RCCL®
REVIEW OF CORNEA & CONTACT LENSES
MARCH/APRIL 2023

GP and Scleral Design Tips:

Livin' on the Edge

PAGE 14

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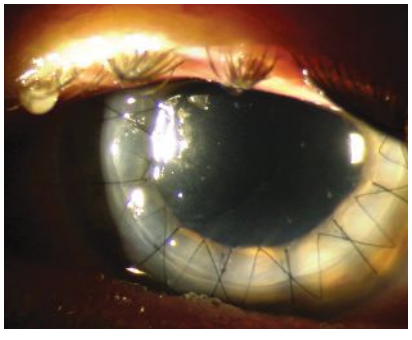
Viral Keratitis Most Common Indication for Corneal Transplant

Bacterial and *Acanthamoeba* infections were the next indicators, according to a recent study.

While infectious keratitis may require corneal transplantation to control the infection, few studies have reported on graft survival or the role of human leukocyte antigen (HLA). The purpose of this recent study was to analyze real-world practice patterns and graft survival after corneal transplantation for infectious keratitis. It showed that viral keratitis was the most common indication for transplantation, followed by bacterial and *Acanthamoeba* keratitis.

A total of 1,111 keratoplasties for infectious keratitis between 2007 and 2011 were analyzed. The most common pathogens were viruses, bacteria and *Acanthamoeba*.

HLA matching did not provide a significant survival benefit, whereas non-HLA-matched procedures showed worse graft survival. Most transplants were performed for visual rehabilitation (optical keratoplasty), with several focusing on debulking and preserving globe integrity (therapeutic keratoplasty).



The volume of corneal transplantation for infectious keratitis has stabilized over the last decade, with the exception of *Acanthamoeba*-related cases.

Two-year graft survival for therapeutic viral keratitis measured 77%, which is high compared with previous studies reporting 55% to 75% at two years.

Two-year graft survival of therapeutic keratoplasty for bacterial keratitis was 81%, slightly lower than that reported in previous studies (over 90%).

Two-year graft survival was 72% for therapeutic keratoplasty and was comparable between viral and bacterial keratitis but substantially lower in *Acanthamoeba* keratitis, even after correcting for type, reason for surgery and graft size. The volume of corneal transplantation for *Acanthamoeba* keratitis accounted for 14% of all indications and increased from a handful of cases before 2009 to double digits since 2015. "This increase may be due to the use of silicone hydrogel contact lenses, multipurpose solutions or local environmental factors," the team noted in their paper for the *Cornea* journal. "Importantly, *Acanthamoeba* keratitis showed the worst outcomes of all causative agents even when outcomes were adjusted for type of procedure, reason for grafting (optical and therapeutic keratoplasty) and graft size.

"The benefit of HLA matching is unclear, but our data suggests that it may not provide additional survival benefits," the investigators concluded. "Timely therapeutic keratoplasty should be considered as needed given the relatively successful outcomes in our study, especially for viral and bacterial keratitis."

Veugen JMJ, Dunker SL, Wolffs PFG, et al. Corneal transplantation for infectious keratitis: a prospective Dutch registry study. Cornea. February 4, 2023. [Epub ahead of print].

IN BRIEF

■ Researchers recently examined **ocular pain after LASIK and photorefractive keratectomy (PRK)** and found that **ocular pain pre-surgery, depression pre-surgery, use of an oral anti-allergy medication and pain intensity day one post-surgery were risk factors.**

A total of 109 individuals underwent refractive surgery (87% LASIK, 13% PRK) and were followed for six months. Participants rated their ocular pain on a zero to 10 numerical rating scale (NRS) pre-surgery and one day, three months and six months post-surgery. Persistent ocular pain was defined as an NRS score ≥3.

Eight (7%) individuals reported ocular pain prior to surgery, with the frequency of ocular pain increasing after surgery to 23% (n=25) at three months and 24% (n=26) at six months. Twelve individuals (11%) reported an NRS ≥3 at both timepoints. The pain was not related to visual acuity or ocular surface signs of disease (*e.g.*, tear production, stability), suggesting that neuropathic mechanisms may play a role.

They found that **use of oral anti-allergy medication pre-surgery was associated with persistent post-op pain as well.**

Betz J, Behrens H, Harkness BM, et al. Ocular pain after refractive surgery: interim analysis of frequency and risk factors. Ophthalmology. February 14, 2023. [Epub ahead of print].

■ Researchers evaluated **the impact of type 2 diabetes mellitus (T2DM) on dry eye disease (DED) and found that higher prevalence and increased severity of MGD was found in patients with both T2DM and DED compared with those only with DED.**

"We observed that the **MG loss was significantly higher in both the upper and lower eyelids of diabetics with DED than in nondiabetics with DED**," the study authors wrote.

OSDI scores of DM-DED patients were higher than those of normal controls but lower than nondiabetic DED patients. Similarly, decreased OSDI scores were shown in the DM control group compared with the normal control group, which is consistent with a previous study.

Yang Q, Liu L, Li J, et al. Evaluation of meibomian gland dysfunction in type 2 diabetes with dry eye disease: a non-randomized controlled trial. BMC Ophthalmol. January 31, 2023. [Epub ahead of print].

RCCL REVIEW OF CORNEA & CONTACT LENSES

jmi

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Corneal Biomechanics May Aid Glaucoma Diagnosis

NTG patients had more deformable corneas, suggesting the lamina cribrosa of these eyes is particularly vulnerable to even normal IOPs.

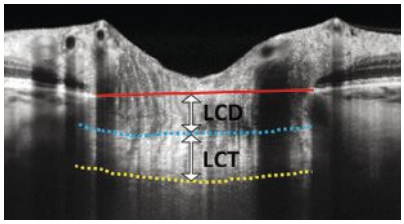
One theory of glaucoma pathogenesis suggests there's an association with lamina cribrosa biomechanics. Since this structure is difficult to study *in vivo*, researchers turned to the cornea for answers, explaining in their paper in *Journal of Glaucoma* that "corneal biomechanics can partially reflect these characteristics [of the lamina cribrosa] since the corneal stroma and sclera are derived from mesoderm." They reported corneal biomechanical differences among subtypes of primary open-angle glaucoma (POAG).

The literature review and meta-analysis included 2,462 POAG patients, 345 ocular hypertension (OHT) patients and 3,281 controls. The team found that corneal hysteresis, corneal resistance factor and highest concavity time were lower in POAG patients vs. controls.

Compared with controls, OHT patients had lower corneal hysteresis, time at second applanation, highest concavity time and radius and deformation amplitude at highest concavity. Corneal resistance factor, time at first applanation and stiffness parameter at first applanation were greater in OHT patients than in controls.

Subgroup analyses revealed that corneal hysteresis, time at and length of second applanation and deformation amplitude at highest concavity were lower in high-tension glaucoma patients vs. controls, while corneal hysteresis, corneal resistance factor, time at first applanation and highest concavity time were lower in normal-tension glaucoma (NTG) patients.

They concluded that NTG patients have more deformable corneas, and high-tension glaucoma and OHT patients have stiffer corneas. "Although the pathology and mechanisms of glaucoma remain controversial, it has been widely accepted that the raised IOP increases the pressure differences across the lamina cribrosa, thus inducing stress and strain on it, eventually leading to compression of the optic nerve head," the researchers explained.



In this EDI-OCT through the optic nerve, lamina cribrosa thickness is measured from the anterior border (blue line) to the posterior border (yellow line) of the lamina cribrosa. Lamina cribrosa depth is measured along a perpendicular line from the anterior border of the lamina to a reference line that connects the edges of Bruch's (red line).

To account for glaucomatous changes in NTG, the researchers suggested the lamina cribrosa in this population may be "abnormally vulnerable to the normal IOP." They reported that their results confirm this hypothesis, as the "corneal stroma collagen is conjunct with the sclera and lamina cribrosa," making corneal biomechanics a surrogate of sorts for the properties of the whole eye wall. "Corneal biomechanical measurements could benefit clinical diagnosis," they wrote in their paper.

Liu M, Zhou M, Li D, et al. Corneal biomechanics in primary open angle glaucoma and ocular hypertension: a systematic review and meta-analysis. J Glaucoma. December 30, 2022. [Epub ahead of print].

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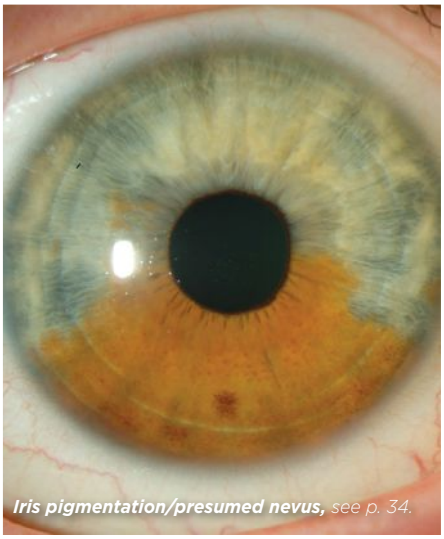

Iris pigmentation/presumed nevus, *see p. 34.*

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#02 OF SERIES

KERATOCONUS and CROSS-LINKING

Practice Considerations in Managing Keratoconus and Cross-Linking

Nicole Albright, OD
Clinic Director,
Moses Eyecare Center
An independent optometry practice in Merrillville, IN

KEY TAKEAWAYS

- Managing keratoconus (KC) meets patients' needs as part of a medical-model optometric practice.
- There is no global period for cross-linking; each follow-up visit is billed as an office visit.
- The progressive KC patients I have referred for cross-linking have become loyal patients.

Many optometrists are shifting towards a medical model of practice, managing chronic conditions with ocular manifestations, including dry eye, glaucoma, and diabetes. Diversifying the services you offer can better meet the needs of your patients.

Managing keratoconus (KC) is a great way to "lean in" to that more comprehensive medical model of optometric care. About 70% of KC patients first present to an optometrist's office,[1] which means that we have a unique opportunity to identify this progressive disease and refer patients for the FDA-approved iLink® cross-linking procedure in the early stages, before there is permanent vision loss. After treatment, we can continue to address the patient's vision needs over time.

Collaborating with cornea specialists in the care of KC patients has provided comprehensive patient care and strengthened my relationships with ophthalmologists in the community. When they realize that we share a common goal of helping our KC patients, it opens the door not only to specialty contact lens fitting and follow-up care after cross-linking, but to collaboration and referrals in other areas, as well.

Follow-up care after iLink® cross-linking is similar to that required for PRK, with five or more visits and one or more contact lens re-fittings in the first year being typical. After that, KC patients will continue to need vision care and annual medical eye care appointments to monitor for any further corneal changes. While the timing and frequency of office visits may vary by patient and at the doctor's discretion, there is no global period for cross-linking. Any necessary post-treatment visits and diagnostic tests, such as pachymetry and topography, are typically billed separately.

I personally find scleral lens fitting and the management of progressive KC patients who are undergoing cross-linking to be among the most rewarding things I do as an optometrist. First and foremost, we offer them a treatment that can slow or halt KC progression. Furthermore, patients are so very appreciative when you can pinpoint the cause of and address their visual quality problems with contact lenses.

Modeling suggests that iLink® cross-linking saves the average patient nearly $9,000 in direct medical costs and nearly $44,000 in lifetime costs[2]—and that doesn't even include the impact on their mental health and well-being. In addition to the cost savings, it is very fulfilling to me to know that I can help protect a young person with early progressive KC from progressing to the advanced stages of the disease, potentially avoiding a lifetime of vision loss and the need for corneal transplant surgery. One study showed a 25% drop in corneal transplants after the introduction of cross-linking.[3]

Our KC patients are grateful for this care. They will rave about you on social media, refer family and friends—and generally become loyal patients. ■

With your medical management and cross-linking referrals, modeling[2] suggests that patients benefit:

$8,677
DIRECT MEDICAL COST SAVINGS PER PATIENT

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REDUCTION IN LIFETIME COSTS PER PATIENT

1.88
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REFERENCES:
1. Eisenberg JS. First Treatment for Keratoconus Itself. Optometry Times, June 1, 2012. 2. Lindstrom RL et al. J Med Econ 2021;24:410. 3. Godefrooij DA, Gans R, Imhof SM, et al. Acta Ophthalmol 2016; 94:675-678.

SCAN WITH PHONE
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Uninvited Guests

Rational antibiotic use is needed to help minimize antimicrobial resistance in your community.

This week my daughter called and texted me pictures to say my four-year-old granddaughter had "pink eye." Not getting a call back immediately from me prompted a quick visit to the local urgent care center. I had trouble reaching her, so I decided to phone in a prescription for Polytrim (trimethoprim/polymyxin B, Allergan) to their local pharmacy. When I finally got to speak to my daughter, the urgent care had already phoned in a topical antibiotic—Polytrim. So, now she has two bottles, which is good because half the first bottle's contents ended up on my granddaughter's cheek. It would be easier applying drops into a squirrel's eye.

Should I have prescribed an antibiotic without first seeing her? The short answer is probably not, but we're two hours away, and the photo surely showed a red, inflamed eye. Second, and most important, were either one of us (the center and me) good stewards for prescribing? Again, probably not. I doubt that I'm alone in sending along an antibiotic when it might not be needed. Of course, my daughter felt both the urgent care provider and I were geniuses since my granddaughter was clearly better in just a few days. Was it a bacterial conjunctivitis? Likely not, very few are.

AVOIDING RESISTANCE

Within the last two decades, bacterial resistance has become a crisis—one that is outpacing the development of new antibiotics.[1,2] The CDC estimates that antibiotic resistant infections cost the US more than $20 billion each year—not to mention lost productivity.[1] Ocular concerns differ somewhat from systemic ones, but the risks and consequences are comparable in many respects.

However, the ophthalmic community is not immune to treatment-resistant organisms. Just this month a multistate cluster of carbapenem-resistant *Pseudomonas aeruginosa* was associated with multiple different infections including the eye.[3] A review of common exposures among patients identified that the majority of patients used artificial tears prior to the infection. The most common brand identified was EzriCare Artificial Tears (Global Pharma Healthcare). Further CDC testing is ongoing to assess if they match the outbreak strain.[3] The agency is investigating a cluster of 56 isolates from 50 patients in 11 states.[4]

In doing our part to minimize and avoid antimicrobial resistance, addressing ongoing threats requires aggressive actions.[1]

- Prevent infections with healthy habits (get recommended vaccines, keep hands and wounds clean and take care of chronic conditions such as diabetes).
- Improve antimicrobial (antibiotic and antifungal) use to slow the development of resistance.
- Stop the spread of resistance when it does develop with surveillance of antibiotic resistance and antibiotic use (report when such events as described occur).

Recent strategies encouraged by CDC include pathogen reduction (decreasing the number of bacterial and fungal pathogens that might lead to infection) and decolonization (goal would be to remove pathogens from our skin, gut, nose, etc.). Future options to reduce pathogens and colonization may involve bacteriophages and other live biotherapeutic products.[1] Understanding the microbial ecology and ecological pressures, as well as looking at the relationship of microbes that allow some germs to survive and multiply in a competitive environment and why others do not, will be a key component to the fight.

BETTER JUDGMENT

I doubt that my indiscretion in prescribing Polytrim for my granddaughter has contributed significantly to the resistance patterns in her local community, but nevertheless I feel guilty for not doing my part in being a good steward of antibiotic use. Overall, rational use of antibiotics, even when used in a topical fashion, is needed to help minimize antimicrobial resistance in your community.

Before prescribing a broad-spectrum antibiotic, examine the conjunctiva carefully for follicles and papillae. Are there any lid or skin findings such as molluscum, vesicles or adenopathy? Is there any significant discharge? And, what involvement—if any—is found on the cornea, especially in contact lens wearers? So, the next time a patient—or relative—calls with what is likely a self-limiting acute red eye often seen in contact lens wearers, consider holding the antibiotic at least until you see them. Simply ordering an NSAID, antihistamine/mast cell stabilizer or just the topical steroid for more severe cases of conjunctivitis will often suffice. RCCL

1. Actions to fight antimicrobial resistance. CDC. www.cdc.gov/drugresistance/actions-to-fight.html. Last updated December 14, 2021. Accessed February 1, 2023.

2. Office of the Press Secretary. Executive order-combatting antibiotic-resistant bacteria. obamawhitehouse.archives.gov/the-press-office/2014/09/18/executive-order-combating-antibiotic-resistant-bacteria. The Obama White House Archives. September 18, 2014. Accessed February 1, 2023.

3. State-based HAI prevention activities. CDC. www.cdc.gov/hai/state-based/index.html. Accessed February 1, 2023.

4. CDC urges discontinued use of EzriCare artificial tears. American Academy of Ophthalmology. www.aao.org/headline/cdc-urges-discontinue-use-ezricare-artificialtears. January 20, 2023. Accessed February 1, 2023.

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A 33-year-old Hispanic male presented for a first-time contact lens fitting OU complaining of blurry, fluctuating vision and glare at night with his habitual glasses from three years prior. He noted a recent diagnosis of keratoconus and was subsequently referred to our contact lens service. We confirmed the diagnosis and discussed the option for corneal crosslinking (CXL) prior to a contact lens fit. The patient declined CXL due to cost, but was interested in seeing better, especially when driving at night.

Entering vision was OD 20/40 and OS 20/50 in spectacles. All other entrance testing was within normal limits. The patient's Pentacam (Oculus) maps showed simulated keratometry readings of OD: 42.5/44.2@110 and OS: 46.9/48.7@129 (*Figure 1*). While the keratometry may appear normal OD, the ectasia was confirmed by assessing the abnormal Kmax, abnormal back surface elevation, reduced pachymetry values and elevated BAD-D value in each eye.

The manifest refraction was OD: +0.25 -1.00x090 and OS: -1.25 -2.50x150 with a distance BCVA of OD 20/30 and OS 20/40. Near VA reached 20/30 in each eye with the same refraction.

ASSESSMENT

From the topography or tomography maps, I like to evaluate the tangential map and elevation map to determine a starting lens. From this patient's elevation map, we could assess the likelihood of success with a corneal lens (vs. the need for a scleral lens design) and predict to some degree what the sodium fluorescein pattern of the corneal lens will look like (*Figure 1*). If the sagittal height difference on the elevation map (height map) at an 8mm chord is <200µm, there is a good chance the patient can be fit in a corneal lens. If the sagittal height difference on the elevation map at an 8mm chord is >400µm, there is little chance we will be successful (and we might as well start with a different lens design). This patient fits neatly into the first category, and I was reasonably confident we would be successful in a RoseK2 design. It is important to keep in mind that all corneal lenses are limited by this sagittal height differential.

Slit lamp evaluation revealed a Fleisher ring along with Vogt striae centrally in each eye. There was no central corneal scarring, but thinning was evident and consistent with keratoconus and the patient's global pachymetry maps on the Pentacam.

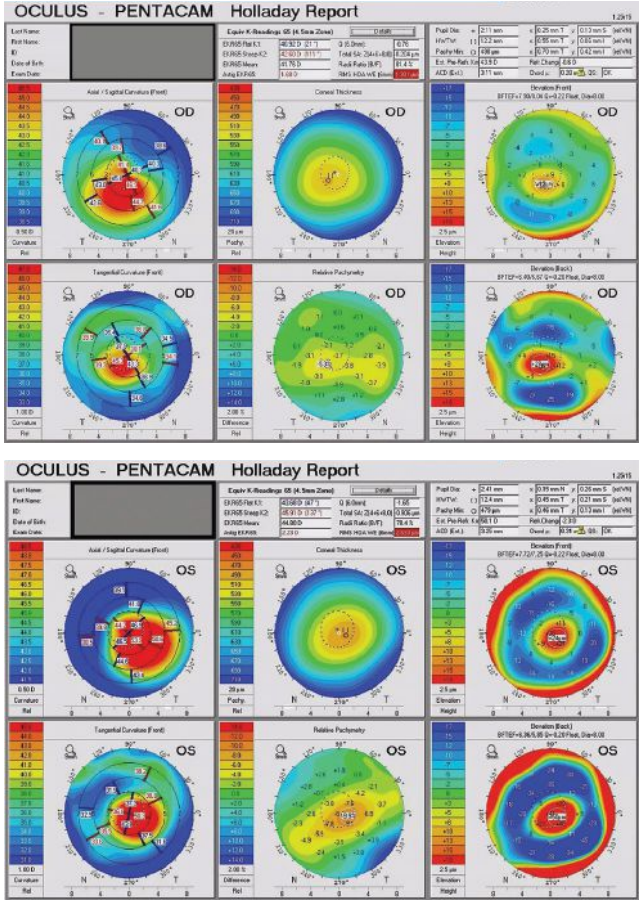


Fig. 1. Pentacam tomography maps for the patient in this case.

LENS REFIT

The patient was fit with RoseK2 corneal lenses (Blanchard, CooperVision Specialty Eye Care) OU. I chose this lens because, based on the tomography maps, I was anticipating that he may need a toric peripheral curve to achieve an even landing on the cornea. The RoseK2 lens was designed by Paul Rose of New Zealand. It is an aspheric design and has a customizable landing zone, including both toric and asymmetric corneal technology options. The lens design is typically fit diagnostically, using keratometry readings and a fitting set. Our practice is fortunate to have several fitting sets and diameters to choose from.

I tried the following diagnostic lenses OD:

7.50/9.2/-2.00DS and OS: 7.10/9.0/-2.00DS. With an over-refraction, the BCVA was equivalent to that achieved in spectacles at OD 20/30 and OS 20/40. The fit was steep OS, and I considered adding in a toric periphery but opted to see how the first pair went without it. Despite minimal improvement in Snellen acuity with the lenses, the patient was happy with the quality improvement achieved in diagnostic lenses and was hopeful that would assist him with night driving.

A custom lens order was placed for RoseK2 with parameters OD: 7.50/9.2/-2.00DS/Optimum Extra (Contamac) in green and OS: 7.20/9.0/-3.00DS/Optimum Extra (Contamac) in blue.

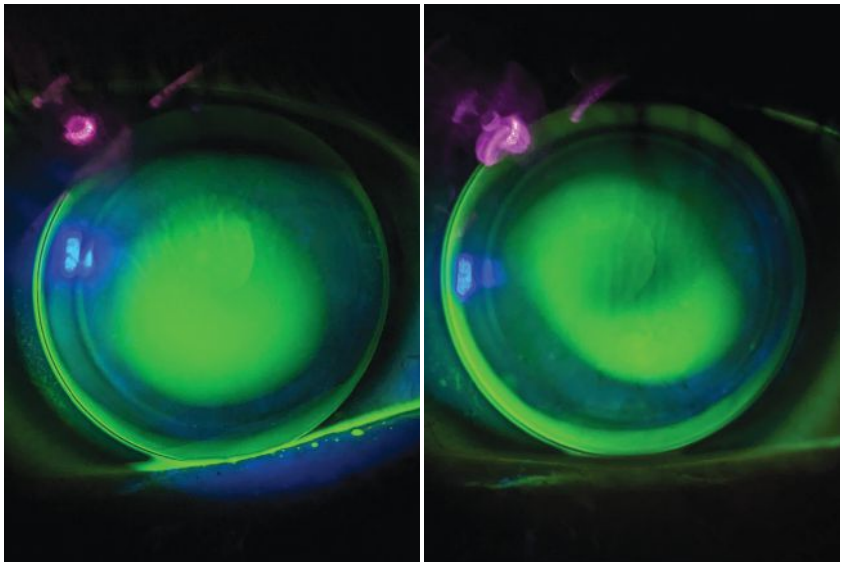


Fig. 2. Final lenses show adequate fit centrally (apical clearance OD, left, feather touch OS, right) with relatively even edges provided by toric peripheral curves.

FOLLOW-UPS

At the follow-up two weeks later, the patient did not wear the lenses to the office, noting he had hardly worn them at all, except the day following his appointment. He described extensive difficulty with lens application due to having shaky hands. The frustration was so much that he gave up and discontinued wear. We used this visit to retrain application and removal procedures, which the patient succeeded at once again. We assessed the fit and decided to proactively place an exchange order in each eye. We saw the patient back in two weeks.

There, we dispensed the new lenses. The patient had not worn the first pair much and once again forgot some of the application and removal procedures. We reviewed them and provided a suction cup remover should he need it. At this visit, we measured a -0.50DS over-refraction in each eye that only subjectively improved vision to add the toric peripheral curves in each eye: OD 0.8mm and OS 1.2mm. We scheduled a one-month follow-up visit and elected to hold off on the reorder for now.

At the follow-up, the patient came in wearing the lenses. He was much happier because of his continued success with application and removal. He felt like the lenses lessened his symptoms of glare and halos at night and overall was happy with his vision. He was well-adapted and did not have any comfort concerns. We confirmed he was following proper cleaning procedures with Clear Care (Alcon). There was now no over-refraction in either eye, with the patient rejecting the -0.50DS over each eye found at the last visit.

At this visit, we did note the presence of peripheral 3-9 staining in each eye; however, the patient was not using any lubricating eye drops. Slit lamp assessment revealed a reduced tear film break-up time of four seconds in each eye. We advised the patient to start instilling contact lens–compatible lubricating eye drops four times daily and we would follow-up in four weeks for further dry eye evaluation and to gauge the level of improvement in 3-9 staining.

Have these important reminders handy while fitting your next patient with GP lenses. First, choose a lens wisely and consider all your options. We often overlook corneal lenses these days, but if the sagittal height dictates, go for it! Second, treat dryness along with GP lens wear (and it would be a great idea to check the patient's dry eye status before you even being a fit.) Finally, consider holding off making small power changes until the neophyte patient is fully adapted to lens and wear. Chances are that over-refraction will change—and may even disappear—once they are comfortable. RCCL

By Becky Su, OD, Marcus R. Noyes, OD, and John D. Gelles, OD

Success Without Sclerals

Here's how freeform corneal gas permeable lenses play a role post-corneal transplant for highly irregular corneas.

A 65-year-old white male with corneal ectasia s/p penetrating keratoplasty (PK) in both eyes was referred from the cornea service for specialty contact lens evaluation. His chief complaint was that he "doesn't want surgery."

His medical history and systemic medications were non-contributory, and he wasn't on any ocular medications. Besides s/p PK and corneal ectasia OU, his ocular history was positive for grade 3 nuclear sclerotic cataracts OU.

CASE

The patient had PK "in the 1970s," after which point he was lost to follow-up. He had deferred surgery for both cataract extraction and repeat corneal transplantation.

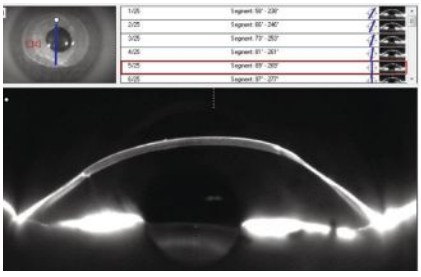
He presented to us with a best-corrected visual acuity of 20/60- OD and 20/300 OS in his spectacles. Pachymetry readings showed 660µm OD and 735µm OS. Unfortunately, his corneal endothelial cell count readings were unreliable due to the irregularity of his corneas, giving values of 140mm^2 OD and 844mm^2 OS.

Contributory slit lamp exam findings included the following (all other findings were within normal limits):

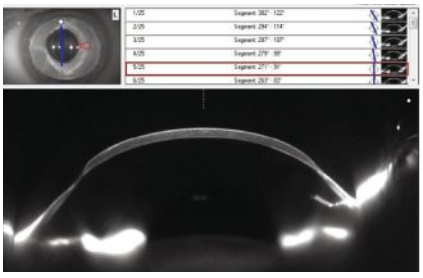
• *Eyelids/adnexa*: floppy eyelid, meibomian gland dysfunction, incomplete blink OU.

• *Cornea*: PK graft with ectasia, thin and ectatic inferior cornea (host and ~1.5mm of donor button), mild stromal haze and peripheral suture scars, punctate epithelial erosions, irregular surface OD, keratoglobus OS.

• *Lens*: grade 3+ nuclear sclerotic cataracts OU.



OCT imaging of the right eye.



OCT imaging of the left eye.

CONSIDERATIONS

Here, we highlight how we would proceed.

Dr. Su. Cases like this can be tricky. Transplants that have scarred, failed or produced inadequate vision can typically be replaced multiple times in a patient's lifetime as long as the patient can tolerate additional procedures and there is a reasonable chance of success. In this case, the patient was adamant about deferring surgery, so the best we could do was prolong his current grafts.

Generally, wearing contact lenses doesn't increase the likelihood of corneal graft rejection, but complications of lens wear can. Whether a using soft or a gas permeable (GP) lens, high Dk material is important to help minimize the risk of hypoxic-related complications. Lenses can also lead to mechanical irritation of the cornea, especially if the lens interacts with an exposed suture.

With this patient's level of irregularity, it is unlikely that a standard soft or custom soft lens would be successful. In this case, a scleral lens may best accommodate the corneoscleral shape, but a corneal rigid GP lens may allow for better tear exchange. However, given the irregularity, success with a standard corneal GP is unlikely.

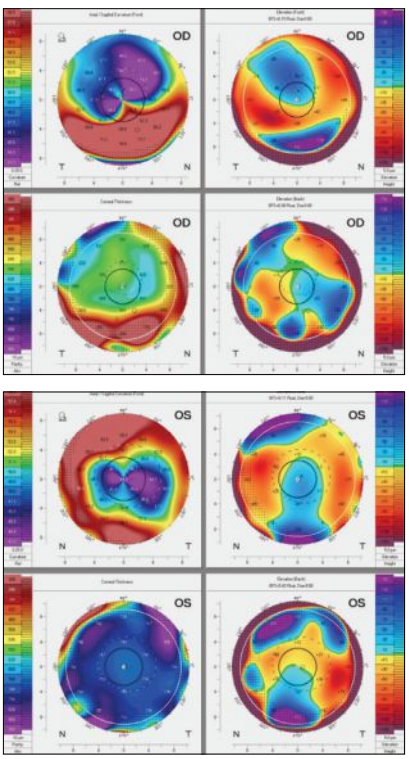
Scleral lens wear decisions should keep endothelial cell health in mind, especially with grafts over 50 years old. Patient motivation is also crucial for scleral lens success, and since the patient is apprehensive about the application and removal process, it adds another challenge for successful scleral lens wear. It may seem like surgery is the only option, but luckily there are advanced lens technologies that can create custom-designed lenses derived from scans or impressions. In this case, a data-driven lens to make a corneal GP may give the patient the best chance of success.

Dr. Gelles. Old grafts with significant irregularity can pose a real challenge. There are no perfect options; both scleral and corneal GPs have problems. GPs aren't going to stay on the eye, and corneal edema has been well-documented with sclerals in post-PK corneas. We know endothelial cell density decreases over time after successful PK. For years, a rule of thumb has been propagated about low endothelial cell counts (sub-1000) and scleral-induced edema, but it's not "how many cells?" that matters, it's "how well do they function?" to keep the cornea clear.

In patients needing a scleral lens where the endothelial function may be compromised, such as in old grafts,

a "scleral lens challenge" can be performed to gauge the probability of wear-induced complications. This includes in-office monitoring, where a scleral lens is worn for a few hours during the initial fitting. If signs of complications, such as reduced vision, Sattler's veil, microcystic edema, bullae, folds or increased corneal thickness, are present in that short period of time, then a scleral lens is likely not an ideal option. If a scleral is a must, it will require significant modifications (increase material Dk, decrease lens thickness, reduce corneal clearance, fit for tear exchange, add channels and fenestrations and/or reduce wear time) to mitigate the response.

If we can limit the physiologic stress of scleral lens wear on the cornea, we can minimize potential issues, but this takes significant skill and time. Add in a patient who's not confident in application and removal, and this venture is unlikely to succeed.



Scheimpflug imaging of the right (top) and left eyes (bottom).

A corneal GP would be a better option health-wise—if you can keep it on the eye. We all know that highly irregular corneas are very challenging to fit with standard diagnostic fitting set–driven corneal GP designs. However, technology has evolved considerably; by using data from corneal topographers, tomographers, profilometers or 3D models derived from ocular impressions, lenses can be made with extremely complex geometries. These freeform GP lenses can be created to follow the contour of complex eyes to remain in proper position with adequate movement and tear exchange. For this patient, a data-driven GP is likely the best option.

Dr. Noyes. From a clinical perspective, this patient was not a candidate for scleral contact lenses due to his endothelium quality (his grafts were over 50 years old), and from a scleral lens insertion and removal perspective, he did not feel he could adequately complete the process.

Traditional rigid GP lenses are also not a good option due to the massive amount of ectasia and corneoscleral irregularity in this case. These irregularities were so severe that when using diagnostic lenses in-office, none could stay on the eye for more than a few seconds. A freeform profile is necessary to combat these issues, particularly in highly ectatic and irregular grafts.

RESULTS

Ocular impressions were taken using an impression system (Blue Goo, EyePrint Prosthetics). These molds were then 3D-scanned to create digital models of each cornea. To mirror the corneal shape, lens design software was used to create custom freeform GP lenses (EyeprintPro, EyePrint Prosthetics). For reference, these lenses had a very deep sagittal depths (2539µm OD and 2677µm OS) for their diameters (10.0mm OD and 9.0mm OS).

Additionally, the lenses were made of high Dk material (Optimum Extra, Contamac). Despite some non-pathologic central bearing and minor edge lift at times, the patient's lenses could stay on his eyes, and he had clear, comfortable vision. For a visual, scan the QR code. His vision improved to 20/25 OD and 20/20 OS, and no further lens modifications or revisions were needed.

Scan the QR code at right to watch a video of the lens's on-eye performance.

TAKEAWAYS

This case highlights the importance of adopting technology in contact lens practice. The technology-driven contact lens design method we used created corneal GP lenses with a level of success surpassing our expectations. This process unlocks the door for a much wider range of complexity that a corneal GP can accommodate and is particularly useful in the case of scleral lens contraindication.

These technology-driven lenses are an additional tool we can use to help further improve the life and vision of our patients. RCCL

Special thanks to David Slater, of NCLEC, for providing images, video and consultation on designing this lens.

Dr. Su is the Cornea and Contact Lens Fellow at the Cornea and Laser Eye Institute (CLEI) Center for Keratoconus. She has no financial interests to disclose.

GP and Scleral Design Tips: *Livin' on the Edge*

This aspect of lens wear can make or break success. Here are strategies that promote comfort and encourage compliance.

By Tiffany Andrzejewski, OD, and William Skoog, OD

No matter the lens modality, discomfort is the leading cause of contact lens discontinuation, which only makes sense if you take a step back and think about it.[1] However, what about when a patient needs or can benefit from the optics from a gas permeable (GP) lens? The comfort of a corneal GP or scleral lens for a patient is multifactorial. It isn't always fit related, but one thing that is certain—if the edge configuration is not optimal, this will impact comfort and create lens awareness.

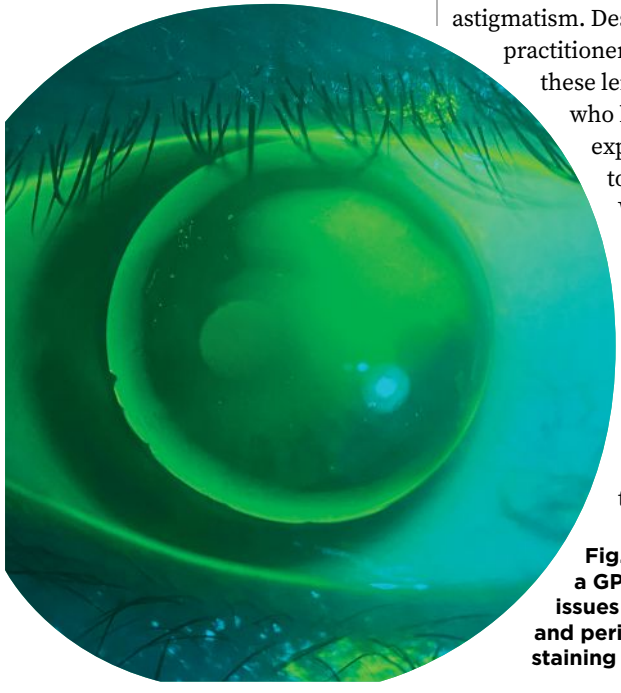


Fig. 1. A patient wearing a GP lens presenting with issues of severe discomfort and peripheral corneal staining from a chipped edge.

GP LENSES

Research shows that GP lenses can provide superior vision quality compared with soft lenses.[2] Their smooth refracting surface with post-lens tear layer delivers crisp, stable optics, especially for patients with corneal astigmatism. Despite this advantage, practitioners still hesitate to fit these lenses, and patients who have had a negative experience are resistant to trying them again. When considering initial patient comfort, it's no surprise why. The smaller diameter of GPs allow for greater movement on the eye, and the eyelid interaction with the edge of the lens causes lens awareness. Even though the majority of lens wearers prefer the initial comfort of a soft lens, it doesn't mean they can't be successful with GPs.[3]

With corneal GPs, the discomfort arises from the interaction between the rigid edge of the lens and the eyelids, particularly the upper lid margin. Edge shape and design are the most important parameters in initial lens comfort.[4] The edge should be smooth and well rounded—in contrast, if a GP has a defective edge (chipped, abraded, blunt or sharp) the patient will be very aware of the lens with each and

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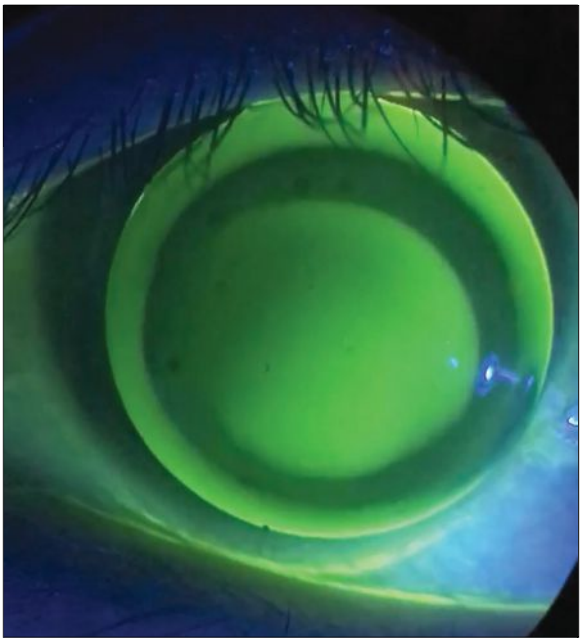

Fig. 2. A GP lens with excessive edge clearance, if not fixed will lead to three o'clock and nine o'clock staining and worse comfort for the patient.

every blink, and it will make for quite the negative experience (*Figure 1*). A well-blended peripheral curve system is preferred to a poorly blended or unblended peripheral curve system, which can produce dryness, itchiness, and scratchiness.[5] Fortunately, advances in computer-controlled designs and lathes have allowed modern GP lenses to be manufactured thinner with improved back surface geometry and more consistent edges.[6]

GP EDGE FACTORS

Three factors relating to the edge of the GP govern comfort: thickness and shape of the edge and the amount of edge clearance.[7] A thin, tapered, rolled-edge design is desirable. It has been found that lenses with a well-rounded anterior edge profile versus a square anterior edge, are significantly more comfortable.[8] One would think that a GP design with a thinner central thickness (CT), which results in a thinner edge thickness, would result in better comfort. However, believe it or not, one study actually found the opposite: thinner CT lenses were actually less comfortable than their stiffer counterparts, which was attributed to on-eye flexure or deformation of the lens during the blink cycle.[9]

One thing that always remains true, though, is that GP lens CT and edge thickness vary with changes in lens overall diameter (OAD) and with different lens powers.[6] Edge thickness is greater in medium-to-high minus powers and thinner in low minus and all plus power lenses. As a result of the variation in edge thickness associated with lens powers, a lenticular design can be added to improve comfort: high minus lenses can benefit from plus lenticular design or an anterior center-near bevel, which will reduce the edge thickness and lessen lens awareness, inferior lens positioning and corneal desiccation from compromised blinking that usually results from a thick edge.

Typically, minus lens powers ≥-5.00D are lenticulated. Conversely, a minus lenticular design is used to increase the edge thickness to enhance lid interaction with the edge and minimize inferior decentration with minus powers ≤-1.50D and all plus power lenses. Avoiding an excessively thick edge can provide closer lid-to-cornea alignment and enhance patient comfort.[10]

Lastly, excessive corneal GP edge clearance can also be problematic for patient comfort. The greater the edge clearance, the greater the interaction with the eyelids and, in turn, the poorer the comfort.[7] In addition, thick edge clearance can cause persistent discomfort because it funnels in surrounding tears, resulting in desiccation and corneal staining at three o'clock and nine o'clock on the peripheral cornea. This also affects the blink quality by an increased interaction between the lens edge and the superior lid, especially when the lens decenters (*Figure 2*).[11] The best way to fix this is to either steepen the peripheral curve radius or decrease the peripheral curve width.

Conversely, if the peripheral curve is too steep to begin with—causing peripheral seal off—then corneal desiccation can occur, which can lead to vascularized limbal keratitis (VLK). This presents as a peripheral corneal lesion with superficial staining. More advanced cases can even lead to neovascularization and an elevated opacified region near the limbus where the edge of the lens was impinging on the peripheral cornea.[12] A GP patient who has VLK will present with significant decrease in CL comfort and reduced wearing time, as well as sectoral limbal injection. This can be ameliorated by flattening the peripheral curve or the base curve if too steep or, in some cases, making the OAD to eliminate a steep fitting lens configuration.[12]

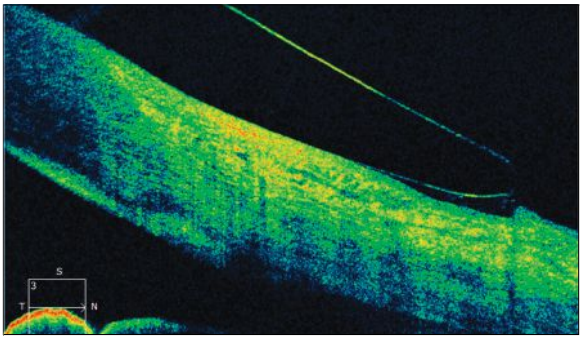

Fig. 3. Anterior segment OCT image showing edge lift of a scleral lens. This indicates a flat landing zone. A steeper landing zone was ordered to improve the haptic alignment.

Although the initial comfort of corneal GPs may be a factor, if the fit and edge design are optimized and the patient is motivated, these lenses can be quite successful. However, if a patient isn't up for the challenge, especially a contact lens neophyte, scleral lenses may be a better option.

SCLERAL LENSES

With a resurgence of sclerals in the last few decades, more patients than ever are wearing them. Indications for these lenses include corneal irregularity, ocular surface disease (*i.e.*, keratoconjunctivitis sicca, Stevens-Johnson syndrome, graft vs. host disease) and refractive error. However, corneal irregularity is the most common.[13] A recent study looked at scleral lens wear success over a 12-month period. During that time, 27% of patients discontinued lens wear. The two main reasons for discontinuation were handling issues (35%) and discomfort (19%).[14]

Discomfort can be multifactorial. One potential reason in scleral lens wearers is poor haptic or landing zone alignment to the conjunctiva and sclera. A steep landing zone will cause blanching of the conjunctival blood vessels at the edge of the lens and would require the optometrist to flatten the landing zone to better align to the conjunctiva. A flat landing zone will cause edge lift and possibly mid-haptic compression of the conjunctival blood vessels requiring a steeper landing zone (*Figure 3*).

These changes can be made to the whole lens if seen circumferentially. However, if seen in certain quadrants of the lens, a toric haptic design or quadrant specific design would lead to better alignment. Using an anterior segment OCT to evaluate the landing zone can be beneficial. The optimal lens edge to bulbar conjunctiva relationship demonstrates that 50% of the lens edge apex sinks softly into the conjunctiva and 50% of the edge apex is above the ocular surface.[15]

The Pacific University Scleral Shape Study showed that the sclera was nearly symmetrical at a chord length of 10.0mm to 15.0mm. However, the 15.0mm to 20.0mm chord was more asymmetrical. This data suggested that if the scleral lens diameter was 15mm or less, a spherical landing zone would likely be successful, whereas a scleral diameter larger than 15mm would benefit from a non-symmetric (toric or quadrant specific) scleral landing zone design.[16] The Scleral Shape Study Group looked at the pattern of scleral shapes and found that a minority of patients (roughly one-third) had rotationally symmetric scleral shape patterns and the majority of patients (roughly two-thirds) had irregular patterns with either asymmetric depressions or elevations.[17]

So what can we take away from these studies? That when fitting scleral lenses, we should consider using toric or quadrant-specific haptics for larger diameter lenses. Using toric scleral landing zones in scleral lenses has been reported to improve comfort compared to spherical scleral landing zones.[18] Interestingly, since these studies have been published, there has not been a shift toward fitting scleral lenses with toric or quadrant-specific landing zones. The majority of lenses being fit still have spherical landing zones.[19]

TROUBLESHOOTING SCLERALS

Discomfort during scleral lens wear can be attributed to multiple fitting issues, one of those being poor landing zone alignment to the conjunctiva. The following describes a few common problems encountered during the fitting process and the remedies that can lead to improved patient comfort and satisfaction.

Conjunctival elevations or obstacles should be taken into consideration when fitting a scleral lens. If the lens is interacting with a conjunctival obstacle, it can cause significant redness, discomfort and decreased wear time. Examples of these obstacles include pingueculae, pterygia, inclusion cysts and filtration blebs. Options to limit or avoid interaction with conjunctival elevations/obstacles include adjusting the diameter of the scleral lens, adding a notch to the edge of the lens, adding a focal area of increased elevation to the edge of the lens, using corneoscleral profilometry to design a freeform lens or impression-based fitting.

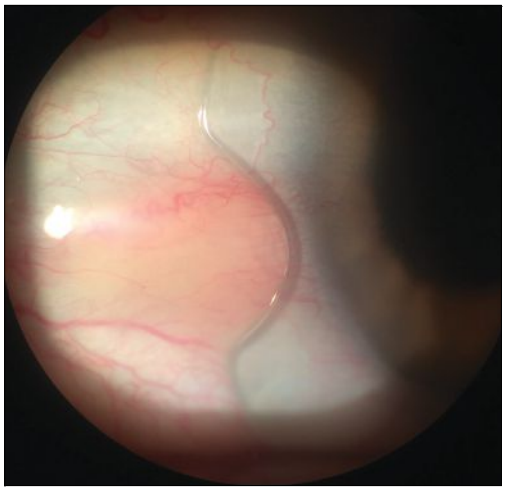

Fig. 4. Scleral lens with a notch to avoid interacting with a pinguecula.

If a conjunctival elevation is present and is located far enough away from the limbus, decreasing the diameter of the scleral lens would allow the haptic to land before the elevation. If the elevation was closer to the limbus, you could increase the diameter of the lens to land past the area of concern. When increasing the diameter of the lens, there will still be some interaction between the landing zone and the obstacle. This compression can lead to redness and lens awareness. If the elevation is not shallow enough, it could also cause edge lift, leading to bubble formation at the edge.

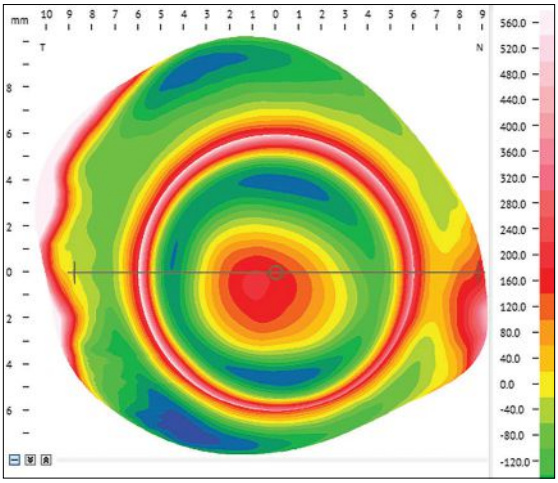

Fig. 5. Corneoscleral profilometry image OD of a patient with keratoconus and a nasal pinguecula.

Adding a notch to the edge of the lens allows the lens edge to avoid the obstacle and fit around it (*Figure 4*). The information needed to design a notch is the location and size of the obstacle. The size of the obstacle will determine the width and depth of the notch. Before adding one, have a centered and stable lens, ideally with toric or quadrant specific haptics. It is recommended to order your first lens without a notch. This will allow you to determine the rotation and stability of the landing zones. If you have stable landing zones at the first follow-up visit, you can design the notch. One way to design the notch is by taking measurements with your slit lamp and taking pictures to send to the lab. Another way is by using a permanent marker to note on the lens the size and depth you want the notch to be. The final option is to create the notch yourself in the office if you have the appropriate tools.

Another option is adding a focal area of increased elevation at the lens edge. This will allow the lens to vault over the area of elevation and minimize the amount of interaction. The fitting process is similar to doing a notch. A stable lens fit with either toric or quadrant specific haptics is needed, along with the location and size of the obstacle. The only new piece of information needed is the height of the obstacle. You can obtain the height of the obstacle by either using corneoscleral profilometry, anterior segment OCT or estimating with the help of the lab consultants.

Corneoscleral profilometry provides detailed measurements of the cornea and sclera (*Figure 5*). This will allow you to have a better understanding of the scleral toricity prior to applying a diagnostic lens to the eye and help determine if spherical, toric or quadrant-specific landing zones are required. It will also show the location and measure conjunctival elevations. Freeform lenses designed from these machines can take into account conjunctival obstacles and include either a notch or focal area of elevation at the edge of the lens on the first lens order.

A final option to consider is using an impression-based method to design a freeform scleral lens matching the exact contour of the globe. Using an impression technique will expedite the fitting process for eyes that have complex conjunctival obstacles or that have failed traditional scleral lens wear. Although this is a more advanced technique, it has been shown to help those who have complex cases and leads to improved patient satisfaction.[20]

TAKEAWAYS

Whether it be a smaller corneal GP lens or a larger scleral lens, one thing is key: proper edge design is critical for comfort. When all else fails, the next time you have a patient expressing their dissatisfaction with their corneal GP or scleral lens comfort and the lens is centered with a good central fit, take a closer look at the edges, as that very well may be the key to success. RCCL

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Preventing and Managing Edema *with Scleral Lenses*

Important factors include lens material selection, optimization of design, customization with fenestrations and channels, and closely monitoring eye health.

By Daddi Fadel, DOptom

In certain cases, fitting scleral lenses is challenging, as they can induce edema and compromise corneal health. Corneal swelling when wearing these lenses may be caused by multiple factors, such as hypoxic stress, increased intraocular pressure (IOP), compromised functional condition of the endothelium and lens suction. Therefore, lens material selection, lens fitting and customization and ocular health monitoring are crucial to prevent or manage edema.

LENS MATERIAL SELECTION

Included in this category are considerations of oxygen permeability (Dk), lens thickness, lens hardness and resistance to flexure and deposits formation. Theoretical models have shown that a scleral lens made of materials with a Dk higher than 100, a thickness less than 260µm and a vault less than 150µm prevents corneal swelling related to hypoxia.[1] Another theoretical approach showed opposing results: a lens with Dk 100 and a central clearance of 1000µm could provide more than sufficient oxygen to the cornea, considering 20% of tear mixing under the lens.[2] Several clinical studies also show that corneal edema was nonsignificant with a lens vault higher than 400µm.[1] Recently, however, a study compared contact lenses made with different Dk materials, ranging from 65 to 180, with the same lens thickness. Results indicated no statistically significant difference in corneal edema between each of the scleral lenses with Dk from 100 to 180.[3]

Special considerations should be addressed for compromised corneas (*e.g.*, post-keratoplasty, endothelial abnormalities, epithelial defects). In these cases, a Dk of more than

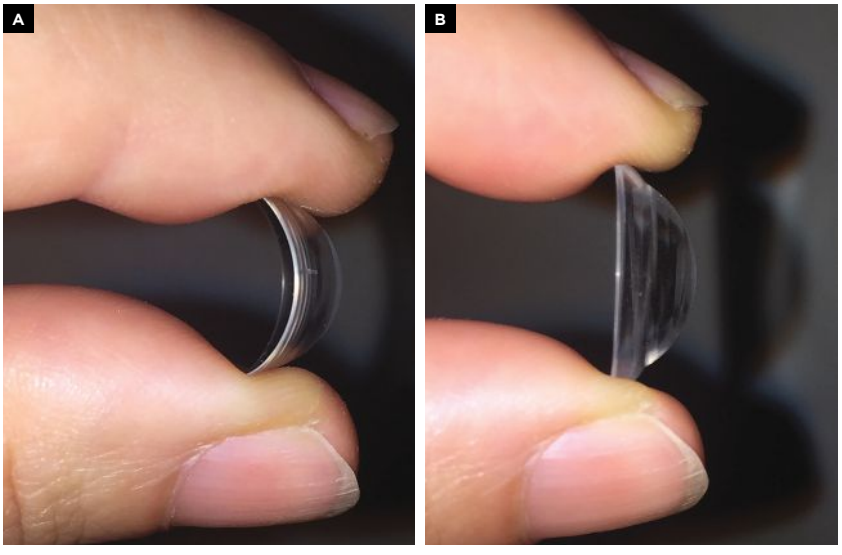

Fig. 1. (A) High Dk scleral lens flexing. (B) A scleral lens of the same diameter and thickness but with higher modulus.

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100 is indicated. Generally, by increasing the Dk the lens flexure will also increase, as the material has a lower modulus rating than low Dk materials (*Figure 1*). Therefore, choosing a material with resistance to flexure with a higher modulus rate is important. Also, the hardness of the material needs to be higher. The harder it is, the higher the material's stiffness. Flexure also depends on lens design; a better alignment with the underlying conjunctiva may reduce lens flexure in the eye. If lens flexure persists, lens thickness may need to be increased.

LENS DESIGN AND VAULT

These deal with Dk and the thickness of the post-lens tear layer. Tear permeability has a Dk value of approximately 80, which is relatively low compared to some high Dk materials.[4,5] Additionally, when fitting scleral lenses, the tear exchange at lens settling is limited to 0.2% per minute.[6] However, the tear exchange rate may vary with lens fitting and be reduced or increased by altering the lens periphery. Additionally, no studies have shown clinically significant levels of hypoxia during daily wear of sclerals, even in cases with oxygen permeability below Holden-Mertz criteria (87). Even if the ideal vault is yet to be determined, it is appropriate to fit a scleral lens with minimal clearance height in compromised corneas to prevent corneal swelling.

OTHER FITTING FACTORS

When wearing scleral contact lenses, edema may occur due to aspects unrelated to hypoxia. Epithelial edema has been reported as an effect of lens suction on the eye.[7,8] Suction occurs due to prolonged contact between the lens and the ocular surface and can increase with conjunctival swelling or a significant pressure of the lids exerted during blinking.[7] If all of these occur, there appears to be a force to increase fluid accumulation within the epithelial epithelium.[9] To reduce lens suction, fenestration in the limbal area or the lens periphery, peripheral channels in the scleral zone or loosening the fit in one or more quadrants may be indicated.

A tight fit and limbal congestion may increase the risk of lens suctioning. Increasing lens diameter and/or flattening the fit by reducing the corneal and limbal clearance resolves this issue. Fenestrations, channels and loosening the fit in the lens periphery may also reduce lens tightening on the eye and limbal congestion.

Scan the QR code at right to watch the two videos referenced in this article.

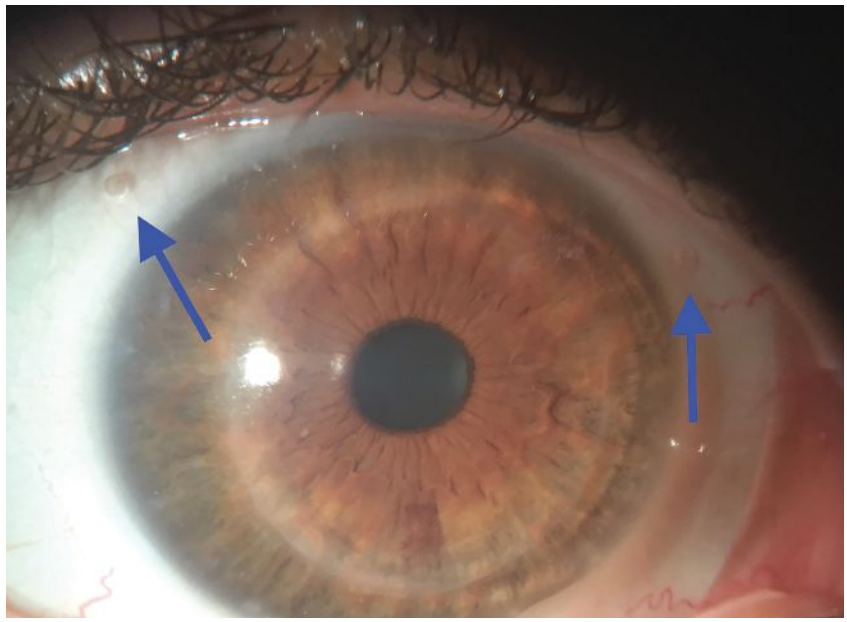

Fig. 2. Two fenestrations are included in the limbal area at two o'clock and ten o'clock.

FENESTRATIONS

One or more fenestrations may be included in the lens and can be positioned in the limbal area or the lens's scleral zone.

Limbal area. The hole in the limbal area has several benefits, including reduced lens suction.[10] To avoid air bubble formation, the hole must have a diameter of 0.3mm to 0.5mm and a limbal clearance of 75µm.[10] Additionally, the lens's back surface should relate as closely as possible to the contour with central clearance not exceeding 150µm. If the diameter of the hole is kept small (not greater than 0.5mm) when filling the lens with preservative-free saline, the solution will not go through the holes and empty the bowl. This is demonstrated in Video 1, which can be found in the online version of this article.

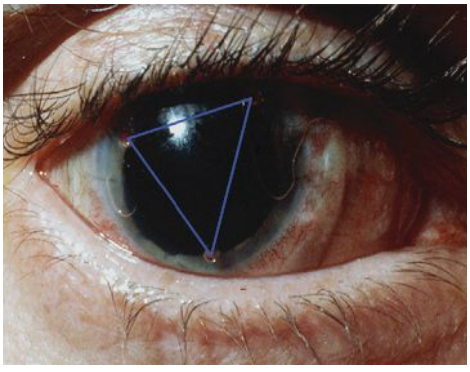

Photo: Don Ezekiel, Dip. Opt (WA)

Fig. 3. Three fenestrations are included, at one o'clock, six o'clock and ten o'clock. The three holes create a triangle.

By appropriately controlling the hole size, the post-lens fluid reservoir releases through the hole when the lens is applied to the eye. This is due to negative sub-atmospheric pressure created behind the lens. Fenestrations are either ordered from the lab or self-made, demonstrated in Video 2.

Once the best fit is achieved and the lens is stable on the eye and not rotating, the fenestrations may be included. They need to be placed in an area that is uncovered by the eyelids. If two fenestrations are included, the best position for them could be at the two o'clock and ten o'clock positions (*Figure 2*). If a third hole is needed, though, its position may be at five o'clock or seven o'clock, so that the three holes create a triangle. The third hole may also be included at six o'clock if it is not covered by the lower eyelid (*Figure 3*). If the hole is self-made, it is necessary to mark the position when the lens is applied to the eye to ensure its correct placement.

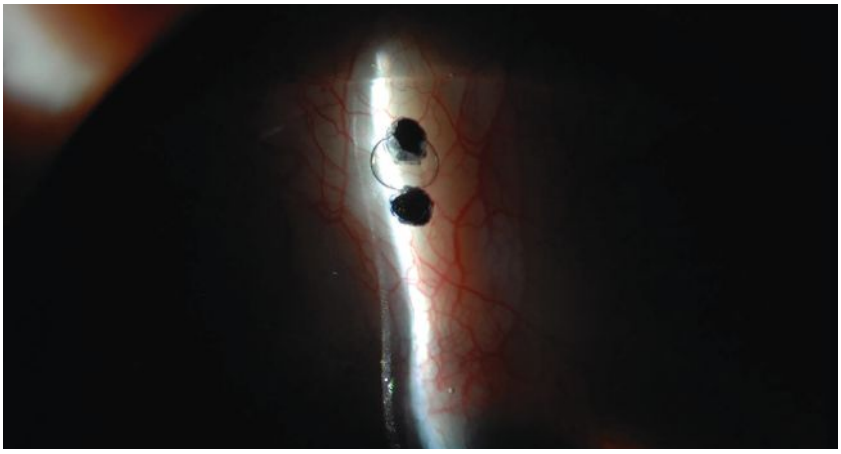

Photo: Karen Carrasquillo

Fig. 4. A fenestration included in the scleral area of the lens.

Scleral area. The fenestration may also be included in the scleral zone to relieve lens suctioning (*Figure 4*). In this case, the lens needs to be flattened where the hole is included to avoid conjunctival tissue penetrating the hole and occluding it, which would result in impeded functioning.

CHANNELS

Peripheral channels to prevent or minimize lens suction was described as early as 1968.[11] Channels will also allow a tear exchange, promoting corneal health (*Figure 5*). If lens suctioning persists, all this technology may be included in the same lens, including fenestrations in the limbal area, as well as in the scleral area and channels (*Figure 6*).

Photo: Karen Carrasquillo, OD

Fig. 5. Channels are included to reduce and avoid lens suction.

IOP

It has been reported that corneal edema is correlated to an increase in intraocular pressure (IOP). Epithelial edema appears as soon as IOP significantly increases and progresses as IOP rises.[12,13]

Recent studies have found similar results, showing that an IOP increase causes damage to the endothelial cells and their density, provoking edema.[14,15] Even though IOP was not demonstrated to be exceedingly high with scleral lens wear, it is essential to monitor IOP at follow-up visits and eventually manage its increase.[16]

HYPERTONIC SOLUTION USE

Severinsky et al. proposed using hypertonic saline (5% NaCl) to accelerate the recovery of edema when it occurs. If edema persists, a topical 5% NaCl solution may be used during scleral lens wear.[17] However, exercise caution when using hypertonic solutions as they may foster the survival of *Staphylococcus aureus*.[18]

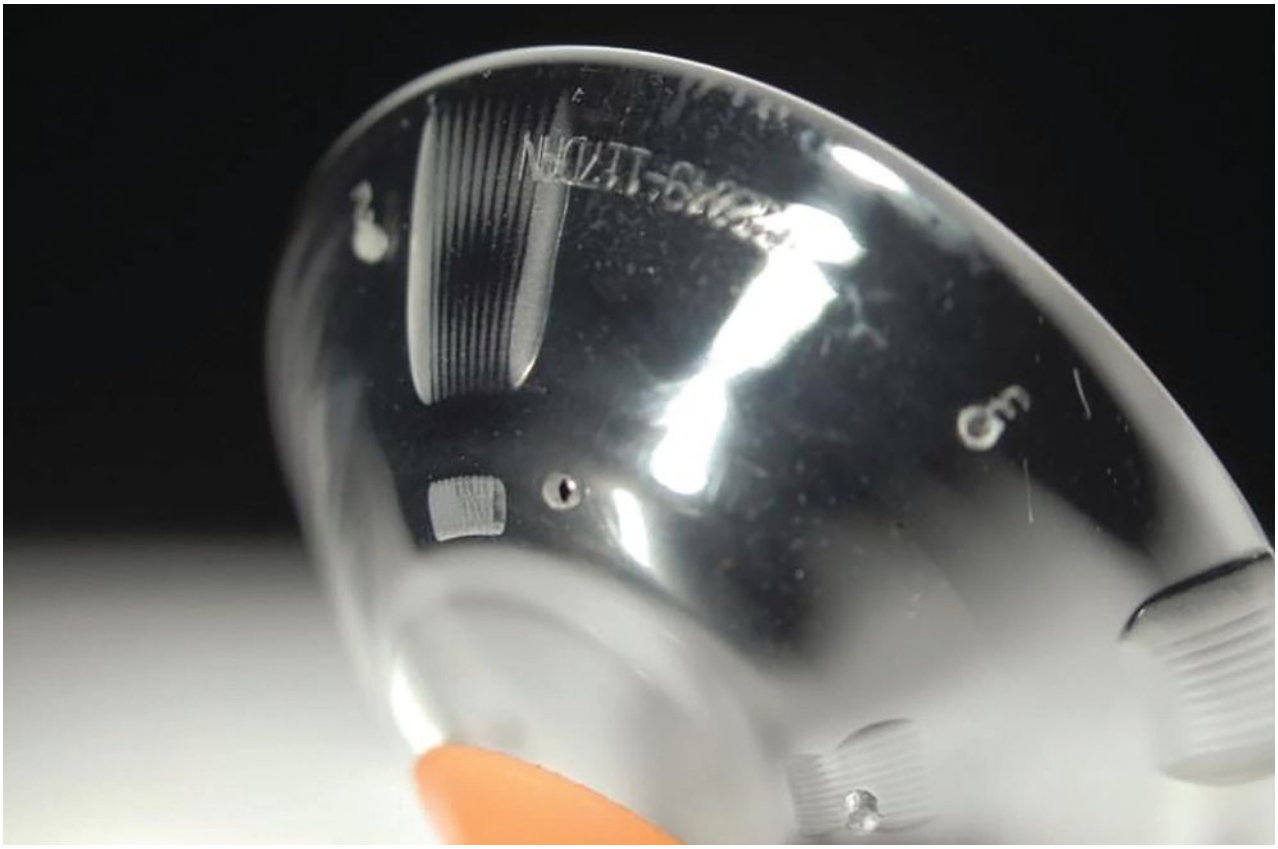

Photo: Karen Carrasquillo, OD

Fig. 6. Fenestrations in the limbal and scleral areas as well as channels were all included to reduce lens suction.

WEAR TIME

If corneal edema persists despite changing lens material, optimizing lens fit and monitoring IOP and osmolarity, reduced wear time may be indicated in patients who desperately need their lenses, although only for a few hours per day. Scleral lenses may be worn for four hours daily, allowing edema to recover during the following awakening hours.

TAKEAWAYS

While corneal edema may occur when wearing scleral contact lenses, there are different ways to mitigate this risk. Strategies like selectively picking lens material, lens thickness, lens design and fitting, customization including fenestrations and channels and monitoring IOP can especially help in patients at higher risk of its increase. If edema persists, hypertonic saline may be used or wearing time may be reduced, allowing corneal thickness recovery. RCCL

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Encourage Patients to Opt for DAILY DISPOSABLES

Educating lens wearers on the various benefits of this modality may help them understand its value.

By Ian Whipple, OD

Though more patients have been trading in their reusable contact lenses for daily disposables in recent years, there are still many who have yet to make the switch. For some, this hesitancy may arise from a lack of education on the advantages of daily lenses, while others may have unexplored concerns regarding the higher price point.

To get more patients on board with dailies, it's an important responsibility of the optometrist to educate patients on the distinct features and pros and cons of both disposable and reusable lenses. While patients frequently cite cost as a reason to stick with reusables, clinicians can assuage this concern through clear and honest communication with the patient, being sure to stress the value of disposable lenses aside from the price.

As an optometrist and owner of two private practice locations in suburban Utah, I have found that patients only feel like they've overspent on contact lenses if they don't understand the value of what they've purchased. With consistent patient education, you can equip contact lens wearers at your practice with the information they need to determine which lens modality might best suit their needs and expectations.

While optometrists hold the primary responsibility for educating patients on disposable vs. reusable contact lenses during their exam, staff members also play a crucial role in continued patient education. Therefore, eyecare staff, along with the optometrist, need to be armed with accurate and compelling evidence to promote daily disposable lens success at their clinic.

Here, I'll offer advice on how ODs and their staff can educate and encourage patients to give disposable lenses a chance, which may also help drive profitability at your practice.

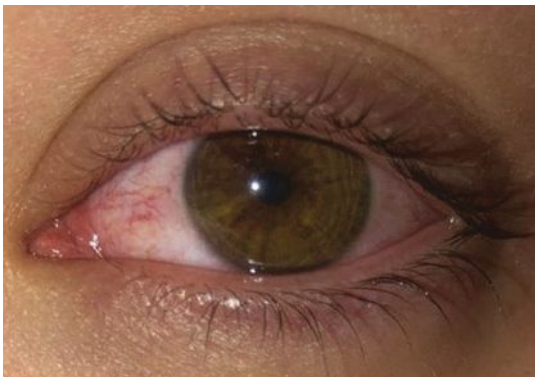

Photo: Jennifer Harthan, OD

Since more patients have began using daily disposable lenses at my practice, the incidence of contact lens-associated red eye has significantly reduced.

EXAM ROOM EDUCATION

Today, daily disposable contact lenses are recognized by eyecare professionals as the safest and most convenient contact lens modality based on the results of various clinical studies. However, unless we communicate the potential advantages of daily lenses to our patients, they may be unaware of their value. Below are a few topics to consider discussing with the reusable contact lens or spectacle wearer in your chair.

Infection risk. While the rate of content lens–related ocular infections such microbial keratitis and *Acanthamoeba* keratitis is not significantly different between patients wearing daily vs. biweekly or monthly

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lenses, research has shown that dailies do seem to reduce the severity of these infections.[1]

To explain to patients how risk of infection compares between lens types, one of our associate optometrists, Todd W. Mumford, OD, describes how he might approach the conversation in the exam room.

"Contact lenses absorb our tears, which is good," he tells the patient. "Anything else that lenses absorb—like pollens or air pollutants, for example—aren't so beneficial Compare a new kitchen sponge with one that has been used for a whole month. Does an old sponge still smell great or look the same? Well, that's essentially what we're doing with a monthly lens. Yes, you may be disinfecting and removing them every night, but by its very nature, the lens is absorbing things. A daily disposable lens reduces this worry."

It's also helpful to point out that the FDA recommends that children use disposable rather than reusable lenses due to the reduced risk of infection.[2]

Compliance. Daily lens wearers are the most compliant when compared with biweekly or monthly lens wearers, though rates of overnight wear are similar across all lens modalities.[3] Not only can good compliance benefit the patient, but it may also increase revenue for your practice, explained Pamela A. Lowe, OD, in an article for *Review of Optometric Business* on how to reduce contact lens dropout.[4]

"The average spectacle-only lens wearer returns for comprehensive eye care approximately every two to three years, and the average contact lens wearer returns in 12 to 18 months," Dr. Lowe reported in her article. She then cited research showing that "compliant contact lens wearers return three months sooner than noncompliant wearers, and compliance increases with frequency of lens replacement (two-week replacement: 34% compliance rate; monthly: 67%; daily: 87%)."[4]

Dr. Mumford and two of our opticians at the contact lens insertion/removal station at Vision Source of Farr West, where we show patients how to safely insert and remove contacts during their evaluation.

One study also found that reasons for noncompliance vary based on lens replacement frequency.[5] The data showed that "forgetting which day to replace lenses" was a main contributor to noncompliance in monthly and biweekly lens wearers, while those wearing dailies often cited cost savings as the reason for their noncompliance.[5] Therefore, patients wearing reusables who struggle with remembering to replace lenses on time—especially elder patients or young children—might particularly benefit from dailies.

Flexible wear schedule. This potential benefit of disposable vs. reusable contact lenses may be especially advantageous for those who have work or home life schedules that vary from day to day, which is a reality for many following the COVID-19 pandemic. Shane Foster, OD, explained in an article for *Review of Optometric Business* that since the start of COVID-19, he's noticed that many of his patients have switched up their contact lens wearing habits due to the rise in remote work.[6] He pointed out that, in his practice, the pandemic has "brought many long-time contact lens wearers in for an updated pair of glasses because their work-from-home schedules found them wearing their spectacles more frequently."[6]

Consider discussing this advantage of disposables with your patients who choose part-time lens wear and/or have varying daily or weekly schedules. Dr. Foster pointed out in his article that "it's a great option because [these patients] don't have to worry about how long a pair of lenses may have been sitting in solution in a case. They can get a fresh, clean pair of lenses each time."[6]

Cost considerations. Although the higher sticker price of dailies is a common deterrent for patients who currently wear reusable lenses, there are numerous other considerations that play a role when comparing the value of different lens modalities.

For example, disposable lenses are the only type that don't require additional costs for cleaning, disinfecting and storing. Biweekly or monthly lens wearers spend up to $150 to $200 a year on contact lens solutions, a cost that is eliminated when a patient switches to dailies.[7]

It's also much cheaper to replace a lost or damaged daily contact lens than it is to replace a monthly one. This could be an enticing selling point for patients or parents of younger children who tend to lose or misplace their contacts more often.

ENCOURAGING PATIENTS TO OPT FOR DAILIES

Rebates may also significantly reduce the monthly cost of dailies for some patients, though the exact amount of savings is variable. Having an optician reiterate this possibility to the patient during the cost presentation post-exam could help alleviate some of their concern about the upfront costs.

One critical point is to be transparent with patients about pricing. After a contact lens evaluation, opticians at our office present patients with the total amount they're going to spend that day, the price of a year's supply and the exact amount that insurance is contributing, as well as any discounts that are available to them if they order the lenses through our office. This prevents cost surprises, allows patients to understand exactly where their money is going and helps them build trust in you and your staff.

If patients are hung up on the price of dailies, it's helpful to stress that contact lenses are an investment that keep our eyes healthy, improve vision and enable us to better perform everyday tasks. Plus, with the lowered risk of severe infection, it's even possible that daily lenses could help to avoid unexpected eyecare costs and visits for certain patients over time.

Environmental concerns. Patients who are trying to reduce their ecological footprint may object to the amount of waste created by disposable products; however, they may be pleased to know that there are greener ways to wear daily lenses. While contact lenses and blister packs can't be recycled locally, they can be collected and periodically sent to TerraCycle for recycling (visit terracycle.com for more information). The program is sponsored by Bausch + Lomb, but all brands of lenses and blister packs are accepted. Additionally, the cardboard boxes that daily lenses come in can simply be recycled as usual.

CooperVision has also partnered with a company called Plastic Bank, which pulls plastic pollution out of coastal communities for recycling.[8] The production of CooperVision's microplastics is offset by recycling other plastics already out there, making for a net-plastic-neutral contact lens. The following CooperVision lens brands are now net-plastic-neutral and may be better-suited options for your more environmentally cautious patients: Clariti 1 Day, MyDay, MiSight 1 Day and Biofinity.[8]

TRIAL PERIOD PEARLS

Our contact lens patients who are trialing a new lens are encouraged to wear them daily for one to two weeks before returning for a contact lens follow-up evaluation. This allows the eyecare practitioner and the patient to recognize the success of daily lens wear, as well as gives support staff an opportunity to educate and close the sale. An estimated nine out of 10 patients in our office recognize after a week or two that the comfort and convenience of daily lenses exceeds that of reusables, and they return excited and ready to purchase their lenses.

Patients switching from biweekly or monthly to daily lenses might take several weeks to notice an improvement in comfort. This is usually because daily lenses offer patients the feeling of a clean, fresh lens every day, whereas monthly lenses tend to wear out throughout the month. You or an optician at your practice can help patients recognize improved comfort by reiterating what the patient has shared so far about their experience. Point out that the patient has been wearing the new lens for a couple of weeks and reports that they are still comfortable.

There are certainly some patients with reusable contacts or spectacles who are hesitant to trial dailies. I encourage these individuals that a lens they haven't previously tried can reset expectations. As for patients who do opt for the trial, some recognize immediately that there may have been comfort or convenience issues with their biweekly or monthly lenses that they simply didn't notice until trialing daily lenses.

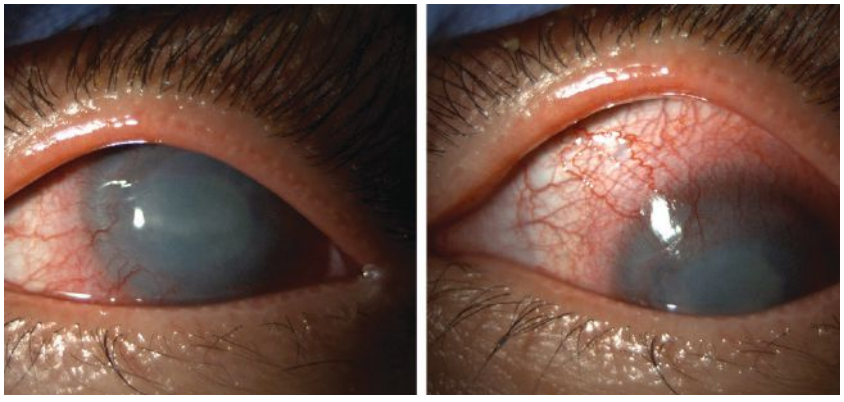

Photo: Suzanne Sherman, OD

Daily lenses can significantly reduce (but not eliminate) patients' risk of severe infections such as *Acanthamoeba* keratitis.

FINAL CONSIDERATIONS FROM A PRACTICE OWNER

In 2013, roughly 10% of our lens sales from my two clinics were daily disposables. Today, that number has surpassed 70%. As patients embrace modern daily lenses, I have seen clinical improvements in ocular health. For example, I have treated significantly less contact lens–induced acute red eye response, giant papillary conjunctivitis and infil-

trative keratitis over the last decade since a greater portion of my patients have made the switch to dailies.

Daily disposable lenses do cost more on average than monthly lenses, but remember to explain to your patients that a portion of that cost differential is minimized due to rebates and lens care supply savings. A patient should easily recognize the value of the remaining cost differential if they have a positive contact lens evaluation experience.

Patients frequently tell me that they love wearing comfortable and safe contacts, and I often reminisce with patients about the days when they felt like they were wearing "rocks in their eyes." Modern practices should embrace modern technology. Many offices have made significant investments in diagnostic equipment. Why do we sometimes fail to offer the latest contact lens options with daily disposable lenses?

Lastly, for our practice, daily disposable lenses have proven more profitable. According to my recent pricing analysis, our office can net $100 or more per spherical daily disposable annual supply compared to a spherical monthly lens annual supply.

TAKEAWAYS

Patients will understand the value of daily disposable lenses when the advantages of these truly cutting-edge contact lenses are frankly discussed during the exam process. Contact lens trial experiences and full transparency of cost can help prove value to patients. They will appreciate your progress towards improved vision and comfort when they're given the opportunity to wear comfortable daily disposable lenses, and you'll ultimately generate more income by also doing what's right for the patient. RCCL

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Keeping Up with Contact Lens Wearers

Here's how to avoid dry eye-related dropout in a post-pandemic age.

By Mahnia Madan, OD, Mark Eltis, OD, and Jaclyn Garlich, OD

Many patients prefer to wear contact lenses over glasses because they provide a more natural experience and correct refractive error without covering the eyes. A survey conducted in the United Kingdom found that the top reasons for wearing contact lenses were freedom and self-confidence.[1] In another study, 80% of consumers agreed that wearing contact lenses makes them feel more confident.[2] This indicates that, despite practical applications, aesthetics are king.

Fig. 1. Patient with eyelash extensions and blepharitis.

DRYNESS AND DISCOMFORT

Usually, if the contact lens is well-fitting, patients can barely feel it. However, in those affected by dry eye disease (DED), contact lens wear can become uncomfortable. As many as 36% of new contact lens wearers drop out of lens wear due to discomfort.[3] A survey conducted by the University of Waterloo included 1,444 contact lens dropouts and found that the primary reasons cited for discontinuation were discomfort, dryness and red eyes.[4]

Changing the contact lens material, design and fitting characteristics will only improve patient comfort to a certain degree. Patient success with contact lens wear is actually hinged on identifying and appropriately treating blepharitis and the ocular surface.

COVID-19 forced meetings that were once face-to-face into the virtual space of Zoom. Many people were stuck at home with little else to do but use electronic devices. This created another "epidemic" of exponentially more prevalent DED.

Now that the world has somewhat returned to normal, patients are wanting to wear their contact lenses more consistently. Many have discovered that their use of screens during the last few years has aggravated their dry eye and made them far less tolerant of contact lens wear.

ABOUT THE AUTHORS

Dr. Madan has over 17 years of experience practicing medical optometry and managing dry eye patients. She is the president of BC Doctors of Optometry and a lecturer at Pacific University College of Optometry. She is a consultant for Lumenis, Myedrop, Thea, Labtician, Sun Pharma, Santen and Abbvie.

Dr. Eltis practices in Toronto and teaches at the University of Waterloo. He is president of the College of Optometrists of Ontario and the Canadian Ambassador for the American Board of Optometry. He is a consultant for CooperVision, Sun Pharma, Volk, Heine, Myedrop, Labtician, Thea, Zocular and Aequus Pharmaceuticals.

Dr. Garlich runs a dry eye clinic that she built within her primary eyecare practice, Envision Optometry, in Boston. She is a consultant for Aldyera, Allergan, Bruder, Dompé, Kala Pharmaceuticals, Lumenis, Novartis, Orasis, Oyster Point, SleepTite/SleepRite, Tarsus and Thea Pharmaceuticals.

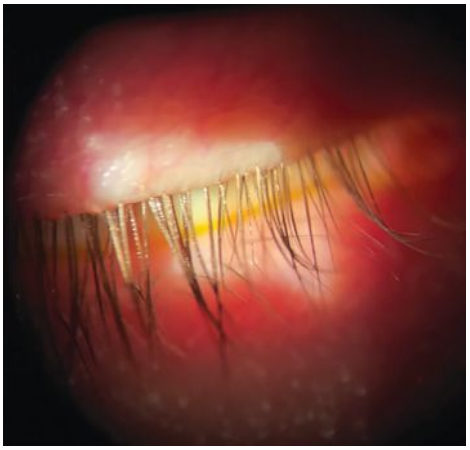

Fig. 2. Patient with incomplete lid closure due to lower lid retraction.

So, how do we keep our patients in their lenses? It starts with taking a good look at the ocular surface.

EXAMINATION

When a contact lens wearer has dry eye complaints, it may be tempting to assume it is simply the contact lens and refit them into the latest technology.

Start by implementing a dry eye questionnaire for all your contact lens wearers. Questionnaires like the Standard Patient Evaluation of Eye Dryness (SPEED), Ocular Surface Disease Index (OSDI), Dry Eye Questionnaire (DEQ) and Contact Lens Dry Eye Questionnaire (CLDEQ) can help gauge symptom severity and establish a good baseline. The scores can also guide your technician on the need for extra testing, which can help with clinic flow, efficiency and profitability.

One of the major culprits of dry eye is systemic medication use. Unfortunately, some of the most commonly used drugs are the biggest offenders. Oral contraceptives, antihistamines and antidepressants are major contributors. While patients may not be able to modify their drug therapies, we can manage expectations and adjust our DED treatments to better accommodate any aggravating factors.

A thorough dry eye evaluation can add very little time to your exam especially if you know what to look for before you begin. With *Demodex* present in roughly 58% of dry eye patients and meibomian gland dysfunction (MGD) present in 86%, a close look at the eyelids is a critical starting point in all your contact lens patients.[5,6] *Figure 1* shows a patient with eyelash extensions and blepharitis.

Start your exam with the patient's eyelids closed to look for lagophthalmos and floppy eyelid syndrome, which will elicit symptoms of morning dryness. Figure 2 shows a patient with incomplete lid closure due to lower lid retraction. In addition, a subtle finding that can lead to patient discomfort is incomplete blinking. Without prompting your patient to blink, observe their blink pattern as you proceed through the exam.

Next, examine the lashes for the presence of debris/biofilm indicating staphylococcal blepharitis and/or collarettes, which are pathognomonic for *Demodex*. With the patient's eyes open, scan the lid margin looking for eyelid telangiectasia and MGD. Consider pushing on the lids to observe the meibum that excretes. MGD leads to poor meibum quality and production, causing tear film instability. This also contributes to the inflammatory cycle of DED and inevitably leads to contact lens intolerance and dropout. Figures 3 and 4 show a patient with MGD.

Vital dye testing is an inexpensive way to gain valuable information. Sodium fluorescein will highlight damaged corneal cells, and lissamine green penetrates damaged conjunctival cells to stain the nucleus.[7] These tests are important to conduct on all your contact lens patients. Also, use the dye to detect the potential occurrence of an imprint of the lens on the conjunctiva, indicating a poor-fitting lens.

Eyelid eversions are beneficial to look for papillary reactions and lid wiper epitheliopathy that may lead to contact lens intolerance. Examination of the cornea for staining, scarring, neovascularization or active inflammation can provide insight into previous lens wear habits or ocular surface conditions and guide lens material selection and patient education to maximize compliance.

Common conjunctival conditions can also play a role and compound dry eye. Studies have demonstrated normal tear secretion but decreased tear breakup time (TBUT) with pingueculae.[8] TBUT was also substantially increased after a single excision.[8] This highlights the potentially significant impact of pingueculae on tear film stability and its underestimated role in dry eye.[8]

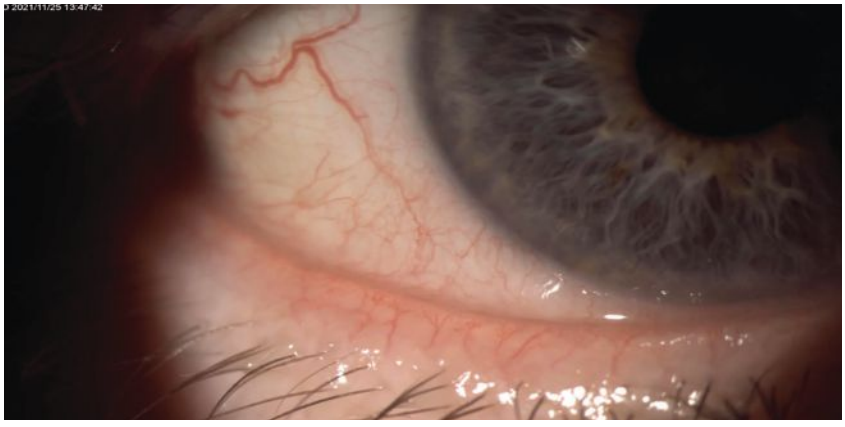

Fig. 3. Patient with ocular rosacea and eye telangiectasia contributing to MGD.

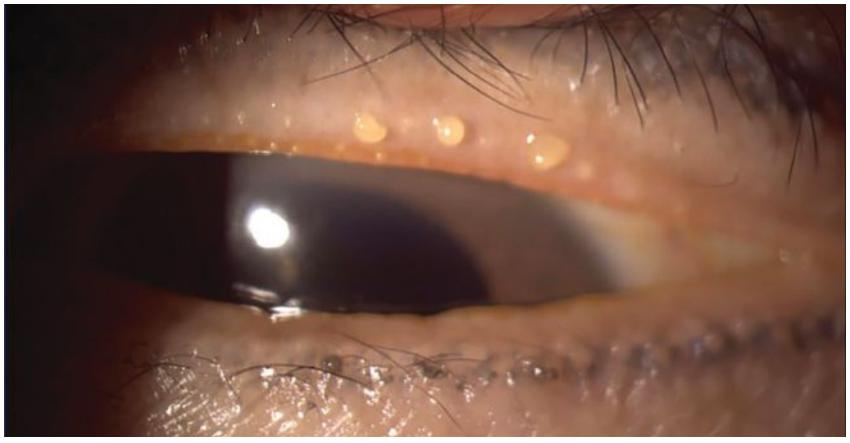

Fig. 4. Patient with poor meibum, resulting in MGD.

Carefully looking for additional aggravating factors like conjunctivochalasis is also important. These structural changes alter tear coverage and can create an environment that is ripe for swelling and irritation with increased friction from DED.

Advanced testing like MMP-9, tear osmolarity and meibography can help further guide treatment and are important tools for patient education and buy-in.

TREATMENT

By the time your patient presents, they will have likely already tried over-the-counter artificial tears. For mild cases, this may suffice; however addressing the root cause will result in better outcomes. Even when your contact lens patients tell you everything is fine, often they are far from it. Interestingly, these patients may ask about alternative options such as refractive surgery. A history of contact lens intolerance may be a predictor of post-LASIK dryness and should be part of the preoperative discussion.[9]

Noncompliance with contact lens care is common; studies suggest that 40% to 70% of patients fall into this category.[10] Healthy contact lens wear depends on many factors, including age, sex, lens brand, smoking habits, cleaning regimen and wear schedule.[10] Higher rates of complications were associated with men, youth, smokers, longer periods of wear, a lack of hand washing and internet purchase.[10]

Noncompliance with the manufacturer's recommended frequency of replacement of contact lenses is highest among teenagers and non-silicone hydrogel wearers.[10]

Patients using hydrogen peroxide solutions were found to be more compliant with their contact lens replacement schedule, perhaps because the care regime is more complex and demanding.[10] Daily disposables were found to be associated with the lowest rate of complications in general. They also have lower risks for severe contact lens–related microbial keratitis and associated vision loss.[10]

All patients should be educated on the importance of UV protection to avoid complications associated with such exposure such as pingueculae.[8] Contact lens wearers who are dry eye sufferers may especially benefit from such precautions.[8]

For patients with staphylococcal blepharitis, at-home treatments that target lid hygiene with hypochlorous spray are excellent at removing debris and biofilm. For *Demodex* blepharitis, lid hygiene that includes tea tree oil has proven beneficial. One particularly exciting drug in the pipeline is TP-03 from Tarsus Pharmaceuticals, which is a treatment for *Demodex* blepharitis. The active ingredient is lotilaner, which causes paralysis and death of the *Demodex* mite. The company's Saturn 1 and 2 data showed a clinically meaningful collarette cure in 89% of patients.[11]

For patients with lagophthalmos, a simple treatment can be the use of gel tears or ointments at night. For more advanced cases, sleep goggles and/or lid tape can help keep the eye closed while sleeping, alleviating morning dry eye symptoms.

For patients who are more symptomatic or who have moderate levels of MGD, combining in-office treatments with at-home management will lead to better results. In-office blepharoexfoliation, similar to in-office dental lid cleaning, can help. Both automated devices like Blephex and manual options like Zocular Zest can be helpful. Manual expression and debridement can also be used in concert to provide a more comprehensive in-office treatment. More advanced in-office thermal pulsation therapies for MGD include LipiFlow (Johnson + Johnson), iLux (Alcon) and TearCare (Sight Sciences). One study found an improvement in contact lens wear after a single in-office thermal pulsation treatment.[12]

Intense pulsed light (IPL) therapy for the treatment of MGD is an effective option that produces results patients can see and feel. IPL uses light energy to destroy abnormal telangiectatic blood vessels, which are a reservoir of inflammatory mediators, thus removing a significant source of inflammation from the eyelids and meibomian glands. IPL also helps kill *Demodex*, soften meibum and improve meibomian gland structure and function over time.[13]

Rosacea sufferers with associated ocular surface disease are ideal patients for IPL treatment. This does have limitations, however, with only certain skin types meeting the criteria

for treatment (Fitzpatrick skin types I through V). Studies suggest combining IPL with lid debridement and meibomian gland expression to create a "force multiplier" and help improve DED symptoms and meibomian gland function.[13]

Another option to consider in lens wearers is the use of immunomodulators to help reduce inflammation in DED. There are currently four FDA-approved immunomodulators on the market. The BID dosing is convenient, as patients can use these drops before they put their lenses on in the morning and after they remove them at the end of the day. For patients who are not keen on using drops, Tyrvaya (Viatris) nasal spray may be a good option.

Punctal occlusion to increase tear volume may be especially beneficial in contact lens patients. Punctal plugs can help reduce dependency on artificial tears while preserving the patient's natural tear film and increase the effectiveness of other DED medications by retaining them longer on the ocular surface. One study found that punctal plugs used in conjunction with cyclosporine provided longer symptomatic relief than either treatment on its own.[14]

Punctal plugs can be a key player in patients who suffer from neurotrophic, aqueous-deficient dry eye or non-resolving persistent epithelial defects, as is the case in patients affected by lagophthalmos.

Fig. 5. Preparation of platelet-rich plasma eye drops.

Before reaching for punctal plugs, though, it is important to manage ocular inflammation first with other methods. Punctal plugs are contraindicated when there are signs of active infection or allergies present. Plugs are also not ideal in patients with blepharitis or meibomianitis, as these patients need management of their lid disease first.

When patients present with moderate to severe dry eyes with significant punctate keratitis, we can turn to blood biologics to help "rescue" and rehabilitate the ocular surface. The two most common drops available in this field are autologous serum and platelet-rich plasma eye drops. Both have been successfully used in the treatment of moderate to severe DED; however, research suggests platelet-rich plasma eye drops are superior in restoring the ocular surface.[15] Figure 5 shows preparation of these drops.

When drawing the patient's blood is not an option, amniotic membranes can also be considered. These come either cryopreserved or dehydrated.

While advanced DED patients may not be able to wear contact lenses full time, appropriately treating the ocular surface will give them the freedom to wear them for certain activities, a gift they will truly appreciate.

TAKEAWAYS

Not addressing ocular surface disease in your contact lens patient can have a domino effect. Cycling through lens after lens eats up valuable chair time, and you are likely losing more contact lens patients than you realize. The number of new contact lens wearers each year is roughly equal to the number of contact lens dropouts despite improved comfort and technology with soft contact lenses, as we now know that contact lens dropout is mainly due to ocular discomfort.[16]

However, those statistics don't have to be your outcomes. Being proactive about treating your dry eye patients makes sense as a business strategy and keeps your patients in their contact lenses longer. RCCL

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By Christina Cherny, OD, and Suzanne Sherman, OD

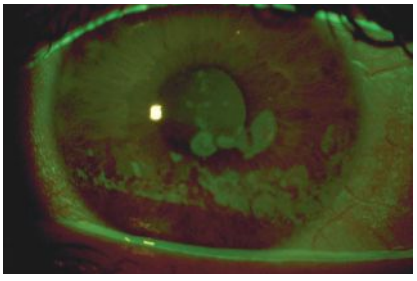
Immune Issues

Dealing with graft-vs.-host disease can cause a dysfunctional ocular surface. Learn what the symptoms are and how to mitigate them.

A 48-year-old Caucasian female presented to the cornea service for an ocular surface check in the setting of ocular graft-vs.-host disease (GVHD), following allogeneic hematopoietic stem cell transplants (HSCT) for recurrent T-cell lymphoma. At the present visit, the patient endorsed new GVHD involvement of the gastrointestinal tract but denied any involvement of other organ systems and was currently off all systemic immunosuppressants. The patient continued to report persistent symptoms of severe ocular dryness, pain, photophobia, visual blur and sensitivity to wind and ambient environments.

Prior treatments, including punctal plugs, cautery of all four puncta, topical Restasis (cyclosporine 0.05%, Allergan) BID, autologous serum tears six to eight times a day, preservative-free artificial tears six times a day, Celluvisc (carboxymethylcellulose sodium 1%, Allergan) gel drops PRN, ocular ointment QHS OU and heat application with hot eye mask provided minimal relief. The patient previously initiated a scleral contact lens fitting with an outside provider but was unable to proceed due to cost. Additional ocular history included excision of a left upper eyelid hemangioma, posterior subscapular cataract in the left eye and nuclear sclerotic cataracts in both eyes post phacoemulsification, with intraocular lens placement post YAG capsulotomy in both eyes as well.

At the present visit, Schirmer scores were 2mm in each eye, and her dense interpalpebral keratopathy, according to the National Eye Institute grading scale, was 7/15 in the right eye and 15/15 in the left. The patient was instructed to continue her current topical lubrication regimen as well as heat application, and a same-day appointment was booked in the specialty contact lens service to initiate a scleral contact lens fitting.



Coarse epithelial keratopathy: a common indication for scleral lens wear in OGVHD patients.

At this visit, the patient was fit into BostonSight scleral lenses, and they were observed to yield excellent comfort in both eyes. They also provided adequate vision with over-refraction (BCVA 20/20 OD/OS) and adequate vault but a loose fit 360° in both eyes. Based on evaluation of this diagnostic lens fitting, a pair of lenses was ordered, and the patient was instructed to return for a dispense visit with insertion and removal training; the patient was also advised to purchase +1.50 OTC readers to be used over the contact lenses.

In several subsequent visits following the initial dispense, the fit was modified slightly by reducing lens diameter and steepening edges to reduce edge lift, with commensurate reduction in lens movement and awareness. Vision was adequate in both eyes—20/20-2 in the right eye, 20/25-2 in the left eye—and continued to improve further, reaching 20/20 in both eyes as keratopathy improved.

Over the course of the next several visits, the corneal surface of both eyes continued to clear and the patient continued to report striking improvement in ocular comfort and vision. She endorsed complete resolution of photophobia and the ability to tolerate ambient environments, like windy conditions, which she was unable to do for several years prior.

OCULAR GVHD

A fairly common complication of allogeneic HSCT, GVHD is a major contributor to morbidity and mortality after treatment. In GVHD, classified as either acute or chronic, a dysregulated immune response targets host organ systems, including skin, mouth, eyes, lungs, gastrointestinal (GI) and genitourinary tracts, leading to organ fibrosis and dysfunction.[1-4]

Ocular GVHD, although a rare manifestation of acute GVHD, is the most common long-term complication with an incidence of about 30% to 60% in patients following HSCT, as well as about 60% to 90% in patients with systemic GVHD involvement.[1,2,5-7] Risk factors for ocular GVHD include concurrent skin, mouth, lung, GI or liver GVHD involvement, pre-existing diabetes, Epstein-Barr virus-positive donors, female donors for male recipients and the use of peripheral blood stem cell or bone marrow vs. cord blood transplantation and ethnicity, with Asians and other recipients more likely to develop ocular GVHD compared with Caucasians.[2,6-11]

In ocular GVHD, dysregulated host immune response damages lacrimal glands, eyelids and the ocular surface via a T cell-mediated inflammatory cascade, resulting in keratoconjunc-

tivitis sicca and cicatricial conjunctivitis.[1,12] On clinical presentation, patients may note symptoms consistent with dry eye disease, including ocular dryness, grittiness, pain, irritation, foreign body sensation, redness, photophobia, tearing and/or visual blur; these symptoms often negatively impact quality-of-life and daily activities.[1-3, 13-16]

Patients with acute-onset ocular GVHD may present with less severe clinical signs, such as conjunctival injection or chemosis. However, many cases present more severe signs, including pseudomembranous or hemorrhagic conjunctivitis, corneal epithelial sloughing, keratitis, filaments or lagophthalmos.[1,2,13,17-19]

In chronic cases, corneal clinical signs range from punctate keratopathy to epithelial erosions or defects which may rapidly progress to stromal thinning, melting or perforation.[1,2,20] Chronic inflammation and fibrosis may lead to development of filamentary keratitis, corneal neovascularization, limbal stem cell deficiency and neurotrophic ulceration.[1,2,21,22] Conjunctival and eyelid clinical manifestations include hyperemia or chronic and/or cicatricial conjunctivitis with associated entropion, ectropion, trichiasis, poliosis, keratinization, subepithelial fibrosis, symblepharon, ankyloblepharon eyelid laxity and/or lagophthalmos. Less commonly, pseudomembranes are seen in chronic cases.[1,2,18,23]

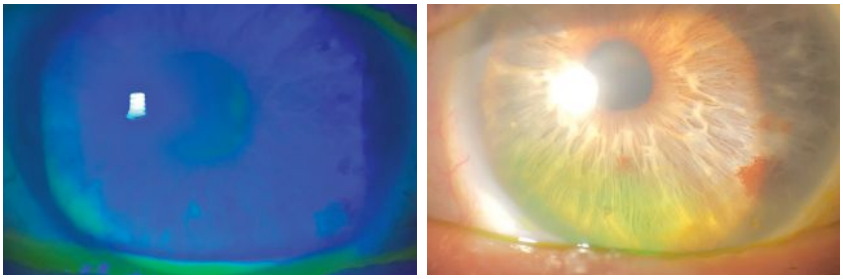
Additional clinical findings may include subtarsal fibrosis of the upper tarsus or superior limbic keratoconjunctivitis, like inflammation due to frictional microtrauma and nasolacrimal duct obstruction.[1,24-26] Infiltration and fibrosis of the lacrimal gland and destruction of the meibomian glands contribute to aqueous tear deficiency and unstable tear film, further contributing to ocular surface disease.[1,2,27,28] Ocular inflammation in chronic cases may also rarely manifest as episcleritis, anterior or posterior scleritis, anterior or intermediate uveitis, cataracts or serous choroidal detachment.[29]

Multiple diagnostic criteria exist for ocular GVHD. To diagnose, it is helpful to evaluate tear meniscus height, tear breakup time and tear production by Schirmer testing. Looking at meibomian gland function by means of clinical appearance, manual expression and/or newer modalities such as meibography, tear interferometry, *in vivo* confocal microscopy or tear film osmolarity are also helpful.[1,2] The NIH recommends a baseline ophthalmic examination about 100 days post-transplant and routine monitoring at least every three to 12 months of patients with confirmed ocular GVHD.[1,30]

THERAPEUTIC APPROACHES

Systemic immunosuppressants, like corticosteroids, are often employed for GVHD; however, they may fail or become associated with relapse.[1,31] Treatment of ocular surface involvement in GVHD aims to improve tear film quality and corneal epithelial integrity, as well as to reduce ocular surface inflammation.[1,31] Frequent instillation, at least four times daily, of topical, preservative-free artificial tears is necessary for surface lubrication. More viscous artificial gels and ointments may also be used, particularly at bedtime.[1,14,31,32] In cases of low tear production, such as with reduced tear lake height or Schirmer scores, tear production may be increased with topical cyclosporine or lifitegrast. This also increases conjunctival goblet cell density and decreases ocular surface inflammation. Other options include punctal occlusion, either by silicone or collagen plugs or with thermal cauterization.[1,29,31,33,34]

Blepharitis is managed with eyelid hygiene (*e.g.*, baby shampoo, lid cleansers) and warm compress application twice daily for at least 10 minutes.[1,31] Eyelid inflammation may be treated with topical corticosteroids or macrolides (*e.g.,* azithromycin) and systemic tetracyclines (*e.g.,* doxycycline), with application of topical tacrolimus also shown as effective.[1,31,35,36] In cases of severe ocular surface disease secondary to GVHD, autologous serum eye drops and/or bandage contact lenses (*e.g.,* sclerals) help to reduce signs and symptoms of dryness.[1,31,37,38]



Significant improvement in coarse epithelial keratopathy following scleral lens wear for OGVHD.

Immune Issues

(Continued from p. 31)

Partial lateral tarsorrhaphy, amniotic membrane transplantation and limbal epithelial stem cell transplantation have also been reported in severe cases.[1,31,39,40] Adjunctive therapy may be used as appropriate, like the use of topical N-acetylcysteine with present filamentary keratitis, instillation of topical cenegermin or topical insulin for neurotrophic keratopathy, epilation of trichiatic lashes and management of ocular hypertension and cataracts that may result from frequent corticosteroid use.[1,31,41]

GVHD is increasing in incidence due to advances in HSCT and a rise in HSCT usage for varied hematological conditions.[1,2] Given the high prevalence of ocular surface involvement in patients who have undergone this procedure, it is imperative for eyecare providers to recognize the signs and symptoms early on and treat aggressively in order to maintain ocular surface structure and function, as well as preserve patient comfort. RCCL

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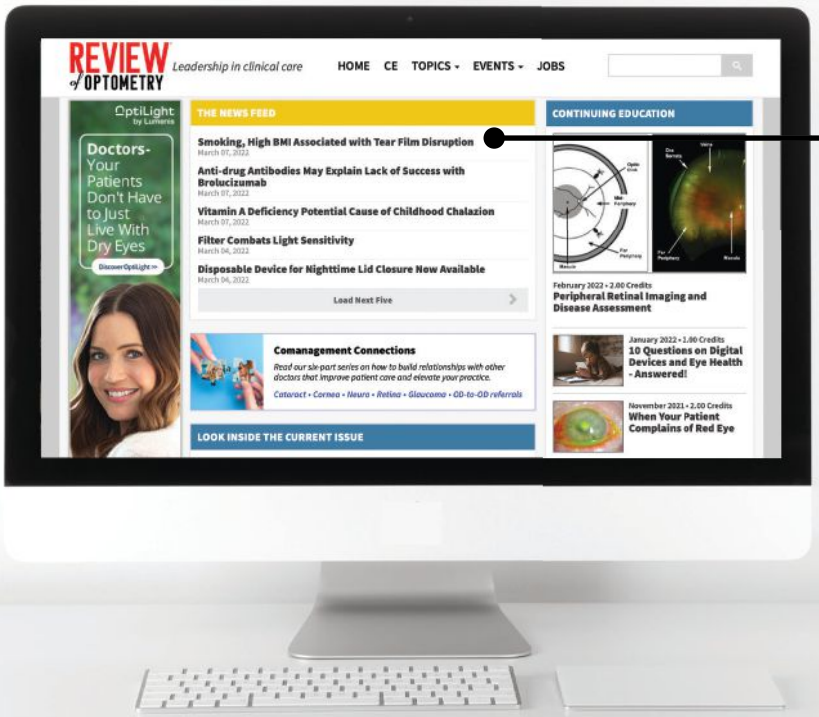

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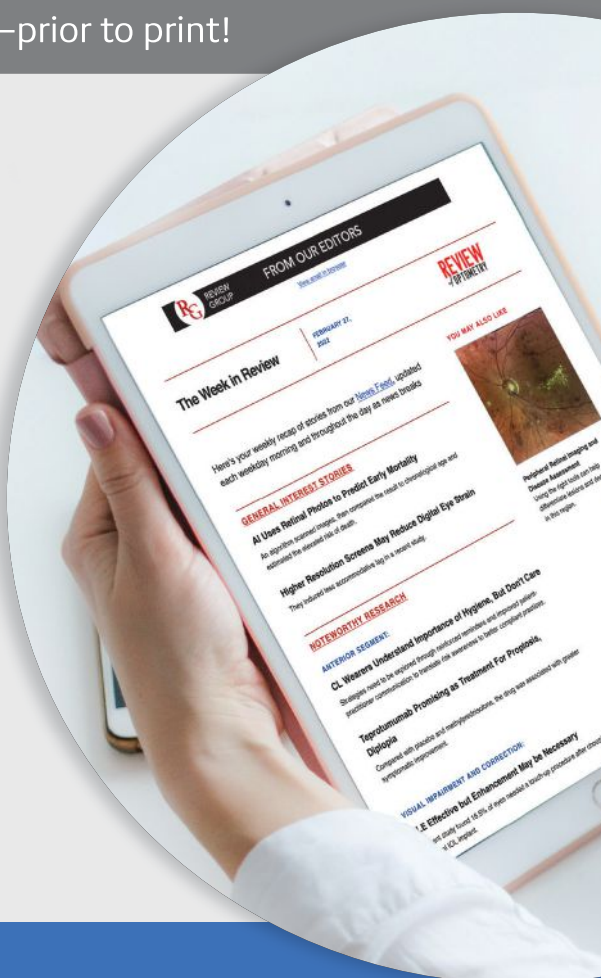

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By Christine W. Sindt, OD

Watch That Splotch

Here's what to be vigilant for in cases of iris pigmentation.

A 26-year-old female presented for a comprehensive exam and contact lens fitting. Her ocular exam was remarkable for a large iris nevus covering the inferior half of her right eye. The patient reported that her eyes have always been two different colors. The pigment appeared shallow with mammillation over the pigmented surface. She did not have a pigmented sclera or pigment around her eyes. She had large optic nerves with 0.8 cupping OD and OS, with inferior and superior nerve fiber layer thinning OD>OS. Her pressures were 17mm Hg OU. Visual fields were full OU.

The differential diagnosis of iris pigmentation includes iris freckle/nevus, iris melanocytoma, iris melanocytosis and iris melanoma. Iris freckles and nevi are just an increase in melanin pigment and not a precursor to melanoma; however, having three or more freckles is associated with an increased risk of cutaneous melanoma.[1] If corectopia or iris ectropion is present, there is an increased concern for uveal melanoma.

An iris melanocytoma will have a large area of brown homogenous pigment with a granular surface, and there may be seed pigment around it. In such cases, there is a small risk for developing melanoma; however, there is an additional risk of developing glaucoma.

Iris melanocytosis is a congenital condition where the uvea gets too much pigment. It can be complete or sectoral, with tiny micronodules (mammillations) in the pigmented area. The sclera and periocular skin may also have pigmentation. There is a 1:400 risk of developing melanoma.[1]

All iris pigment should be monitored for evidence of growth, vessels in the pigmented lesion, pigment seeding in the angle, evidence of tumor in the ciliary body or elevated IOP. Any pigment covering more than three clock hours is suspicious.

Our patient had a complete glaucoma work up, including gonioscopy, echography of the ciliary body and photodocumentation. She will continue to be monitored at six-month intervals. RCCL

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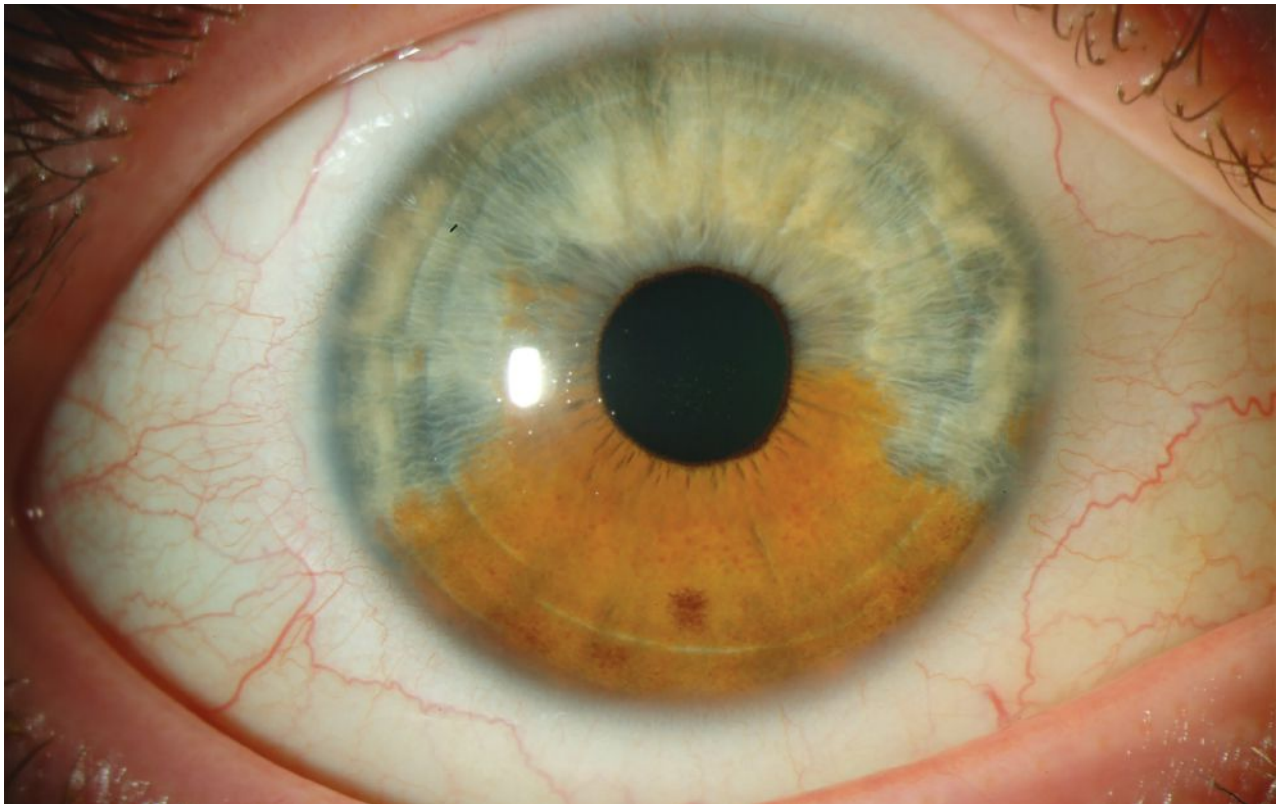

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