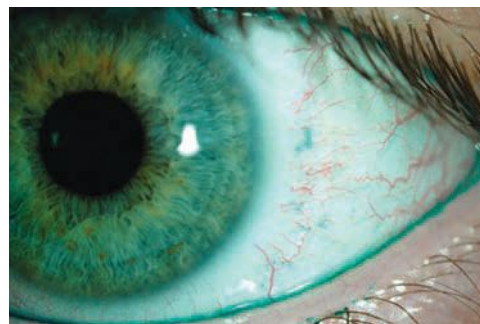
“Finally, I assure the patient that I am available for them throughout the year should they feel that their vision is declining,” he says. If a patient’s lenses aren’t to their satisfaction or if their prescription changes before the next annual exam, Dr. Zingaro exchanges any unopened boxes. “They can order an annual supply of contact lenses without having to worry about getting stuck with ones they can’t wear,” he says.

Fortunately, many of Dr. Fischer’s patients don’t view cost as a barrier to vision correction. “After experiencing near vision difficulties, most of these patients understand that a more premium lens is necessary for them to reach their visual goals compared with their standard lenses,” he says.

When cost is more of a factor, Dr. Fischer explains that the more advanced optics of a multifocal contact lens are the reason for the higher price tag. He also provides a price comparison chart that details different lens options. This gives the patient some input in the fitting process, Dr. Fischer adds.

“I also make sure they are aware that the cheapest lens doesn’t always provide the best fit, best vision or safest lens for their eye. They should never sacrifice their eye health for cheaper lenses,” Dr. Fischer explains.

Cost tends to play the biggest role for patients who wear a daily



Lens discomfort, commonly caused by dry eye, is a leading cause of dropout.

disposable multifocal, Dr. Dattolo says. When the price becomes an issue, she suggests another wearing schedule option. The financial burden is also less significant for those who only wear the lenses for special occasions.

TAKEAWAYS

Despite the challenges many practitioners face in keeping their presbyopes in multifocals, this modality remains a go-to option.

“With the advancements made in contact lenses, both with better materials for increased comfort and improved designs for better vision, I still believe they are the way to go,” Dr. Dattolo says. “We can now successfully fit presbyopic astigmats in multifocal contacts. I look forward to seeing where multifocal contact lenses are in the next few years. I believe they will only get better.” **RCCL**

1 Rueff EM, Varghese RJ, Brack TM, et al. A survey of presbyopic contact lens wearers in a university setting. *Optom Vis Sci.* 2016;93(8):848-54.

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ARVO 2021 Highlights: Abstract Review

Learn how new discoveries can help clinicians preserve vision.

By Review of Optometry/RCCL Staff

Each year, the Association for Research in Vision and Ophthalmology (ARVO) annual meeting gifts the eye care profession with a cornucopia of new research that let us see where the winds are blowing clinically. Here, we've compiled research specific to cornea and contact lens care we feel may be most impactful for practicing optometrists.

This year, the meeting was held entirely virtually, as researchers either presented their findings via video or with a virtual poster. The theme of ARVO 2021 was “the next revolution” in clinically translating research discoveries to restore and preserve vision. The findings summarized here are only a snippet of those presented at the meeting, but show the rich expanse of insights ARVO generates each year.

CORNEAL DISEASE

Several research teams took a close look at keratoconus risk factors and the systemic impact of Fuchs' endothelial corneal dystrophy (FECD):

Keratoconus. According to new research, individuals short in stature may be at greater risk of developing spherical dioptric powers of 48.00D or greater—a hallmark of keratoconus. The researchers from the Icahn

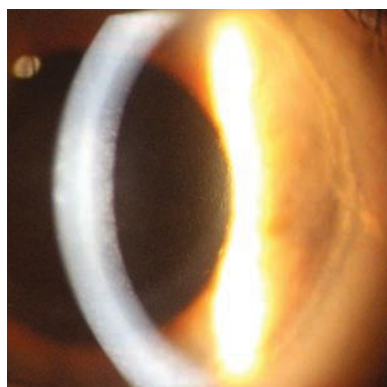


Photo: Michal Beah, OD, and Larae Zimprich, OD

FECD elevates cancer risk in older patients.

School of Medicine Mount Sinai in New York City also found that gender seemed to play a role in this relationship. They observed a higher prevalence in women than men.¹

Using data from the National Health and Nutrition Examination Survey from 1999 to 2008, the investigators considered participants' visual exam results, in addition to demographics and other ocular and body measurement information. The study included approximately 170 individuals with the keratoconus trait and about 20,000 controls.

The team used multivariate analyses, in addition to three separate models that assessed the keratoconus trait with BMI, height and weight.

The study reported a strong inverse relationship between height and the keratoconus trait in the pooled population and women. Specifically, for every one-inch increase in height, the researchers observed a 16% reduced risk of the keratoconus trait. In women, this was slightly higher, with a 19% reduced risk of the keratoconus trait for every one-inch increase in height, but the inverse association was borderline in men.

These findings can contribute to improved understanding of the pathogenesis of keratoconus, the study authors concluded.¹

“Height may indeed be a ‘surrogate’ for more severe disease especially in females. Looking at genetic profiles has recently caught our attention with the introduction of approved genetic detection options,” says Joseph Shovlin, OD, of Northeastern Eye Institute in Scranton, PA. “This will definitely help guide us in the future with early interventions like corneal crosslinking.”

FECD. Older patients with this condition may be at greater risk of developing certain cancers, a team from the Mayo Clinic suggests. Their paper specifically found that Fuchs' patients aged 65 and older appear

to have an increased chance of malignancies of the breast, cutaneous basal and squamous cells and ovaries. On the other hand, they also may have a decreased risk of lung and prostate cancers.²

Genetics may play a role in these findings. It's unknown whether FECD patients are at variable risk of systemic disease, but several other trinucleotide repeat expansion disorders, such as myotonic dystrophy type 1, are associated with increased cancer risk, the authors explained.

The investigation considered 1.5 million Medicare patients. Roughly 16,000 (about 1%) had an ICD code for FECD. The study included data from 2014 to 2016 and compared cancer risk between those with FECD and those without.

The researchers believe additional studies are needed to confirm this association, further explain potential disease mechanisms and identify genetic and environmental risk factors.²

CORNEAL INFECTION

Researchers determined new information on how viruses and bacterial species interact with the cornea.

COVID-19. The presence of SARS-CoV-2 RNA, spike and envelope proteins in the corneas of COVID-19 donors has been reported, but the presence of viral RNA and antigens hasn't equated to infection. Researchers examined the replication ability of SARS-CoV-2 in cornea tissue of human eyes from affected patients and to understand the innate immune response.³

Eyes from healthy and COVID-19 donors were assessed in a variety of lab tests, including infecting primary human corneal epithelial cells from normal and diabetic donor corneas with SARS-CoV-2. Polymerase chain reaction testing assessed the expression of inflammatory and antiviral

genes and confirmed RNA sequencing data in corneal tissue and cells.

RNA analysis showed the presence of both positive and negative strands of SARS-CoV-2 viral RNA in the epithelium of COVID-19 donor corneas. This coincided with infiltration of CD45+ cells in the stroma and induced expression of inflammatory and antiviral genes. RNA analysis revealed significant upregulation of genes involved in the viral response, inflammation and injury along with induction of factors involved in modulation of the immune response.

The study confirmed the presence of replicating SARS-CoV-2 viral RNA and antigen in the corneas of COVID-19 affected donors resulting in the production of inflammatory mediators and recruitment of CD45+ immune cells to the cornea. Additionally, epithelial cells from diabetic patients increased SARS-CoV-2 replication and immune response, suggesting that diabetes is a potential risk factor for ocular transmission of COVID-19.

"We could detect replicating virus in the tissues with an antiviral response," the authors explained in the abstract of their study. "Interestingly, the cornea tissue from diabetic patients had higher permissivity to viral infection and antiviral immune response—signs of productive infection. Therefore, our finding indicates that SARS-CoV-2 can infect and replicate in cornea tissue, and diabetes

condition can increase the susceptibility and severity of COVID-19."³

"How we get from corneal infection to systemic disease is something for future study, especially the risks," Dr. Shovlin proposes. "It's interesting to see the increased effects on the diabetic patient, which matches what we see in general with systemic disease."

ARMOR 2021. Antibiotic resistance is one of the most pressing challenges to global health today, resulting in longer hospital stays, higher medical costs and increased mortality, according to the WHO.⁴ The long-running Antibiotic Resistance Monitoring in Ocular microorganisms (ARMOR) surveillance study informs clinicians of antimicrobial susceptibility patterns in ocular bacterial pathogens.⁵ Among ocular infections, gram-positive bacteria such as staphylococci are the most prevalent culprits.

The ARMOR investigators analyzed *in vitro* resistance among staphylococcal isolates collected between 2009 and 2020 (Table 1).⁵ The 12-year results indicated that staphylococci generally had minimal or no change in *in vitro* antibiotic resistance.

Researchers performed susceptibility testing on *Staphylococcus aureus* and coagulase-negative staphylococci (CoNS). The minimum inhibitory concentration (MIC) was defined as susceptible/resistant to 16 different

Table 1. Cumulative *in vitro* MIC₉₀ Values for Staphylococci Collected in ARMOR (2009-2020)³

Antibiotic	S. aureus (n=2,599)	MRSA (n=900)	CoNS (n=2,143)	MR CoNS (n=1,041)
Besifloxacin	1	2	2	4
Moxifloxacin	4	16	16	32
Gatifloxacin	4	16	16	32
Ciprofloxacin	128	256	64	64
Levofloxacin	16	128	128	256
Ofloxacin	>8	32	16	256
Vancomycin	1	1	2	2

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antibiotics based on Clinical and Laboratory Standards Institute methods and breakpoints.

They found a **significant decreasing trend in methicillin resistance (MR) among *S. aureus* but no change in MR among CoNS**. Other significant decreasing trends were observed in resistance to azithromycin, ciprofloxacin and tobramycin, and to ciprofloxacin in CoNS. Trends in increasing resistance were reported in tetracycline among *S. aureus* and in trimethoprim for CoNS.

Multidrug resistance (three or more antibiotic classes) among MR strains remained prevalent in 2020, the researchers reported. **No isolates were vancomycin-resistant, and besifloxacin retained “consistently low” minimum inhibitory concentrations during the study period.**⁵

“On a positive note, vancomycin remains the gram-positive, methicillin-resistant treatment with best efficacy,” Dr. Shovlin notes. “There are obviously geographic differences in whether to use vancomycin initially or not.”

The investigators concluded that staphylococci demonstrated only minimal changes in antibiotic resistance; however, they cautioned about the small decrease in methicillin resistance in *S. aureus*, noting, “The high level of methicillin resistance in staphylococci warrants attention when selecting empiric antibiotic therapy, particularly with respect to multidrug resistance in these organisms.”⁵

CORNEAL SURGERY

Care and management surrounding surgical patients were explored in this year’s presented research.

DSEK. Endothelial keratoplasty has become the gold standard for treating corneal endothelial dysfunction, but long-term outcomes remain largely unknown. A research team reported Descemet stripping endo-

thelial keratoplasty (DSEK) **provided superior long-term visual rehabilitation and had a 15-year survival rate comparable to penetrating keratoplasty** when performed for similar indications.⁶

The researchers, from the Cornea Research Foundation and the Price Vision Group of Indiana, also found DSEK failures within the first year were mostly associated with the learning curve at a time when techniques and instrumentation were still being developed and refined.

The retrospective observational study assessed 15 years of postoperative outcomes in 360 DSEK cases performed between 2003 and 2005 at a single center. The transplant indications included Fuchs’ (84%), bullous keratopathy (9%) and previous keratoplasty failure (7%).

At 15 years, 50 grafts had failed or been replaced (14%) and 136 (38%) were in patients who had died. Only 55 of the remaining 174 grafts (32%) were available for examination. The 15-year graft failure/replacement rate was 22%, taking loss to follow-up into consideration, the researchers noted.

Within the first year, 15 grafts were replaced due to early failure to clear (nine cases) or unsatisfactory vision associated with excessive graft thickness or wrinkles (six).⁶



Photo: Christopher Kuo, OD and Richard Mangano, OD

The 15-year failure/replacement rate of DSEK was reported to be as low as 22%.

“Lamellar surgery for endothelial disease appears to be an excellent surgical option with a low replacement rate at 15 years,” Dr. Shovlin says. “This group has advocated for chronic use of a topical steroid following any lamellar surgery which may account for the good extended outcomes to 15 years and beyond.”

ALK grafts. With better survival and lower rejection rates, anterior lamellar keratoplasty (ALK) has gained popularity as an alternative to penetrating keratoplasty to treat corneal stromal diseases. Because of this, researchers from Singapore evaluated the common protocol of donor/recipient age- and sex-matching on the outcomes of eyes that had undergone ALK surgeries.⁷

A total of 359 eyes from 322 patients who had ALK over an 11-year period were identified using graft registry data. Records show that 246 grafts were presumed compatible, 14 failed and eight were rejected. There were trends of lower hazard ratios in graft failure and rejection in the presumed compatible group.⁷

The study found that **sex- or age-matching had no significant effect on ALK transplant rejection and failure.** “However, the number of ALK surgeries performed that would be required to show such differences would be too large for any study to obtain,” the authors explained.⁷

“Future studies with pooled data may show a lower trend for rejection/failure using matched tissue and change the allocation recommendation for matches,” Dr. Shovlin says.

CONTACT LENSES

One study explored corneal swelling with scleral lenses of different diameters. Researchers presented a study where they measured corneal thickness after short-term small- and large-diameter scleral lens wear.⁸

Twenty healthy participants were divided into two groups to measure

change in corneal thickness after wear of either a 15.2mm or 18mm lens for one hour. Central corneal thickness was measured using the Pentacam both prior to lens wear and immediately after removal.

After an hour of small-diameter lens wear, corneal thickness increased by 1.2%; for those in the large-diameter lens group, the increase was 2.4%. Next, subjects switched to the other modality for one hour. Small-lens wearers had an additional 1.4% increase in corneal thickness after the change. Those who wore the large lens initially and then wore the small lens experienced a 1% increase.

“There is concern that scleral lens wear may cause the cornea beneath the lens to swell,” the researchers noted. “They also noted that differences in lens diameter and design may influence the corneal physiology differently.”⁸

“For now, maximizing oxygen permeability and working for ideal center thicknesses seems to be our best strategy to minimize long-term untoward changes as result of wearing scleral lenses; however, some of the new highly permeable materials have helped reduce these changes,” Dr. Shovlin says. “Corneal grafts continue to pose significant risk with reduced oxygen transmission sclerals and need to be watched carefully.”

DRY EYE/OCULAR SURFACE

Multiple studies exhibited new findings on patients at risk.

Osmolarity of refractive surgery patients. A retrospective study offered an analysis of the largest current sample of osmolarity in a normal population and post-refractive patients.⁹

In all, 1,404 patients undergoing screening for refractive surgery from 2017 to 2020 were reviewed. Routine exam included dry eye testing with osmolarity and the Ocular

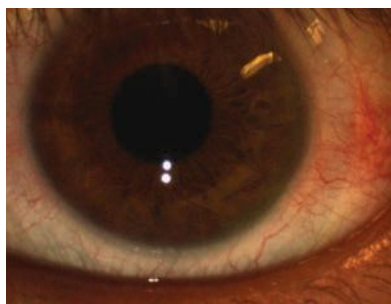


Photo: Maria Walker, OD

Both small- and large-diameter scleral lens designs induced some edema after an hour of wear.

Surface Disease Index (OSDI) questionnaire. Patients were instructed to refrain from topical drops for at least two hours before the appointment.

Results indicated normal tear film homeostasis by osmolarity testing in 82.3% of eyes; post-refractive surgery patients indicated higher mean OSDI values compared with the remainder of the population.

The researchers concluded that a **significant correlation exists between osmolarity scores and OSDI classification for the general population.** Contact lens use correlated inversely with osmolarity and OSDI scores, while artificial tears correlated with OSDI scores in the post-refractive group only.

The authors noted that osmolarity and OSDI scores indicate that the majority of the standard population falls within normal ranges. “The impact of our findings may resonate” with surgeons and comanaging optometrists, “as a reasonable percentage of individuals will be diagnosed with tear film hyperosmolarity and represent a risk for reduced postoperative outcome and ocular comfort,” they concluded in their presentation.⁹

Statins and MGD. According to a number of studies, statins have an anti-inflammatory effect in addition to their cholesterol-lowering effect. Researchers at the University of Pennsylvania and the University of Tennessee examined the association

between oral statin use and dry eye signs and symptoms. They reported that statin use wasn't associated with severity of symptoms among moderate and severe DED, but noted that **higher-intensity statins reduced MGD.**¹⁰

The study was composed of participants from the DREAM study, a randomized multicenter trial that evaluated the effect of omega-3 supplements on dry eye treatment. The researchers collected self-reported statin use at baseline and classified it as low-, moderate- and high-intensity, based on the American College of Cardiology guidelines.

At baseline, 129 of the 535 DREAM study participants with moderate to severe DED reported statin use. Of these, 15 were low-intensity, 77 were moderate-intensity and 31 were high-intensity statin users. The team found statin users were significantly older than non-statin users (mean age 64.7 vs. 55.9).¹⁰

“Further analysis is needed to identify whether there is a specific type of MGD associated with intensity of statin use,” they concluded.¹⁰

Blink patterns and tear film. Although meibomian gland structure and function can be assessed through meibography and lipid layer thickness (LLT), the role of blink parameters on the tear film is not as clear. A recent study suggested **blink patterns may be able to predict which tear film parameters correspond to dry eye and can potentially guide treatment.**¹¹

The single-center, retrospective cohort study assessed 456 eyes and evaluated the relationship between LLT, meiboscore and blink rate, including the total number of blinks in 20 seconds, partial blinks and time between blinks.

For every one-point increase in the meiboscore, the average LLT declined by 1.31nm and the total blink rate decreased by 4%. Still, these

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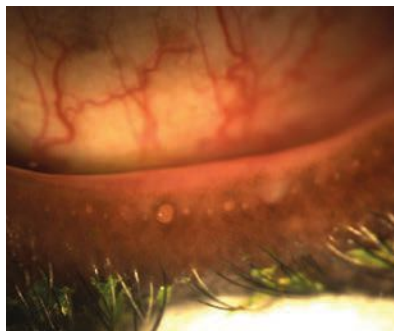


Photo: Dean Huynh Kwak, OD

While statins had no effect on DED symptoms, some might reduce MGD.

findings weren't statistically significant, the researchers noted.

Additionally, patients who had more complete blinks—or an incomplete blink rate less than 50% of the time—had shorter inter-blink intervals. “In patients with an increase in partial blinks, the longer inter-blink interval results from impaired corneal sensation related to the chronic exposure,” the researchers wrote in their paper.

The study also found no major difference in LLT in subjects with a partial blink rate greater than 50% vs. those whose partial blink rate was less than 50%.

“By carefully studying blink patterns associated with dry eye signs and symptoms, we may be better able to predict which parameters of tear film composition and blink function correspond to DED and potentially guide treatment,” the researchers wrote in their ARVO abstract.¹¹

“In the future, clinicians need to continue to look at lid anatomy—by lifting, pulling and pushing on the lids—and assess the blink for the rate and amount of completeness in closure,” Dr. Shovlin advises.

Pterygium flare ups. DED also plays a role in pterygium recurrence. More than one-third of recurrences developed after the first year, which the researchers said highlights the importance of long-term follow-up in these patients.¹³

The study was conducted from 2017 to 2020 and analyzed the recurrence rate of conjunctival autografting with and without mitomycin C, as well as amniotic membrane grafting. Roughly 290 patients had pterygium, with 94 operated cases (32%). The investigation's main outcome was pterygium recurrence over an average follow-up period of about 29 months.

Pterygium involving the cornea was found in 55% of cases. Gender also seemed to play a role, as females appeared to be more likely to have pterygium encroaching on the cornea.

The overall recurrence rate was 17% over a 14-month period, with pterygium returning 37% of the time after the first year. The only significant recurrence risk factor was DED.

Following conjunctival autografting with and without mitomycin C, patients had new pterygium flare ups about 16% of the time.

On the other hand, the recurrence rate following amniotic membrane grafting was almost double at 27% following conjunctival autograft, but the difference wasn't statistically significant.

In participants who underwent conjunctival autografts, the addition of fibrin glue to their sutures didn't lessen the chance that their pterygium would return.¹³

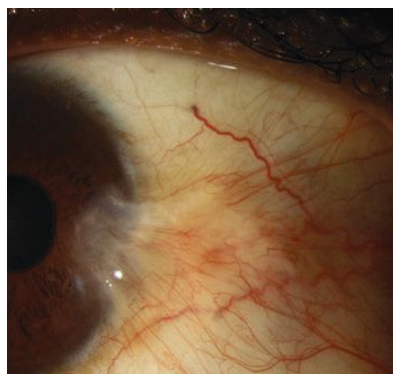


Photo: Christine Shindt, OD

More than a third of pterygium recurrences develop after the first year.

“Pterygium recurrence poses a major problem in ophthalmic care, and many strategies have been suggested over the years to minimize recurrences,” Dr. Shovlin says. “Minimizing DED appears to be a viable approach to minimize recurrences.”

This wonderful research will aid practitioners and provide useful information that could benefit their patients. Check out ARVO's full listing of abstracts and posters to see for yourself the latest advances in eye and vision care. [RCLC](#)

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6. Price M, Price F. Descemet stripping endothelial keratoplasty: 15-year outcomes. ARVO 2021 Meeting.
7. Ong HS, Chiam N, Htoon HM, et al. The effects of donor-recipient age and sex compatibility in the outcomes of anterior lamellar keratoplasties. ARVO 2021 Meeting.
8. Nau CB, Shorter E, Schornack M, et al. Corneal swelling after one hour of small and large diameter scleral lens wear. ARVO 2021 Meeting.
9. Xuan R, Lawless M, Sutton G, et al. Tear film osmolarity in a cohort of 1404 patients undergoing refractive surgery assessment. ARVO 2021 Meeting.
10. Yu Y, Maguire MG, Roy N, et al. Association of oral statin use with dry eye symptoms and signs in the DRY Eye Assessment and Management (DREAM) study. ARVO 2021 Meeting.
11. Brahmabhatt P, Brahmabhatt S, Adams W. Lipid layer thickness, blink parameters and meiboscore in patients with dry eye disease: a retrospective cohort study. ARVO 2021 Meeting.
12. Zhu C, Weiss M, Scribbick F, et al. Prevalence of conjunctival intraepithelial neoplasia in pterygium specimens. ARVO 2021 Meeting.
13. Alsarhani W, Alshahrani S, Showail M, et al. Characteristics and recurrence of pterygium: a single center study with a long follow-up. ARVO 2021 Meeting.
14. Qian X, Li Y, Musch DC, et al. The critical period of myopia, insight from the myopic shift in school age children after COVID-19 home confinement. ARVO 2021 Meeting.



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Slippery Slope

Though benign in nature, lipid keratopathy can still prove deleterious to vision.

Lipid deposition can be a detrimental effect of many systemic pathologies. As healthcare providers, we often think about lipids depositing within arterial walls, presenting as lesions within cutaneous tissues or causing myriad vascular conditions such as carotid artery sclerosis and coronary artery disease. Its appearance in the eye, however, is less widely recognized. While we understand the importance of a systemic work-up for cases of lipemia retinalis or corneal arcus in young individuals, how do we address discovering dense lipid deposition within the cornea?

Lipid keratopathy (LK) is a disorder defined by abnormal deposition of lipids in the cornea. The lipids present as yellowish or opaque deposits within the corneal stroma (*Figure 1A*) and are usually associated with feeder vessels (*Figure 1B*). There are two main forms of LK—primary and secondary—which are discussed in further detail below.

PRIMARY LIPID KERATOPATHY

This form is extremely rare, occurring in the absence of any known systemic or corneal disorder. These cases tend to be bilateral in nature, and the lipid deposition is slowly progressive over a span of years. Often, the lipid is present full-thickness through the stroma and may even cause posterior bulging toward the anterior chamber.¹ Histochemical analysis has found neutral fats, free fatty acids, phospholipids and cholesterol in affected eyes.² Contrary to what one may anticipate, primary LK has not been associated with

abnormal serum lipid profiles and remains largely idiopathic.³

SECONDARY LIPID KERATOPATHY

Nearly all the LK we see clinically is the secondary form. Though there are systemic causes for LK, such as lipoprotein metabolic disorder or Cogan's syndrome, they are exceedingly rare. Secondary LK more commonly results from infectious keratitis, corneal trauma or surgery, interstitial keratitis or other forms of corneal inflammation. It can be found in non-inflammatory conditions such as Terrien's marginal degeneration and has been associated with excessive soft or small-diameter rigid gas permeable contact lens wear.^{4,5} Corneal ulcers and herpetic keratitis are also commonly associated predecessors.

Corneal inflammation and subsequent neovascularization (NV) precede LK in most cases. Once blood vessels and lymphatic channels invade the avascular cornea, they act as mini freeways by which blood constituents gain access to the stroma. The lipid deposits may present at any depth but typically exist at the terminus or along the path of the vascular changes.

MANAGEMENT

Depending on the area of involved cornea, patients' complaints can range from being completely asymptomatic to experiencing debilitating loss of visual function. Eliminating the stressor—such as excessive contact lens wear, for example—should be our first step. Herpetic keratitis is among the most frequent culprits. In these settings, it is prudent to consider long-term prophylactic dosage of oral antivirals and recommend avoidance of possible reactivation triggers, such as excessive ultraviolet exposure or significant stress.

Once a visually significant lipid is present within the stroma, we should consider additional strategies. The pathologic neovascular vessels have been a popular treatment target due to their role in LK pathogenesis. Topical steroids have a positive impact in prevention of NV, but can cause small vessel regression.⁶ Though steroids should be considered a first-line option due to their ease of accessibility and relatively low-risk, their effectiveness may be limited with large-caliber vessels or NV that is not primarily inflammatory in nature. Superficial vascularization from inflammatory

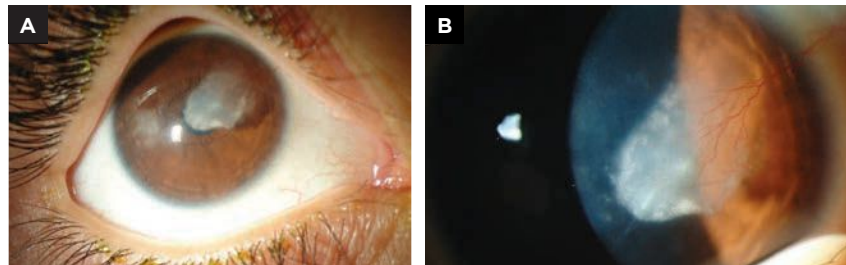
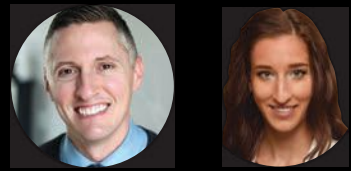


Fig. 1. (A) This child has a history of bilateral herpes simplex keratitis (top). Notice the dense lipid deposition in the pupillary axis. **(B)** Closer magnification reveals a major feeder vessel is the cause of lipid exudation.



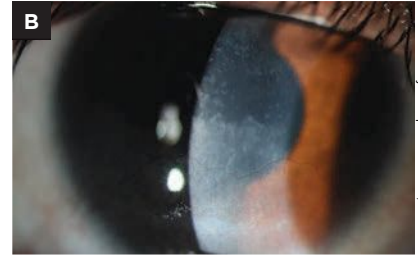
causes can also respond favorably to topical cyclosporine or compounded doxycycline, but these topical treatments will likely fall short in cases of deep stromal NV, which is more commonly responsible for LK (Figure 2).

When readily available treatments fail to improve a patient's LK and deep corneal NV, the management may need to be escalated. Some treatment approaches center on directly obstructing the vessel arborization. A few of these tactics include photodynamic therapy (PDT) and photocoagulation.

PDT works by first administering a vascular-selective, photosensitizing agent either intravenously or topically. Then, the area of NV is irradiated with activating light, leading to vascular endothelial damage and microvascular occlusions in the aberrant blood vessels.⁷ This treatment can be repeated and is minimally invasive, but it is relatively expensive and risks include possible stromal scarring and inadvertent retinal irradiation.⁸

Argon laser photocoagulation has also been used with success, but concerns arise regarding vessel recanalization, iris atrophy, descemetocoe formation and risk of an inflammatory response to the thermal damage.^{8,9}

Fine-needle diathermy is an additional means of direct vascular occlusion, targeted at large, arborized vessels. A single needle is used in conjunction with a unipolar diathermy unit to directly treat each individual feeder vessel. Results have proven largely successful in causing regression of NV, but the treatment may need to be repeated in a select group of patients. The main risks are intrastromal hemorrhage (which



Photos courtesy of Stephanie Frankel, OD.

Fig. 2. This young patient presented with superficial corneal NV due to chronic blepharitis. She was treated with lid hygiene, oral antibiotics and topical corticosteroids before transitioning to maintenance therapy of cyclosporine, compounded topical doxycycline and scleral contact lens wear. Note the improvement in the superficial vascularization.

clears with time), corneal microperforations and epithelial defects.^{10,11} Once the vessels are successfully occluded and any comorbid inflammation is managed, LK may gradually resolve.

Antiangiogenic therapies are among the newest class of treatments that focus on reducing vasculature within the stroma. Promoters of corneal NV include VEGF and other growth factors, matrix metalloproteinases and pro-inflammatory cytokines. Anti-VEGF agents dominate retina therapy, and have also proven beneficial for use in the anterior segment realm, as they reduce the formation of blood vessels and lymphatic channels.¹² They have been used as topical ophthalmic drops as well as intrastromal and subconjunctival injections.

While all preparations have shown reduction in corneal NV and even lipids in some cases, one study noted spontaneous epithelial defect and stromal thinning with application of the topical drop.¹³ This could signal that VEGF maintains a delicate role in wound healing and maintaining epithelial integrity, but overall it remains a promising avenue for corneal NV and LK.

SUMMARY

Though relatively uncommon, LK can significantly impact patients and we should be aggressive in treating early inflammatory precursors. If prevention isn't possible, various treatments can help clear the cornea and improve visual outcomes. [nccl](#)

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Birds of a Feather

If a corneal scar has diffuse, wispy borders, suspect chronic, long-term myofibroblast activity as a consequence of healing, rather than an acute process.

A 50-year-old male who underwent PRK 12 years prior presented with complaints of increased blur. Examination revealed a superior-central scar located in the mid-anterior stroma. It has a lined/feathered appearance; while initially rather faint, it has increased in density over the past several years.

Feathery-looking corneal scars are a common response to infections, injuries and surgeries. This occurs when myofibroblasts—alpha smooth-muscle actin cells—are produced in excess by stromal keratocytes. Myofibroblasts are contractile and opaque cells that produce large amounts of disordered extracellular matrix (largely collagen), which creates the corneal scar appearance.

These fibrotic cells are derived from keratocytes in response to growth factors from the epithelium, tears, endothelium and other stromal cells. There must be the epithelial basement membrane and/or Descemet's basement membrane injury, which must persist for months, years or decades, in order for these growth factors to reach adequate levels in the stroma to drive fibrosis formation. Therefore, these scars may appear a significantly long time after the initial injury.

Since myofibroblast scarring often limits vision when occurring centrally, it is easy to think of it as a pathologic state. However, myofibroblasts have specific roles in wound healing, such as replacing damaged subepithelial tissue,

producing extracellular matrix for tissue regeneration and contracting incisional wounds to help prevent corneal perforation. Over time, scarring produced by myofibroblasts will diminish.

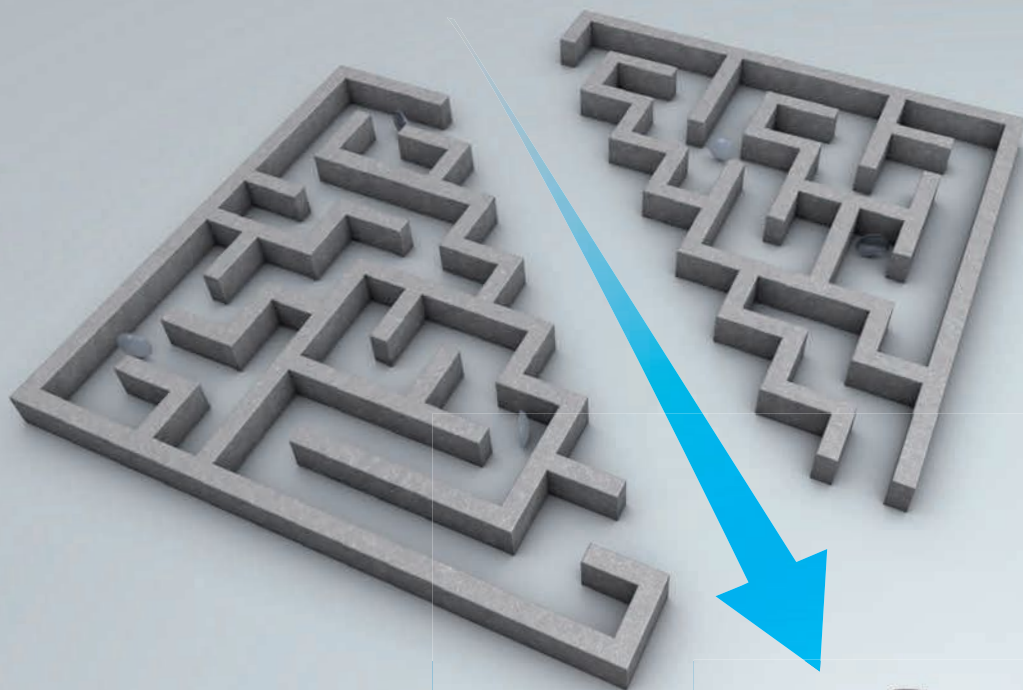
Our patient was fit in a scleral lens for improvement of vision and for protection of the ocular surface. He will be routinely monitored for progression or regression. Unless the scar is imminently sight-threatening—requiring penetrating keratoplasty—no other treatment is required. [RCCU](#)

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