RCCL
REVIEW OF CORNEA & CONTACT LENSES
JANUARY/FEBRUARY 2024

HITTING *The* TARGET *With* GP MULTIFOCALS

With dozens of good options these days, you can find one suited to just about every patient. Turn to page 16 to read our report on the 2024 lineup.

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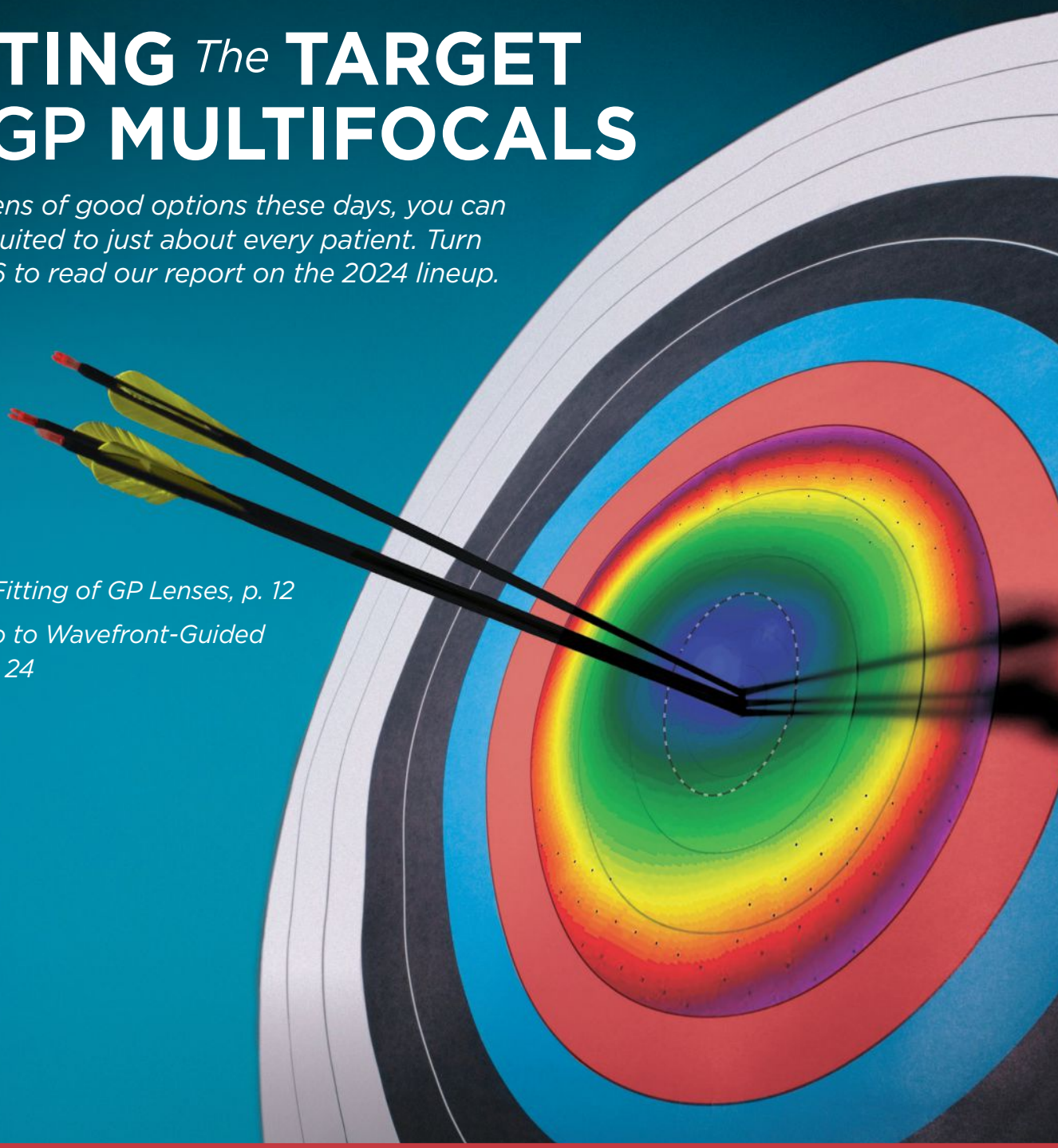

ALSO

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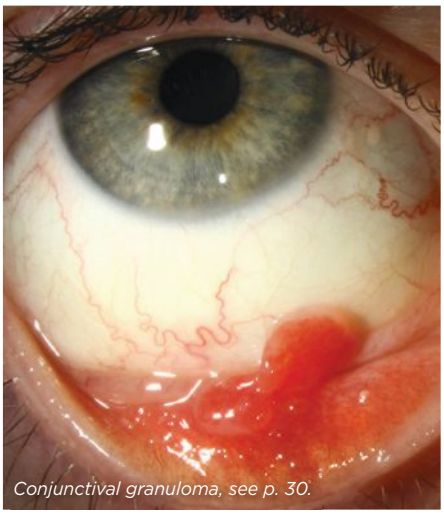

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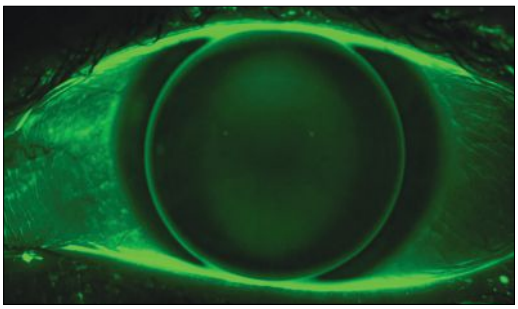

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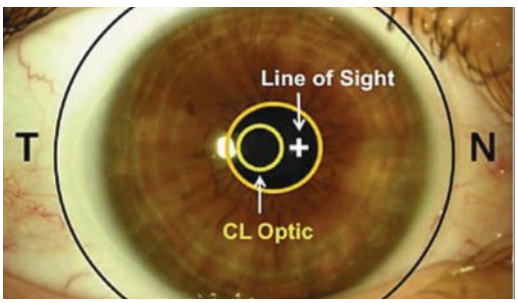
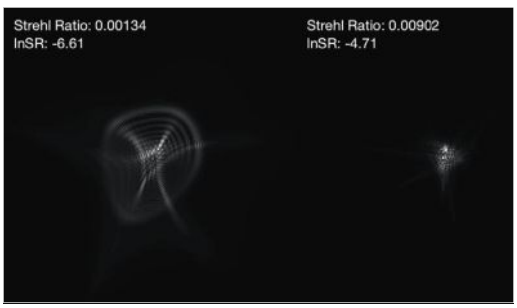


24 Wave Hello to Wavefront-Guided Sclerals

These lenses are a great option for those with residual higher-order aberrations but also can be used to create excellent multifocals.

By John D. Gelles, OD, and Travis M. Pfeifer, OD



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Postoperative LASIK Ectasia Exhibits Distinct Pattern

Using higher-order aberration maps, researchers identified inferior paracentral "hot spots" as identifiable characteristics of this surgical complication.

LASIK is nearly always safe, but the risk of post-op ectasia still looms, especially for those with thin corneas. Doctors with access to a wavefront aberrometer may be able to pick up this complication sooner, a new study suggests.

Included were 28 eyes of 22 post-LASIK ectasia patients. All HOA maps exhibited an arrangement of two elliptical paracentral ablation islands in direct mirror-like opposition to each other, one deep inferior and the other shallow superior. The deeper, inferior island was in the inferior quadrant in 100% of eyes and temporally in 92.3% of eyes, while the shallow, superior island occupied the superior quadrant in 100% of eyes and nasally in 68.0% of eyes.

The deep inferior paracentral island "hot spot" corresponded with the topographical apical POE cone and was highly reproducible in angular position. Ablation depth varied, as well as depth of superior crescents. Both paracentral ablation islands stayed within a 3.4mm diameter central ring. The corneal irregularity index and ablation depth difference between deep and shallow paracentral islands strongly correlated.

The researchers state in their paper that "while the use of wavefront aberration metrics is not new, the novelty of our work lies in the characterization of the HOA ablation map and its potential value as a diagnostic and monitoring tool for post-op ectasia."

They suggest these maps are useful to provide data on position, eccentricity, depth, orientation and shape of anterior corneal HOAs, unlike Zernike whole-eye HOA values. They may also be used to quantify post-LASIK ectasia severity. The amount of coma reflected by corneal irregularity increased as the difference between ablation depth of both deep and shallow ablation islands increased; thus, the difference of depth between the two islands may be a novel metric to quantify severity.

"The corneal HOA ablation map can potentially yield new information to diagnose, grade and monitor" post-LASIK ectasia progression before and after CXL, the researchers concluded.

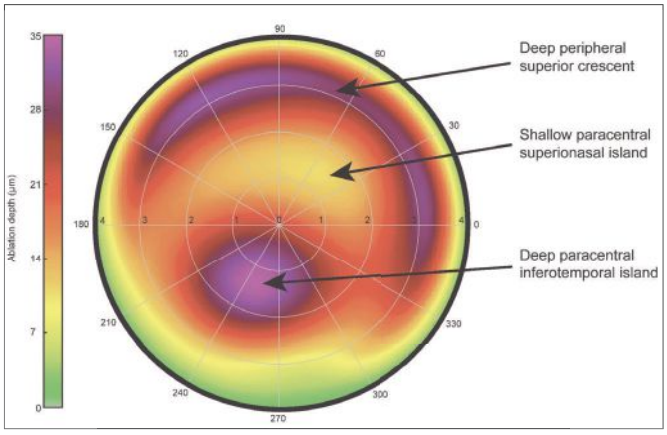

Photo: Wallerstein et al. BMC Ophthalmol. 2023;23:517

As in keratoconic eyes, postoperative ectasia often manifests with an inferiorly displaced cone, a unique and highly recognizable pattern on an HOA ablation map.

Wallerstein A, Santhakumaran S, Tabunar L, et al. Characterization of postoperative LASIK ectasia features on higher-order aberration excimer ablation maps. BMC Ophthalmol. 2023;23:517.

DSO Procedure Shows Durability Through Seven Years Post-op

A small cohort of Fuchs' patients who underwent this new surgery had increased central endothelial cell count and improved BCVA and CCT at final follow-up.

In Fuchs' endothelial disease, the gold standard for treatment has long been Descemet's membrane endothelial keratoplasty (DMEK). However, a newer procedure—Descemet's stripping only (DSO)—that requires no donor tissue has gained popularity in recent years. A recent retrospective study reported on the technique's long-term durability on a small cohort of patients with up to seven years of follow-up.

Included in the study were 26 eyes (20 patients) that underwent DSO at some point during a seven-year period (mean age: 73; mean follow-up: 23.7 months). Eligibility criteria included peripheral endothelial cell count above 1000 cells/mm^2 and symptoms caused by central guttata. The researchers described in their *Cornea* paper that "patients underwent a central circular 4mm descemetorhexis using a reverse Sinskey hook and a pair of descemetorhexis forceps using a peeling technique." Preoperatively and at final follow-up, the following three parameters were measured: BCVA, central corneal thickness (CCT) and endothelial cell count both centrally and at the periphery.

Twenty-two of the 26 eyes responded to DSO. Some results included:

- The mean post-op BCVA improved from 0.3 logMAR to 0.09 logMAR.
- The mean CCT decreased from 588mm before surgery to 546mm post-op.
- The mean post-op central endothelial cell count was 780 cells/mm^2.

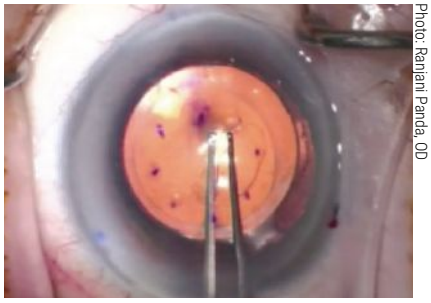

Photo: Ranjani Panda, OD

Twenty-two of 26 eyes with Fuchs' responded to DSO in this study.

- Peripheral endothelial cell count decreased post-op (1,837 cells/mm^2 pre-op to 864 cells/mm^2 post-op).
- Peripheral endothelial cell polymegethism remained stable.
- Average peripheral endothelial cell polymorphism decreased post-operatively (63.1% pre-op vs. 33% post-op).

While the sample size in this study was small, several conclusions can be drawn from its results, the researchers argue. First and foremost, the largely positive long-term outcomes observed add to the growing evidence that DSO is a viable treatment option for patients with Fuchs'. Secondly, the results reinforce that suitable candidates are patients with central guttata and a good peripheral cell count (1000 cells/mm^2).

This new research adds to the growing vault of evidence that DSO is an effective, durable option for select patients with Fuchs' endothelial disease. The authors suggest that future studies may help to understand prognostic factors and improve patient selection.

Rizk M, Dubois M, Elahi S, et al. Long-term follow-up of Descemet stripping only: data up to 7 years postoperatively. Cornea. December 26, 2023. [Epub ahead of print].

IN BRIEF

■ A new study found that **lung cancer patients treated with EGFR inhibitors, especially second-generation afatinab, may be subjected to a 50% or greater increased risk of keratitis.**

"Notably, keratoconjunctivitis, a common presentation in dry eye disease, was a frequent subtype observed in this study, suggesting that **EGFRi-treated patients may have a higher risk of dry eye disease,"** the researchers wrote in their paper, published in *JAMA Ophthalmology*.

When seeing patients undergoing treatment for lung cancer, **it's important to clarify which medication(s) they are taking to assess the potential risk for keratitis.** EGFRi-associated ocular effects require prompt diagnosis and management to prevent serious complications or treatment disruptions, the authors urge.

Huang P, Lin C, Dana R, Ma KS. Epidermal growth factor receptor inhibitors for lung cancer and the risk of keratitis. JAMA Ophthalmol. January 11, 2024. [Epub ahead of print].

■ Using a Pentacam device to assess the pigmented arc in children's corneas could help improve ortho-K efficacy, new research shows. Since the pigmented arc is always located in the inferior reverse curve area, it may indicate lens location on the cornea during lens wear.

The analysis included 62 eyes. The data showed that **age statistically correlated with annual AL change.** Also, the annual AL change was **negatively associated with the relative vertical distance of the lowest density of pigmented arc point based on the visual center, pupil center and corneal thinnest point after adjustment with age.**

"In the condition without Pentacam, clinicians can still observe the relative vertical distance from the most obvious point of pigmented arc to the pupil center under a slit lamp to evaluate the efficacy of myopia control," the study authors wrote.

Kuo YK, Chuang LH, Lai CC, et al. Exploring the location of corneal pigmented arc and myopia control efficacy in orthokeratology-treated children using Pentacam measurements. Eye Cont Lens. January 9, 2024. [Epub ahead of print].

By Becky Su, OD, Travis M. Pfeifer, OD, and John D. Gelles, OD

Scan, Prescribe, Succeed!

Profilometry-based scleral lenses for pesky pinguecula.

A 56-year-old man presented with a history of keratoconus OS>OD. He had a history of corneal cross-linking OU and has been wearing corneal RGP lenses for approximately 10 years, reporting discomfort OU.

His entering acuity with habitual RGP lens wear was 20/30 OD and 20/25 OS. On manifest refraction, he was best-corrected to 20/40 and 20/50 with a prescription of pl-4.00x090 in the right eye and -0.50-5.50x110 in the left. Scheimpflug tomography (Pentacam Wave AXL, Oculus) showed an IS ratio of 4.00D in the right eye, 12.00D in the left eye and a maximum keratometry reading of 48.50D and 55.60D in the right and left eyes, respectively.

On slit-lamp evaluation, there was no significant corneal haze or scars present. His bulbar conjunctivas were white and quiet with small focal nasal and temporal pingueculae on each eye.

CONSIDERATIONS

Here, we highlight our thought processes and consider how we would proceed:

Dr. Su: This patient has a history of wearing corneal RGPs and reporting poor comfort with them. Looking at his tomography maps, it may be possible to refit the right eye with the same lens modality to improve the comfort. Refitting the left eye with another RGP may be more difficult, since the keratoconus is more severe and the IS ratio may cause the RGP to rock on the eye, making it less stable. If the patient is comfortable with switching lens types for both eyes, I would refit with a scleral, as this would likely improve comfort. As for the pingueculae, a scleral that lands on the elevation may also cause discomfort and irritation.

Another option would be to avoid the pinguecula altogether—this could be achieved by making the lens smaller. I usually don't like to start with this selection, though, as a smaller lens may put more pressure around the conjunctiva and subsequently cause irritation. Comparatively, the use of a larger lens provides the ability to better spread out pressure over a greater surface area. There are also options to microvault and notch, but depending on the ocular shape and size of the lesion, this may take a few lens iterations. Looking at his ocular shape from the profilometry scans, he has a lot of scleral toricity which can make the fit more complex, even in the absence of the pingueculae. To save chair time and increase first-fit success, there are newer methods like impression-based scleral lens designs and scan-based designs using scleral profilometry—if available, I would start here.

Dr. Pfeifer: Given this patient's history of successful RGP wear, my initial inclination would be an attempt to improve the fit of his RGPs

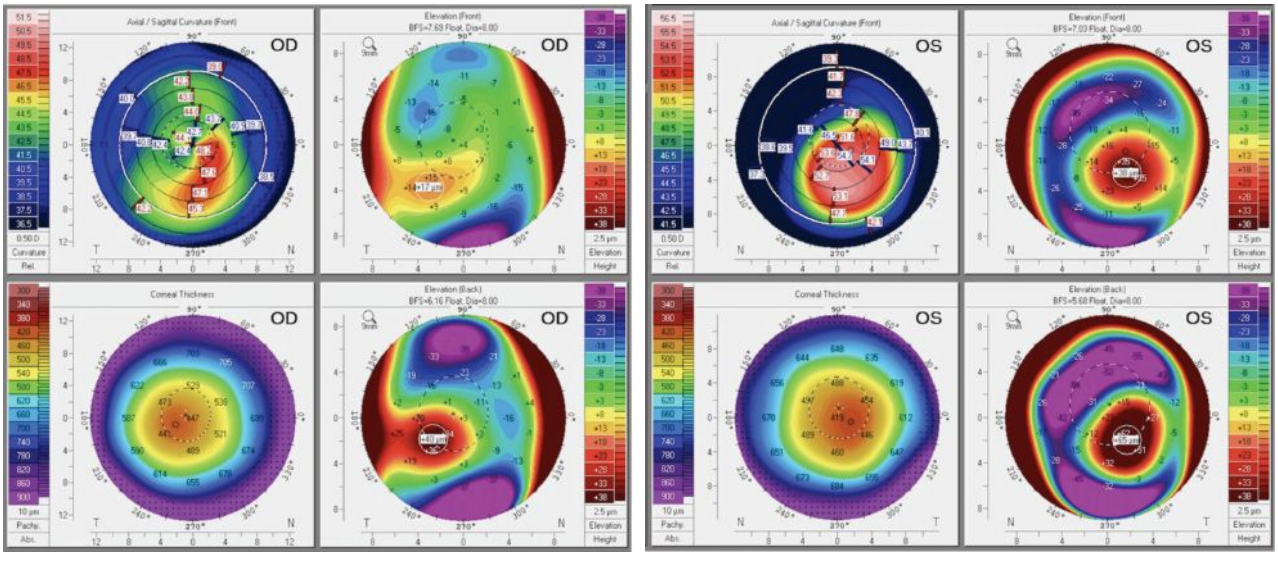

Fig. 1. Corneal tomography of the patient's right and left eyes.

to reduce his symptoms of discomfort. Though his keratoconus is more severe in the left eye, the anterior elevation differences in both the right and left eyes are below 350µm, thus predicting some degree of success in RGPs. Reducing the lens diameter, steepening the edges to reduce excessive movement or even just incorporation of a coating are all options that may dramatically improve his symptoms. Pingueculae can be a difficult bump in the road when fitting lenses, but a corneal RGP lens would perform well by avoiding these elevations altogether.

Conversely, a scleral lens may indicate compression over these areas that can often lead to discomfort. If the lens edge is flattened to avoid this compression, you run the risk of tear exchange around the edge of the pinguecula, which could not only lead to discomfort, but also post lens fogging. However, if the patient is unable to tolerate RGP wear, scleral lenses are still a viable option to pursue. In this case, my ideal lens would be a smaller diameter to avoid the elevations entirely. A larger-diameter lens incorporating a vault, notch or lift also has potential to be considered, taking the pressure off of the lesions. The downside of choosing a larger diameter is that it may require some troubleshooting to correctly orient the lens modification and vault the pinguecula.

There is also the option of an impression-based or a profilometry-based scleral lens. These more advanced options offer a higher degree of customization to accommodate these lesions; they would also account for the irregularity of this patient's scleral toricity to improve overall lens fit. Ultimately, the patient's motivation to either improve his current lens modality or try a new one will help guide how to proceed.

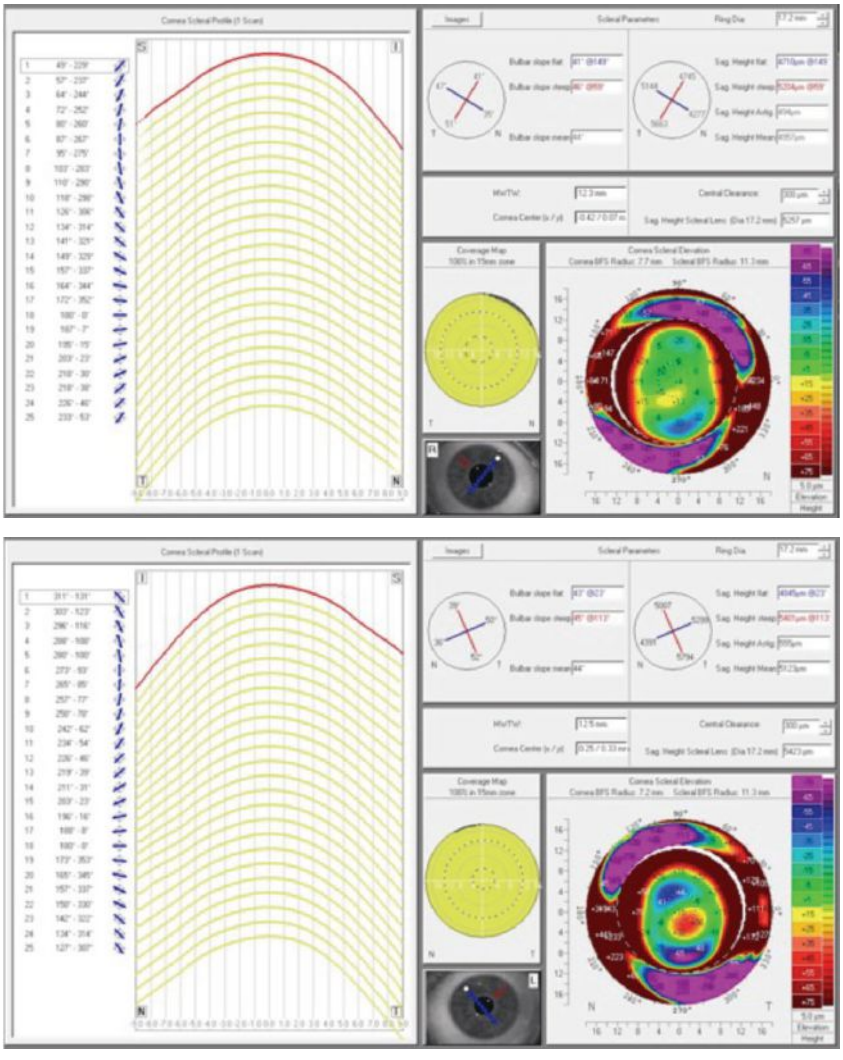

Fig. 2. Corneoscleral profilometry of the right (top) and left (bottom) eyes.

Dr. Gelles: If a scleral lens is the right lens modality for a patient with a pinguecula or another type of elevated obstacle, it will require the use of a focal custom haptic modification, such as a notch, peripheral elevation or channel. Typically, having to create a complex haptic shape takes longer. Using a scan-based scleral lens can be ideal in these cases, as it will get us much closer to an endpoint than the diagnostic lens-based design. But what if we are in a practice that does not have a device capable of capturing corneoscleral profilometry or even one that uses scleral lenses? This case could be handled in a variety of ways.

By Becky Su, OD, Travis M. Pfeifer, OD, and John D. Gelles, OD

Scan, Prescribe, Succeed!

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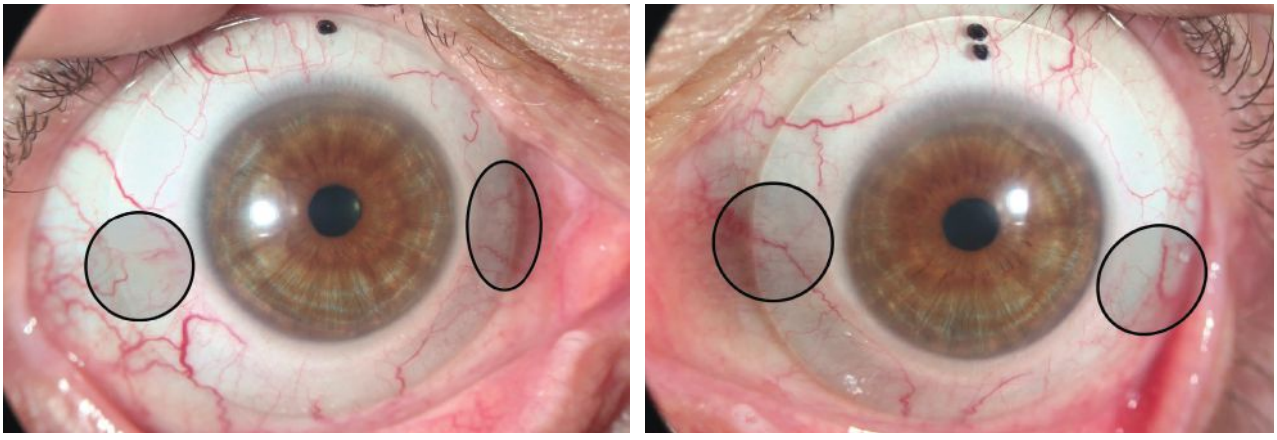


Fig. 3. Final scan-based sclerals. Note the lack of vessel compression over the small nasal and temporal pingueculae.

The first and simplest option to consider in the absence of sclerals is to create a piggyback system. This is achievable by taking a low plus power standard soft lens and placing it on the eye, then placing the patient's habitual corneal RGP on top of it. This can be trialed in the office, with the benefit of receiving immediate feedback from the patient. Even if this doesn't turn out to be the final choice, it could still give the patient improved comfort for the time being, as they wait for another lens design to arrive.

The next possible option would be the use of a hybrid lens, which may provide more comfort for the patient by improving lens stability and reducing lid interaction with the lens. Another reason to choose this design is because the soft skirt will contour to the pinguecula—no need for complex haptics.

Generally, if a patient is already struggling in a lens modality, I do not prescribe the same type of lens. However, if a corneal RGP is desired using scan-based software, it can be employed to make a freeform corneal RGP, which may elevate lens performance through improving fit and stability. If I am going to use the same lens modality, I make it a priority to educate the patient that the lens I am creating is designed by an entirely different process than the one they currently use. I don't want them to feel as if I am repeating options that have previously been tried and failed. Making sure to communicate this builds a higher level of trust and understanding.

This does require a corneal topographer capable of exporting data to lens design software, but I am going to assume that anyone prescribing or designing specialty contact lenses has a corneal topographer.

DISCUSSION

Pingueculae may present difficulties during scleral fittings. Compression of the lens on the lesion(s) can cause a suboptimal fit, leading to discomfort and potential long-term complications. Collaborating with laboratory consultants and using advanced options to customize the lens haptic can ensure that it conforms to these obstacles, guaranteeing comfortable and healthy wear over time.

RESULTS

The patient was diagnostically fit with a larger diameter, 19.0mm scleral (BostonSight Scleral), originally without special focal haptic modifications. Later, SmartChannels were added to help relieve pressure on each pinguecula. He was best-corrected to 20/25 OD and 20/20 OS. On follow-up, he reported good vision, but was experiencing fogging of the lenses after only three hours of wear. He also had an impression ring in both eyes with localized redness on the nasal side. Slit lamp findings showed the landing of the scleral lens on the nasal pinguecula with adjacent edge lift. Corneoscleral profilometry scans from the initial visit were reviewed and scan-based scleral lenses (BostonSight Smart360 Scleral, BostonSight, Needham, MA) were ordered for each eye.

At the subsequent follow-up appointment, the patient was able to achieve 20/20 vision OD and OS, reporting no more issues with lens fogging. He also experienced good comfort while wearing the lenses for 10 hours a day. RCCL

By Lindsay A. Sicks, OD, and Marin Nagelberg, OD

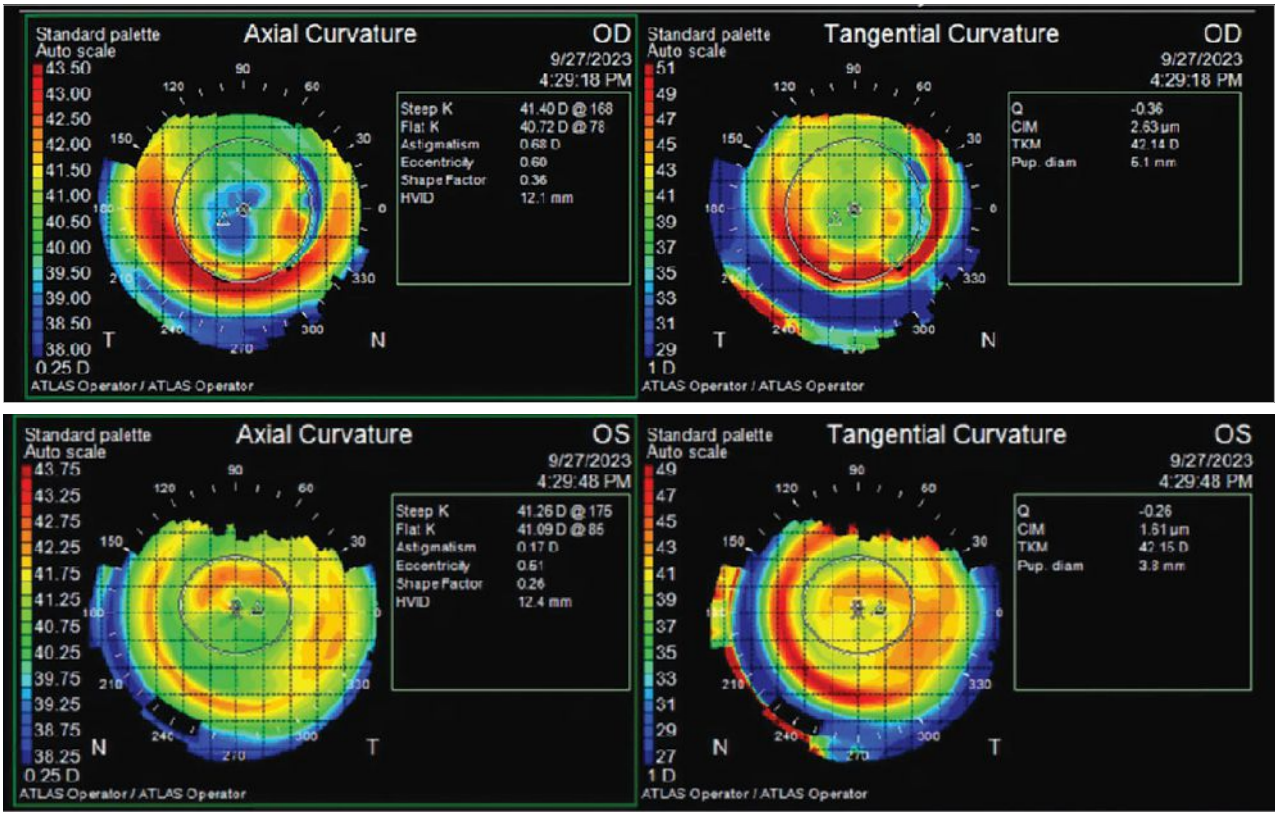
Not Just for Kids

Monovision orthokeratology can be very beneficial in adults, too.

With myopia management becoming a newly recognized standard of care (per the 2021 World Council of Optometry Resolution), orthokeratology (ortho-K) is becoming more mainstream in eyecare practices worldwide.[1] While used in myopia management for children, ortho-K can also be useful for correcting standard ametropia in adults seeking an alternative to spectacles, daily wear contact lenses and/or refractive surgery. If the adult patient is presbyopic, further consideration should be given to whether correction will be for distance vision (with use of reading glasses for near as needed), near-only (with use of supplemental glasses for distance) or monovision (correcting one eye for distance and one for near with the ortho-K lenses, with the possibility of needing glasses for intermediate vision and/or driving).

Monovision ortho-K is highly customizable and can be adjusted to give the patient more "span" (or difference) between the two eyes as needed. Best practice for monovision ortho-K fitting involves determination of the myopic patient's best manifest refraction, near add at the preferred working distance and dominant eye. From there, lenses can be ordered empirically or fit diagnostically from a fitting set. For the distance eye, the fit does not change from the typical procedure used in pediatrics, with a base curve flatter than the cornea at a level equivalent to the amount of spherical myopic refractive error plus a compression factor or "Jessen factor," which is added correction to account for natural regression toward myopia that occurs after lens removal and over the course of the day.[2,3] For near, the targeted correction is reduced by the amount of the patient's add power so that the near vision is maintained at the near point.

Keep in mind, the patient may complain (even if the fit is as you intend) of loss of intermediate vision;



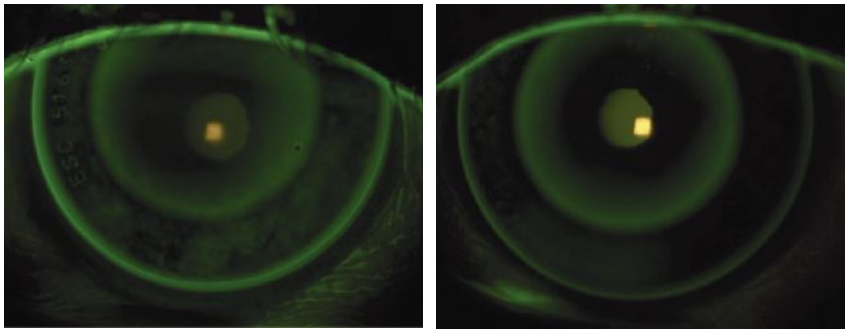
Topography (Humphrey Atlas) maps of entering ortho-K lens result showing a less distinct treatment zone OS (the near eye) on the tangential map (right).

By Lindsay A. Sicks, OD, and Marin Nagelberg, OD

Not Just for Kids

(continued from previous page)

this is consistent with the use of monovision. You can choose to adjust the base curve to compensate for this, but you may alter the patient's near visual acuity (VA) in the process. We recommend allowing distance VA to stabilize for two weeks. Then, perform an in-office over-refraction using the monocular in a binocular field approach, with loose lenses at the preferred working distance in order to determine the best add power for the non-dominant eye.



Entering lens fit in each eye (right eye distance, left eye near) showing a fairly similar bull's-eye pattern in each eye.

PATIENT CASE

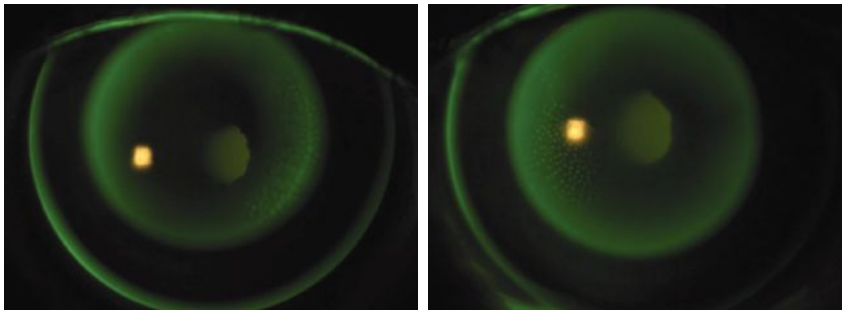
A 57-year-old African American female was fit with monovision ortho-K lenses at an outside office approximately 10 years prior. Her pre-fit refraction was OD -3.75 -1.50 x 085 and OS -4.25 -1.50 x 085. She had been a patient at our practice for many years with several lens adjustments made throughout, including a full refit into distance-only lenses in 2020 with readjustment of the near add following. She reported being generally happy with both distance and near vision since that time but still used +1.25 readers for "very small" print. Her main struggle was with intermediate VA and her goal was to be less reliant on reading glasses. Of note, one solution here could have been to have the patient use dissimilar adds or combining the lenses in two pairs of readers.

The monovision in this case was OD distance (the dominant eye) and OS near. The patient could achieve fairly good uncorrected distance VA in each eye with her habitual lenses worn at night. The Emerald Ortho-K lenses (Euclid Vision Corporation) gave entering uncorrected VA of 20/25 OU at distance and 20/30 OU at nearby late afternoon. The refraction was OD PL and OS -0.75DS with a +2.00 add.

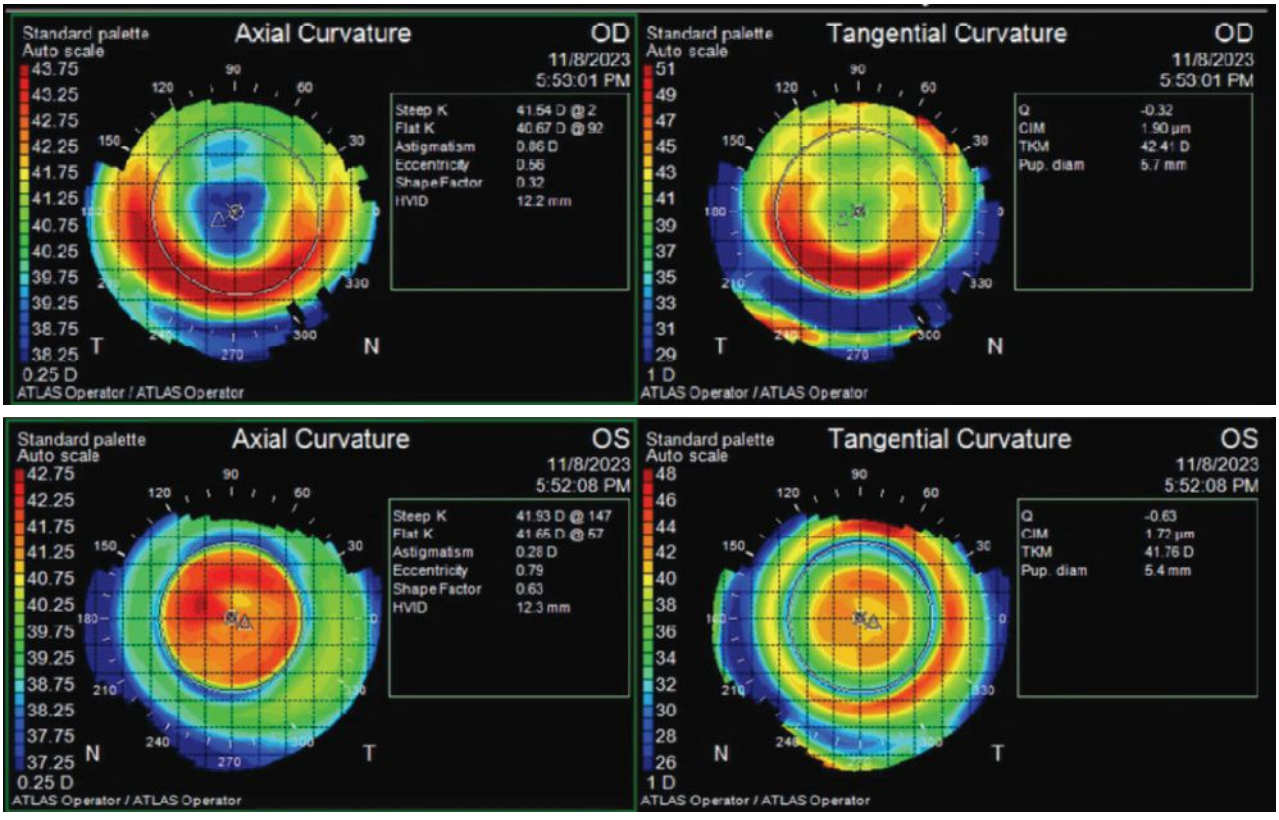
The lens parameters were OD +0.75DS/8.85 BC/10.60 diameter and OS +0.75DS/8.54 BC/10.60 diameter (cc 20/20-2 OD, OS). The refraction over-lens was +0.50DS OD and -1.00DS OS. The overall lens fit showed a bull's-eye pattern in each eye, and the topographies showed a centered treatment zone (though less distinct OS). (For reference, the initial BC OS was 9.0 to achieve true distance VA OS and was steepened to 8.54 to give the monovision OS near correction).

With the help of laboratory consultation, we worked to further increase the difference in correction between the two eyes since the entering distance VA was fairly similar and the patient complained of lack of intermediate VA. The goal was to achieve a "truer" monovision resulting in reduced distance VA OS in order to improve intermediate and near VA OU.

The new lens parameters were OD +0.75DS/8.85BC/10.60 diameter and OS +0.75DS/8.28 BC/10.60 diameter. With the new lenses worn for one night, daytime uncorrected distance VA remained 20/20 OD and was reduced (as anticipated) to 20/30 OS. At near, VA was 20/40 OD and 20/25+ OS. The refraction over-lens was +1.00DS OD and -1.50DS OS. The overall lens fit showed a bullseye pattern in each eye, with slight central pooling OS, as expected due to the steepened base curve adjustment.



Final lens fit in each eye (right eye distance, left eye near). Dimple veiling is visible in the reverse curve nasally in each eye. The OS treatment zone is less distinct as this is the near eye.



Topography (Humphrey Atlas) maps of new ortho-K lens result showing central steepening OS (the near eye), which corresponds to improved near acuity in that eye.

After wearing the new lenses for two weeks, the patient came back with distance uncorrected VA of 20/20 OD and 20/30 OS. At near, the VA was 20/40 OD and 20/25 OS. The O/R was consistent with that at the one-day visit. Topographies reflected a well-centered treatment zone for distance in the right eye, with a centered area of steepening in the left eye. The patient was overall satisfied with the improvement in near and intermediate VA.

At one-month follow-up, she presented with stable uncorrected VA. Her refraction was OD PL and OS -1.50DS. The main concern was that she was no longer able to use her +1.25D readers for the computer due to asthenopia OS. She was happy with the overall improvement in intermediate vision and felt more freedom from needing the glasses. Loose lens over-refraction was performed at the computer and resulted in +1.50 OD and plano OS. We prescribed this for computer glasses, but the patient could also easily trial it by popping out the OS lens from a pair of readers.

Monovision ortho-K can be a great option for presbyopes who do not want to wear contact lenses during the day. Patient selection is important, as is education that a loss of intermediate vision is possible—especially with increasing add powers. Despite this caution, monovision ortho-K can (mostly) free presbyopic patients from reliance on daytime distance correction and should be a consideration in presbyopes who are resistant to full-time wear of reading glasses. RCCL

The authors thank Abbey Cantolina at Euclid Vision Corporation for her assistance with this case.

1. World Council of Optometry. Resolution: The Standard of Care For Myopia Management by Optometrists. Accessed January 14, 2024. https://myopia.worldcounciloftoptometry.info/standard-of-care/.

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Empirical Fitting of GP LENSES

Advanced technology has paved the way for a quite easy and successful approach.

By Ed Bennett, OD

Empirical contact lens fitting is defined as the designing of lenses without the use of diagnostic lenses.[1] This is traditionally accomplished by providing refractive information supplemented by keratometry values to the fabricating laboratory. In 2024, the empirical fitting of gas permeable (GP) lenses has become more of the rule than the exception. This is the result of many advancements, including:

- The lenses are designed through a well-tested manufacturer's nomogram.
- The use of contemporary online calculators.
- The use of corneal topography data, which sometimes includes lens design software.
- Corneal-scleral topographers allowing for the ability to design scleral lenses empirically through profilometry.
- Improved manufacturing methods, including state-of-the-art lathing equipment.

As a result, most designs commonly used today can be successfully designed empirically, especially with the recent advancements in both instrumentation and manufacturing technology. These latter advances may ultimately result in the empirical fitting of all GP lenses in the future.

WHY EMPIRICAL FITTING?

It most certainly saves chair time, with both patients and eyecare professionals (ECPs) benefiting from not having an initial fitting visit with application and subsequent disinfection of multiple diagnostic lenses. Empirical fitting also eliminates any concerns over whether a practice's diagnostic lenses are properly disinfected and maintained.

Of course, a very important benefit is the powerful effect achieved when the initial GP lens worn provides very good vision. It would not be unrealistic to think that this "wow effect," which is not uncommon with initial GP lens wear, would actually detract from the perception of initial awareness and serve as a very good incentive for ultimate success in this modality. This is a powerful effect for both patients and ECPs.

With today's technology, a lens that has been empirically designed and subsequently manufactured can be customized specifically to the patient's corneal topography and refractive considerations. Combined with an ultrathin, reproducible edge and optimized edge clearance (often pseudo-aspheric) peripheral designs, empirically designed GP lenses are likely to achieve an optimal lens-to-cornea fitting relationship which, in turn, enhances patient satisfaction.

FITTING CHALLENGES

Traditionally, and even today in practices that still maintain a large number of fitting sets, diagnostic fitting was the preferred modality for GPs. It allowed for the ECP to "trial" a lens on the eye and evaluate the fit and change the design to optimize the fitting relationship if necessary. This is followed by a careful overrefraction, thus providing a level of confidence that the lens ordered will ultimately fit well, provide optimal vision and result in patient success.

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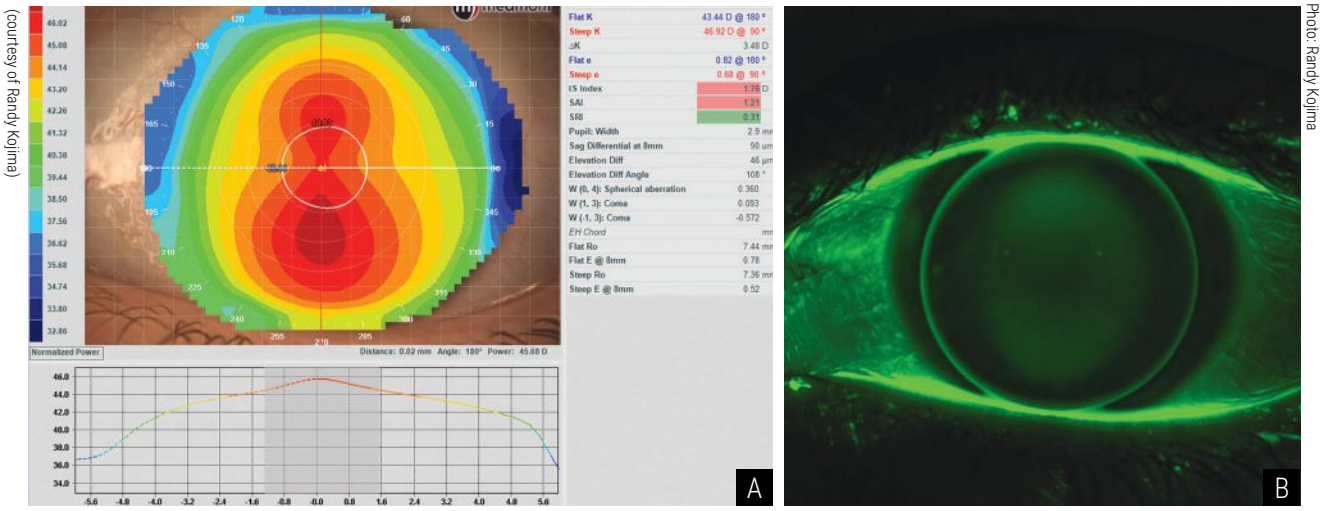


Fig. 1. (A) The topographical map of a patient. (B) The resultant empirical lens generated from the topographical and refractive information.

In the past, soft lenses were not available with both the quality and quantity of different refractive corrections. Limited technological capability of corneal topography software and laboratory fabrication methods (not as advanced) made empirical design less initially successful; therefore, diagnostic fitting was most certainly justified. In 2024, however, patients desiring contact lens wear expect to leave the office with lenses that will likely be successful after initial application. Diagnostic fitting is time-consuming, both for staff and the ECP, and time is money for a busy practice; certainly, this can serve as a disincentive to fit GP lenses in clinic.

There is also the "elephant in the room," which is, of course, initial comfort. If the patient's initial GP lens experience is with lenses that are not in their prescription, it would make sense that the resultant blurry vision would exacerbate any perceptions they have about the initial lens awareness. This could be quite disconcerting for both patient and ECP.

Diagnostic fitting sets themselves can pose several challenges. Each diagnostic lens is a standard design from the manufacturer and not necessarily custom-designed to provide the best possible lens-to-cornea fitting relationship, especially as you consider the advancements that have been made in recent years.[2] Secondly, there is the matter of storage space and disinfection upkeep for each fitting set which can represent a challenge in the contact lens supply room. Recent standards require the disinfection of all trial contact lenses following guidance provided by the International Organization for Standardization 19979.2018(E) and endorsed by the American Optometric Association Contact Lens and Cornea section and American Academy of Optometry section on Cornea, Contact Lenses and Refractive Technologies.[3] A practical, easy-to-use disinfection nomogram is available from the Gas Permeable Lens Institute.[4]

These standards are consistent with current COVID-19 concerns and the need to clean and thoroughly disinfect every diagnostic lens. However, these disinfection standards can be time-consuming to comply with, requiring attention to detail and appropriate logging.[2] Likewise, these lenses are typically stored in a dry state and need to be both cleaned and conditioned (preferably stored in a multipurpose solution) prior to initial application for optimal surface wettability.

HOW TO OPTIMIZE SUCCESS

There are myriad resources available to help ECPs achieve success in empirical fitting. A laboratory consultant can assist with lens selection design and troubleshooting. Since they manage their lab's designs on a daily basis, their guidance throughout the entire fitting process is invaluable. ECPs can easily transmit corneal topography information and lens fit photos and/or video, the latter simplified by the use of a slit lamp camera or mobile phone slit lamp adaptor. Careful refraction of the patient's refraction, lid position and pupil size are often helped in empirical design. Corneal topographers with lens design software, in particular, has been especially beneficial in empirical fitting with the ability to show the simulated fluorescein pattern such that an optimum fitting relationship would be likely after ordering the lens (*Figures 1a and 1b*).

APPLICATIONS

There are many applications for empirical GP lens designs and the use continues to increase. According to a recent survey, the empirical prescribing habits (vs. diagnostic fitting) resulted in five modalities that were predominantly fitted empirically.[5] This included multifocals (86%),

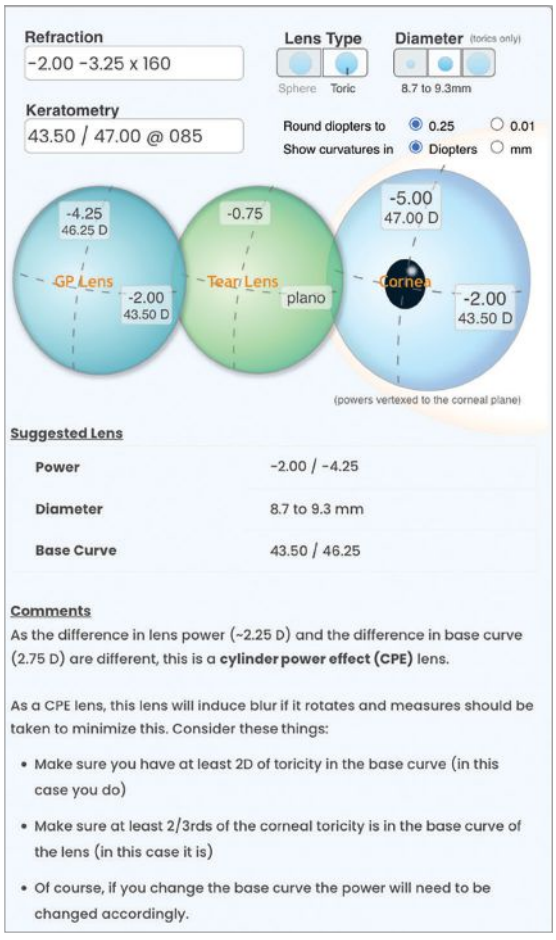
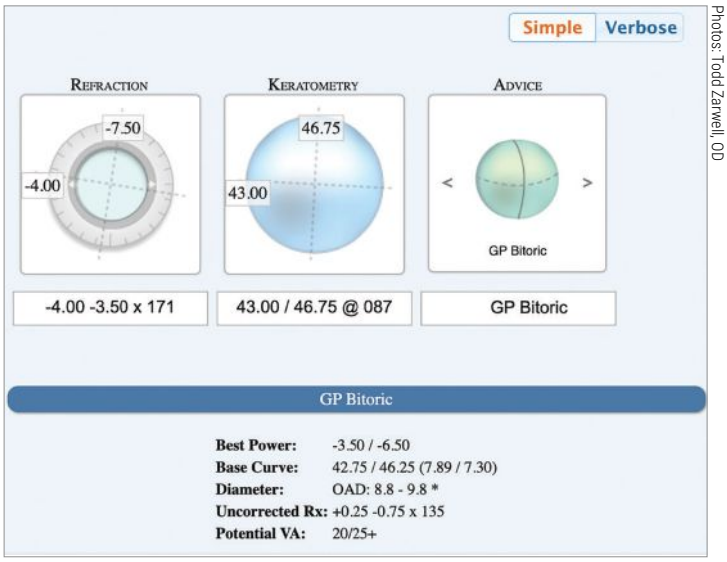


Fig. 2. A representative bitoric example using the GPLI Toric and Spherical Lens Calculator (Available at www.gpli.info).



Photos: Todd Zarwell, OD

Fig. 3. A representative bitoric example using the EyeDock Calculator (www.eyedock.com).

torics (83%), spherical (79%), corneal reshaping (71%) and hybrids (67%).

GP multifocals. There are a number of presbyopic patients—including spectacle wearers and those dissatisfied with their vision in soft lens multifocals—who could benefit from empirical fitting of GP multifocals. Aspheric designs, in particular, can both result in good first fit success.[6] An optimal fit would include movement with the blink. Initial lens awareness should be less than a standard spherical GP design. Fitting these can be as simple as providing the refractive (and topographic if available) results and add power to the laboratory. Pupil size can be another value add for determining best first-lens parameters in certain designs. Not all laboratories provide diagnostic lens fitting sets of their GP aspheric multifocal designs. However, diagnostic fitting regains the standard for fitting segmented, translating designs, to ensure the lens is translating on down gaze, is not lifted excessively on the blink and that the segment line is located in the appropriate position.

Torics. Fitting a bitoric lens is actually quite simple and can be more successful when compared to soft toric lenses due to better visual results.[7] There are a number of online calculators that, in a matter of seconds, provide the necessary powers and base curve radii (*Figure 2*) while also providing some key design and fitting pearls (*Figure 3*). Other online calculators include the Mandell-Moore Guide for Empirical Bitoric Design and Dr. Clarke Newman's custom bitoric fitting guide (both available at www.gpli.info). Both are downloadable forms that can allow ECPs to custom design a bitoric lens. GP bitoric lens success is also more likely as a result of improvements in the toric-generating lathes and tools in common use by laboratories today.

Spherical corneal GPs. Although less commonly used than in the past, the ability for manufacturers to make consistently good ultrathin lens designs custom manufactured to a given ocular surface bodes very well for first-fit success. The availability of several online calculators—as with toric lenses—is also quite beneficial.

Corneal reshaping. Whereas it was once commonplace to use diagnostic fitting sets or inventories to fit orthokeratology/corneal reshaping lenses, with today's corneal topography capabilities, complimented by the ability to generate high-quality lenses, success can easily be achieved in the first fit. In fact, one multicenter study reported a first-fit success of 80% with empirically fit corneal reshaping lenses.[8]

Hybrids. Essentially all forms of hybrids lenses can be ordered empirically. It is as simple as using the SynergEyes Empirical Lens Calculator, which calculates the lens parameters for the Duette Progressive Center-Near hybrid multifocal (*Figure 4*).

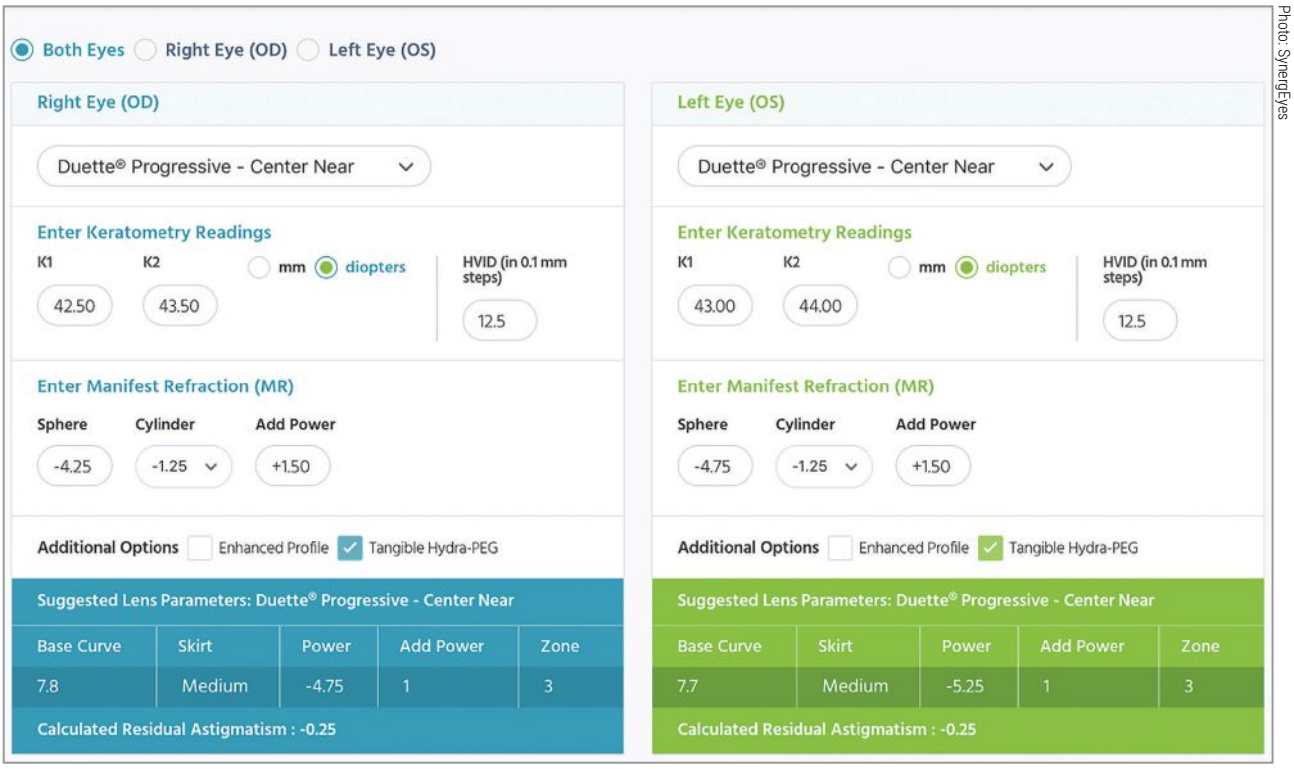


Photo: SynergEyes

Fig. 4. The SynergEyes Empirical Lens Calculator.

WHAT ABOUT SCLERAL LENSES?

As most of the sclerals are toric and asymmetrical, the use of diagnostic lenses has traditionally been recommended.[9] However, elevation-driven scleral lens designs combined with the manufacturer's ability to custom design the lenses using profilometry or corneal-scleral topographer information, is driving increased uptake and success in empirical scleral lens fitting. As more ECPs integrate advanced forms of topography instrumentation into their practice, this trend will continue.

Small-diameter corneal GPs for application on irregular corneas is still predominantly via diagnostic fitting as a result of the irregularity of the cornea, making it more challenging to determine what lens parameters would be optimum. That said, several topographers incorporate keratoconus lens design software to make empirical design possible in many cases.

CONCLUSION

The benefits of empirical GP lens fitting are numerous and only increase each new technological advance introduced to contact lens practice. At a time when increased efficiency and reduced chair time (if possible) can be critical to success, empirical fitting can contribute to patient satisfaction.

Sophisticated lens manufacturing equipment, complemented by high-quality in-office ocular surface instrumentation, is a marriage made for producing custom GP lenses that are well aligned to the eye, achieve less lens awareness and provide optimal vision—all without the need for a diagnostic lens fit.

Adoption of this approach enhances the patient's sensation of initial comfort, optimizes ocular health and competes effectively with the inventory approach to soft lens fitting. And the good news is, it will only get better with time!

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GP MULTIFOCAL CONTACT LENSES: THE 2024 LINEUP

Recent design advancements give clinicians even more options to help meet patients' vision demands.

By Thomas Stokkermans, OD, PhD, and Nicholas Gidosh, OD

In the November/December 2023 issue of *RCCL*, we published a feature exploring the numerous options in the soft multifocal (MF) contact lens (CL) market. In the present article, we plan to tackle the other category of MF lenses: rigid gas-permeable (RGP) CLs. Patients with irregular corneas, higher or out-of-range prescriptions or greater visual demands will benefit most from these specialty designs compared to non-custom soft lenses.

RGPs provide crisp vision, good ocular health and are typically cost-effective.[1] When asked to consider visual acuity, one study found that 75% of patients with astigmatism preferred the performance of rigid over soft CLs.[2] Multifocal GPs have also been shown to provide better quality of vision than soft MFs.[1]

Despite their many advantages, GP MFs made up only 1% of all fittings in the United States in 2022, while soft multifocal contact lenses made up 12%.[3] Barriers to their broader acceptance may include the absence of an immediate on-eye experience, upfront costs, risk of initial discomfort, absence of frequent replacement modalities, complexity of fitting MF GPs and the danger of corneal molding with some of the aspheric designs.[4] However, the arrival of a new generation of hybrid GPs and scleral lenses, as well as improved designs of corneal GPs, has created a renewed interest in fitting these lenses.

LENS DESIGNS: PROS AND CONS

When considering vision correction and level of customization among the many lens designs—aspheric, concentric, extended depth-of-focus (EDOF) and alternating/translating—each has notable strengths and weaknesses. Before laying out all the unique products in today's market, we'll first discuss the potential advantages and drawbacks of the numerous rigid MF lens designs to consider when selecting and fitting patients.

Aspheric Designs

This approach uses eccentric shaping on the front and/or back surfaces to create a gradual blending of add power (*Figure 1*). These power profiles can change at varying rates across different zone diameters.[5] Center-near profiles are particularly effective for moderate to advanced presbyopes because the add is centered around the visual axis giving better acuity at near. Back-surface aspheric center-near MFs are often fit 1.50D to 3.00D steeper than flat keratometric values to create a higher plus power tear lens. A disadvantage of this design is the risk of corneal molding under the lens because of the steep fitting relationship. This can cause steepening that leads to myopic shift

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Dr. Gidosh is assistant professor at the Pennsylvania College of Optometry. He serves as chief of the Cornea and Contact Lens Service at The Eye Institute and has presented lectures and workshops in PCO's Advanced Studies Program and International Program on topics including scleral and hybrid lenses, irregular cornea and contact lens fitting. He is a Fellow of the American Academy of Optometry and has served as a clinical investigator for studies involving hybrid, scleral, multifocal and orthokeratology lenses, presenting lectures and posters at national and international conferences on these topics.

and, ultimately, temporary spectacle blur after lenses are removed.

There are now many aspheric designs that use front-surface eccentricity to generate the add power. Each of these designs is an example of simultaneous vision, which requires adaptation and, in the case of center-near designs, suppression. It is often necessary for the patients to trial these designs for several weeks to adapt to having both distance and near vision simultaneously inside the pupil.

Considering pupil size is extremely important when fitting aspheric lenses, since patients with small pupils can experience problematic vision at a distance in center-near designs, while those with large pupils can find difficulty focusing near in center-distance designs.

Aspherics have the advantage of being simpler to design empirically. Many lab designs are successful in calculating parameters based on keratometry values, horizontal visible iris diameter (HVID), manifest refraction, eye dominance and pupil size. These can be easier for non-established GP wearers to adapt to since they are thinner than translating designs.

Lower add, emerging presbyopes often do well with aspheric lenses. They can be more comfortable in these than translating designs due to a lack of ballasting or truncation. However, some designs can't generate as much add power effectively, which can be problematic for older, more advanced presbyopes. These patients, in addition to those that have a critical near vision demand, will likely have better success with bilateral center-near lenses. Emerging presbyopes or patients with critical distance visual demand typically prefer center-distance designs. The success of all these designs is influenced by the power profiles, zone sizes and lens centration.[6]

Concentric Designs

This type of lens features annular rings of power that can be blended and progressive or defined bifocal zones of power to provide another option of simultaneous MF correction. These changing zones of power occur inside the pupil and therefore are very dependent on lighting and pupil size. Centration of the lens on eye is also critical. These lenses also take significant adaptation on the patient's part.[7] This is partly because when the outer zone is defocused, the point spread function will also be an annulus, creating a blur halo that will increase in size as the pupil dilates. Patients may especially notice this effect in high-contrast situations (*e.g.*, streetlights at nighttime).[8]

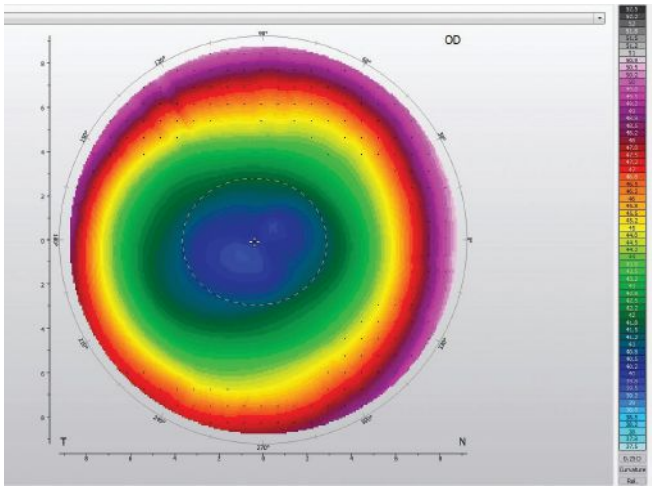


Photo: Cory Collier, OD

Fig. 1. Topography of a center-distance aspheric corneal GP. Aspheric lenses often employ a center-distance zone that gradually increases in power to a near peripheral zone.

EDOF Designs

A popular new alternative in simultaneous vision has come in the form of EDOF optics. These power profiles use an aperiodic, non-harmonic variation in power, allowing them to be less influenced by pupil size and lens decentration. EDOF designs create an optical "pinhole effect" to provide a range of clear vision rather than one or two focal points. This would still be considered simultaneous vision, so adaptation to the optics is important, just like with aspherics.[7]

Alternating/Translating Designs

The alternative to simultaneous vision is an alternating or translating design. These lenses are fit to stabilize on the lower lid and move on the surface of the eye. This movement allows for the patient's visual axis to focus through different zones of the lens. These lenses are highly customizable, with adjustable segment heights to ensure the patient can comfortably work in the various zones. They are stabilized through prism-ballasting and/or truncation methods. Ideally, these patients have a lower lid position at, or just above, the lower limbus. This type of lens is excellent for patients with the most critical vision demands due to their customization.[5,7]

Now that we've explored the advantages and disadvantages of the different lens designs, below we'll take you through the gamut of RGP multifocals available today, pointing out along the way the features that set each apart.

HYBRID GP LENSES

Patients who desire better vision at near, intermediate and distance, as well as post-LASIK and keratoconic patients, may benefit from this type of lens. Here are a few hybrid MF CLs available today.

CooperVision

This company—one of the "Big Four" in this space—augmented its rigid MF portfolio after recent acquisitions

Photos: CooperVision

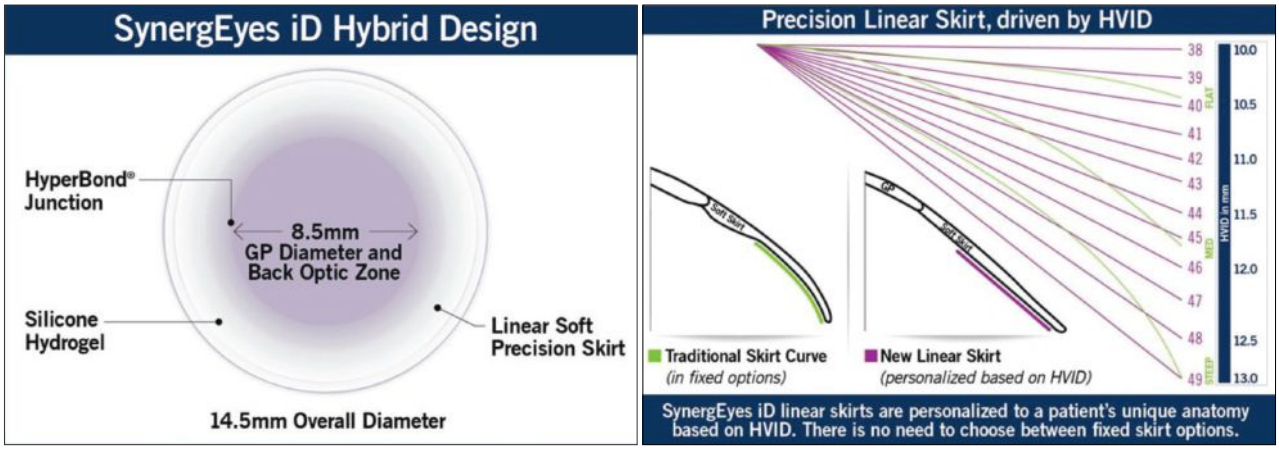


Fig. 2. SynergEyes iD MF EDOF design is fit empirically based on HVID, corneal curvature and refractive error. The linear skirt, personalized for each lens, promotes oxygen permeability and reduces the risk of tight lens syndrome.

of Blanchard in 2019, GP Specialists in 2020 and SynergEyes in 2022. SynergEyes and Duette lenses come in sphere powers up to ±20.00D and can correct up to 6.00D of corneal astigmatism.

• ***SynergEyes iD Multifocal EDOF.*** This lens, available since early 2021, has a silicone hydrogel skirt and high-Dk center (hemlarafilcon A/Dk 84, petrafocon A/Dk 130) treated with a polyethylene glycol coating for moisture. The personalized lens skirt is designed with a linear profile to improve comfort and reduce the risk for tight lens syndrome by promoting greater oxygen permeability. This MF option comes in three add powers and has a continuously changing non-monotonic and aperiodic power profile that differs from a zonal bifocal, aspheric or diffractive MF design. The iD Multifocal is ordered empirically based on HVID, corneal curvature and refractive error (*Figure 2*).

• ***SynergEyes Multifocal.*** This lens predates the SynergEyes iD Multifocal. This earlier MF design comes in four add powers up to +2.25D and two near-zone sizes. The Dk of the GP portion is slightly lower than the iD Multifocal (100Dk), and the skirt is made of low-Dk HEMA material.

• ***Duette Progressive.*** This lens has been available since 2018 and is made of the same materials as the SynergEyes iD Multifocal. It offers a progressive center-near design with add power up to +2.50D and a center-distance design with add power from 0.75D to +5.00D. A design feature that CooperVision calls "FlexOptics" gives the lens an adjustable center zone size based on pupil size. The Duette Progressive is ordered empirically based on HVID, corneal curvature, photopic pupil diameter, refractive error and required add power.

• ***Duette Multifocal.*** The oldest of these four lenses (and least customizable), the Duette has been on the market since 2011 and is made of the same materials as the other Duette lenses (hemlarafilcon A and petrafocon A). It comes in seven base curves, four skirt curves and two different sizes of center-near add zones. While this lens is certainly a viable option, patients who would benefit from a more customized fit and wider range of parameters may wish to consider one of the newer Duette or SynergEyes designs.

SCLERAL MF LENSES

Patients with irregular corneas or severe dry eye are often fit with scleral lenses and given the option of monovision correction or reading glasses despite the availability of an MF as an add-on in many of the scleral lenses on the market. For patients who may benefit from a scleral multifocal, here are some of the options at hand.

ABB Optical Group

• ***The Atlantis scleral lens*** offered by this company can be made with an add power up to +4.00D with adjustable distance zones (3.6mm to 4.4mm). This lens comes in base curves 6.50mm to 9.12mm, diameter 14.0mm to 17.5mm, sphere power ±20.00D, cylinder up to -5.00D and adjustable periphery including toric haptics and quadrant specific control.

Acculens

• ***EasyFit and Maxim scleral lenses.*** These two scleral design profiles feature customizable center-near or center-distance aspheric options. The first of the two, which Acculens calls the "EasyFit" design, has a smaller diameter intended for the regular cornea patient, while the "Maxim" design is larger for intended use on irregular corneas, such as in keratoconus (*Figure 3*). Both offer decentered MF optics, which offset the central zone to realign with the pupil center after a lens decenters on eye. This can be achieved with measuring decentration directly through a laser-etched diagnostic fit set or empirical measurement.[4]

Photo: Acculens

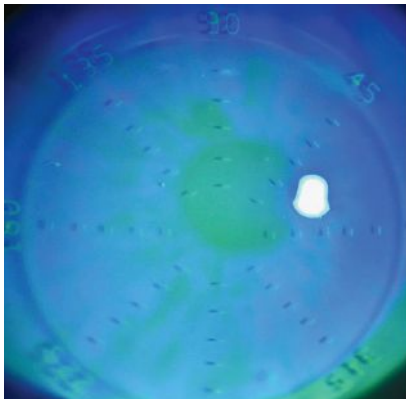


Fig. 3. A diagnostic Maxim scleral lens with alignment markers measuring three hash marks of decentration along the 45° meridian. With a larger diameter than Acculens' "EasyFit" scleral, this lens is indended for irregular corneas.

Advanced Vision Technologies (AVT)

• ***Naturalens scleral, Naturalens mini scleral and AVT scleral.*** These are three designs by AVT that are available in an MF design. These lenses can accommodate up to +3.50D add power and consist of a central distance zone surrounded by an aspheric intermediate zone, then a concentric near zone followed by a peripheral distance zone. A sophisticated fitting guide uses the HVID and a diagnostic fitting to adjust central, intermediate and peripheral alignment. Front toricity, toric haptics, notching and flexure control can be added. These sclerals come in the following diameters: Naturalens scleral, 15.0mm to 20.0mm; Naturalens mini scleral, 13.8mm to 15.5mm; and AVT scleral, 15.0mm to 22.0mm.

Art Optical

• ***The SoClear progressive*** is designed for patients with corneal ectasia. This corneal-scleral lens is available in base curves 6.6mm to 9.5mm, sphere powers ±20.00D, add powers up to +3.50D, adjustable peripheral curves and a diameter from 13.0mm to 15.0mm. The center-near zone can adjust from 0.5mm to 6.0mm.

• ***Ampleye scleral MF.*** This center-near design lens employs a feature the company calls "custom aligned optics." This allows the clinician to compensate for scleral lens decentration, which is often present due to scleral elevation differences, lens mass and/or lid interaction (*Figure 4*). The feature also decenters the MF add from the geometric lens center so that when placed on the eye, the optics are positioned directly in front of the pupil as desired. The amount and direction of decentration can be customized as needed. The lens is available in add powers from +1.00D to +3.50D and center-near zone sizes from 1.0mm to 4.0mm.

Bausch + Lomb

• ***Zenlens MF scleral***. This lens was launched by B+L in 2019 and is a viable option for patients with scleral abnormalities, such as pingueculae or filtering blebs. It features a broad landing zone on the sclera, as well as a feature that the company calls "MicroVault technology," which allows for vaulting over scleral obstructions. It comes in four diameters (14.8mm to 17.0mm), oblate and prolate designs and the option to correct for residual astigmatism with front-surface toric optics. Another unique feature of this lens, which B+L calls "SmartCurve," allows the intermediate (limbal clearance) curve to be changed without affecting the SAG and peripheral curves.

The Zenlens can also adjust for the toric nature of the sclera. The center-near multifocal optics are centered over the visual axis instead of the center of the pupil for sharper acuity (*Figure 5*). This is generated by measuring add power, pupil size, eye dominance and lens rotation.

Blanchard

• ***Onefit Scleral.*** Blanchard, now owned by CooperVision, offers this MF lens, which employs smaller diameters (14.7mm and 14.9mm) with minimal mass and corneal clearance, intended to provide optimal oxygenation, stability and convenience. Designed for both regular and irregular corneas, features to enhance fit include: a front-toric option (SymToric) combined with toric haptics for residual astigmatism and maximum lens stabilization; a feature that accommodates scleral elevations; an option called "central clearance reduction" for oblate post-surgical corneas; an option to add extra limbal clearance for boosted edge lift; and, finally,

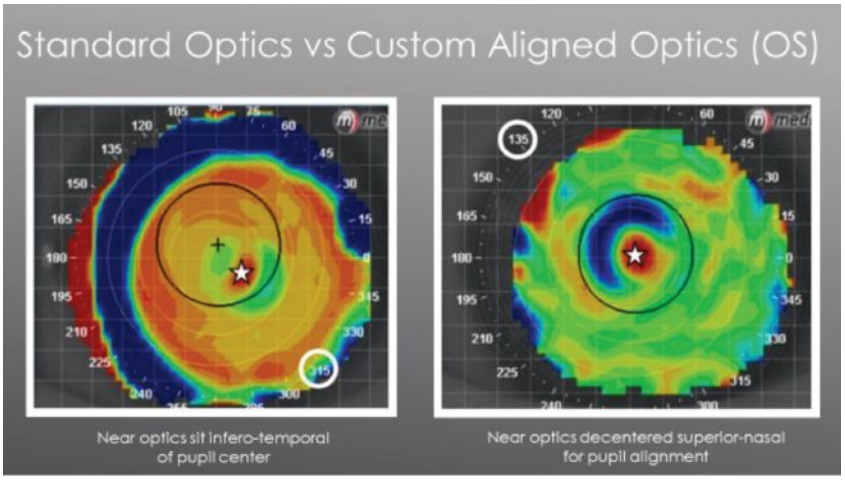


Photo: Art Optical

Fig. 4. The Ampleye scleral MF can incorporate decentered MF optics by determining the direction and amount of decentration by measuring topography over top the initial MF trial (left) then manufacture a new lens with recentered optics (right).

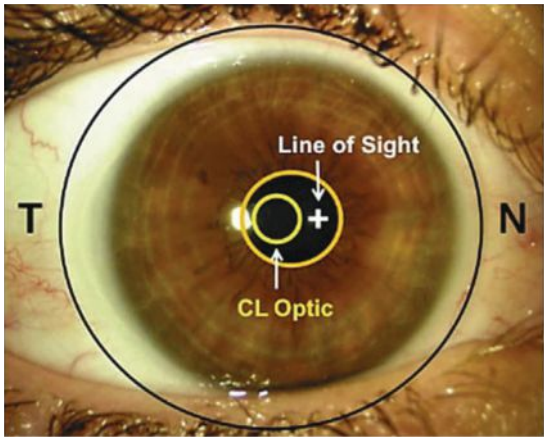


Photo: Matthew Lampa, OD

Fig. 5. The optical center of most lenses aligns with the pupil center and cornea, which are inferior and temporal of the line of sight. The Zenlens allows alignment of the visual axis and the center of the near zone for better acuity.

an adjusted near-zone diameter for the dominant and non-dominant eye ("D" and "N" lens; *Figure 6*).

Menicon

• ***The Rose K2 XL*** is a popular option for patients with irregular corneas. This highly customizable semi-scleral lens comes in a center-near simultaneous vision design with a front-surface add power. It comes in base curves 5.6mm to 9.0mm, diameters of 13.6mm to 16.6mm and adjustable front optic zone adjustment from 0.5mm to 5.0mm.

Metro Optics

• ***InSight Scleral*** is a lens that is compatible with both regular and irregular corneas. It comes in base curves from 32.0mm to 67.0mm, sphere power +20.00D to -25.00D, cylinder power up to 8.00D in 5˚ steps, diameters 14.0mm to 18.2mm, spherical or toric periphery and a center-near aspheric MF up to +3.00D add power.

Valley Contax

• ***The Custom Stable Aurora*** scleral lens is a front-surface MF that uses a dominant (distance-center)/non-dominant (near-center) system that works in unison with the patient and accommodative demands. Decentration can be measured topographically or with the XWave aberrometer (Ovitz). The customization of MF designs in the Custom Stable platform is a great starting point for scleral MF fitting. This can be used on irregular cornea and dry eye patients, as well as for high or out-of-range refractive errors. If vision remains suboptimal, the decentration option with Ovitz is a great troubleshooting tool.

Visionary Optics

• ***The Jupiter Plus lens*** is a center-distance lens with an add power of up to +1.75D, diameter 15.0mm to 18.2mm, sphere powers ±20.00D and custom features such as oblate geometry and toric haptics.

• ***The Europa Scleral*** was developed as an advance on the Jupiter scleral lens. It is available in a center-near and center-distance design. Additional features include a highly customizable periphery to vault scleral elevations, quadrant-specific steepening and flattening and front and back toricity. Intermediate curves can be precisely adjusted, as well.

• ***The Latitude Scleral*** conforms exactly to the shape of the sclera. It requires profilometry (corneo-scleral topography mapping) and can be ordered in an MF option.

• ***The Elara for Presbyopia*** 15.0mm prolate scleral lens is a concentric center-near bifocal with a maximum +3.50D add power and an adjustable center zone from 1.0mm to 3.5mm. Since this lens employs a center-distance design, toric optics and toric haptics are options. It is designed for regular corneas for patients with dry eye that desire the visual acuity of a rigid lens.

CORNEAL GP LENSES

These lenses—available in translating, concentric and aspheric designs—are often considered the top choice for managing keratoconus, but they can also target many other vision concerns, such as corneal astigmatism, presbyopia or post-refractive surgery eyes (*Figure 7*). Here are the options.

ABB Optical Group

• ***The Mandell Seamless*** multifocal has a front-surface concentric design up to +3.00D in add power providing a customizable seamless transition between the spherical distance and near optic zones. It is available in a reverse curve and astigmatism correction.

• ***The Natural Vision Bifocal*** is a translating, truncated and prism-ballasted lens design with a spherical near and distance zone that are customizable.

• ***The Versare*** features what ABB Optical Group calls "controlled zone technology," allowing easier transition from the distance zone into the near zone. This lens is ideal for emerging presbyopes with less than 2.00D corneal astigmatism, providing up to +2.00D add power.

• ***The XTriVision*** is a simultaneous vision MF lens that allows a customized optic zone size and up to +3.00D of bifocal add power. It is also available in a back-toric design and reverse-geometry profile.

• ***The Tangent Streak*** comes in a simultaneous-focus "no line" multifocal lens designed for emerging presbyopes with significant corneal astigmatism, as well as a more traditional choice: a translating segmented bifocal and trifocal lens design for optimal distance and near acuity and higher reading power corrections.

AVT

• ***The Naturalens GP*** family provides the option of a center distance with concentric intermediate and near zones MF with the "mid pro" design

having a wider distance zone and the "pro" a wider near zone. Front-toric and bitoric designs, as well as toric peripheral curves, are available. The edge is designed to create "tear cushions" and a reduced edge lift to improve comfort and promote tear exchange. The lenses come in a 9.0mm to 11.5mm diameter. Those for irregular corneas (*i.e.*, the Naturalens VIP cone) can have an MF option added.

• ***TransbyLite.*** This translating MF is designed for normal and irregular corneas with an add power up to +3.50D. It is available in a spherical and bitoric design, a wide range of base curves, sphere and cylinder powers and a diameter range of 7.0mm to 12.0mm.

• ***Varifocal, Varifocal Plus and Varifocal High Add Plus.*** Each of these is a back-surface center-distance MF with a back-surface aspheric blend to a peripheral near zone that comes with the option of a front-surface toric for residual astigmatism. They come in a wide variety of base curves and sphere and cylinder powers, in a diameter range from 7.0mm to 12.0mm.

• ***The Pediasite.*** Suitable for children with pediatric aphakia, this high-Dk lens may be preferred over a soft aphakic CL in cases of corneal irregularity. To reduce amblyopia risk, it has the option of an MF lens and comes with a VIP edge design in a wide range of spherical and cylindrical corrections and diameters ranging from 8.5mm to 11.5mm.

Art Optical

• ***The Renovation MF*** is best suited for add powers over +2.25D and has an adjustable front-surface and base-curve eccentricity that reduces spherical aberration and easy translation into the near zone. Adjustment of the distance zone to accommodate pupil size and lens thickness to maximize lens centration and wearing comfort are both available options. A diagnostic lens set comes in base curves 7.2mm to 8.3mm, diameter 9.2mm and 9.5mm and +2.50D add power.

• ***The Expert Progressive*** is a segmented lens that provides equal thickness at the 360° edge. The distance-to-near transition is blended, and this "intermediate" zone is customizable. This lens comes in base curves from 6.90mm to 9.00mm, diameters 8.5mm to 10.0mm, an add power of up to +4.00D and power range ±20.00D.

• ***ClasikCN*** is a center-near, reverse-geometry lens suitable for presbyopes with a history of refractive surgery. The design can be made empirically or using a diagnostic fit set.

• ***mPower!*** is a center-distance MF lens that uses multiple front-surface curves to improve near vision for patients who have failed with other MF designs. A diagnostic lens set comes in base curves 7.2mm to 8.1mm, diameter 9.5mm and +2.50D add power.

• ***The One Piece Bifocal*** has a prism-ballasted segment bifocal and high-definition optics to reduce blur often caused by the transition line. It is designed for higher presbyopic demands and those who have had problems with simultaneous-vision MF lenses, especially those with high corneal cylinder.

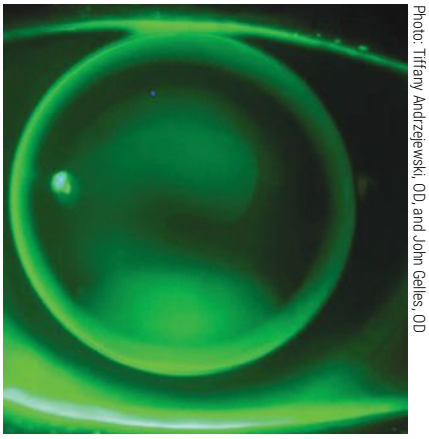


Photo: Tiffany Andrzejewski, OD, and John Gelles, OD

Fig. 7. Corneal GP MFs are available in translating, concentric and aspheric lens designs. They can be fitted for patients with keratoconus, corneal astigmatism, presbyopia and other vision concerns.

Bausch + Lomb

• ***The Boston MultiVision*** lens, which has been around since 1997, uses a posterior-surface multi-aspheric design manufactured exclusively in the Boston ES material. The 9.6mm diameter lens is available in 11 base curves (7.3mm to 8.3mm), sphere powers ±20.00D, an add power of +1.50D and multi-aspheric posterior curves. The low add makes this lens most suited for emerging presbyopes.

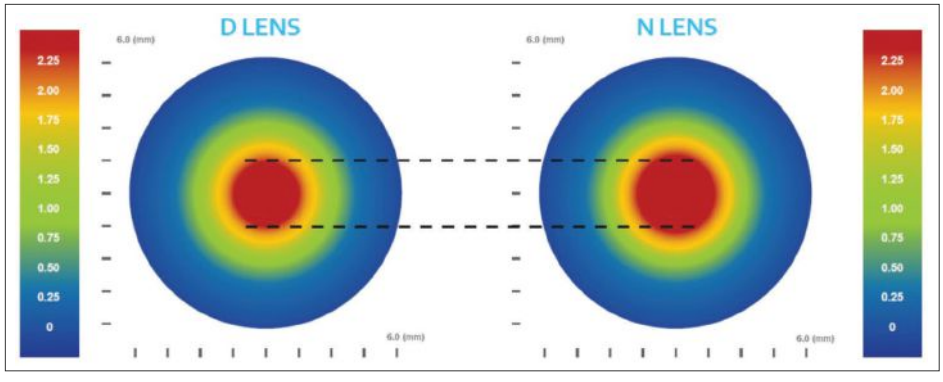


Photo: Blanchard

Fig. 6. The Onefit scleral lens MF features an adjustable near-zone diameter for the dominant ("D" lens) and non-dominant ("N" lens) eye.

Blanchard

• ***The Essential*** lens functions as both a translating and simultaneous-focus lens with a flatter back-aspheric surface to reduce risk of corneal molding. This lens, as well as the other two from this company described next, use a unique manufacturing process that creates a greater add power and promotes better contrast sensitivity.

Clinicians also have the option to add a front-surface annular component that creates a translating aspheric MF. The lenses come in base curves from 6.9mm to 8.3mm, diameters 8.8mm to 10.5mm and a front- and back-surface combined add power of up to +4.00D.

• ***The Reclaim HD Bi-Aspheric*** lens features an aberration-controlled aspheric center-distance design that provides up to +4.00D add power. It comes in base curves 7.0mm to 8.3mm, diameters 8.8mm to 10.2mm and sphere powers ±20.00D. The anterior distance zone is also adjustable from 2.0mm to 4.0mm.

• ***The Refractive Surgery Specific*** lenses come in an MF option and feature a reverse-geometry aberration control design to fit flat corneas. Lenses come in fitting curves 7.34mm to 8.65mm, with central base (reverse) curves 1.00D to 9.00D flatter, diameters 9.5mm to 12.0mm and sphere powers ±20.00D.

Conforma

• ***Variable Focus Lens3 (VFL3).*** This is a progressive center-distance lens designed to minimize aberrations while providing a maximum add power of +2.25D. The lens comes in base curves from 6.7mm to 8.0mm with adjustable peripheral curve and a recommended diameter of 9.4mm. Recent design developments include an aspheric front surface in the VFL3 HD that adds +0.50D add power, followed by additional front aspheric add power increases in the VFL3 HD-AP and the VFL3 HD-CAP.

Essilor

• ***ContinuVu and ContinuVu Plus.*** These back-surface center-distance lenses have a +1.75D progressive add power. The "Plus" lens offers the option of a front-surface add for a total power of up to +4.00D. Lenses come in base curves 6.0mm to 10.5mm, diameters 8.2mm to 11.6mm and sphere powers ±25.00D. These lenses center well and have a reduced risk of corneal molding.

• ***MVP and MVP BiToric*** are aspheric MF lenses with add powers up to +4.00D, base curves 4.7mm to 11.26mm, diameters 8.0mm to 12.5mm and sphere powers ±32.00D.

• ***The Flex-3 MF*** has a concentric trifocal center-distance design of up to +3.50D add power that does not employ asphericity, eliminating the risk of corneal molding. Lenses come in base curves 7.0mm to 8.5mm, diameters 9.6mm to 10.0mm and sphere powers ±20.00D.

• ***The EZEyes*** combines a progressive back surface with a full add power up to +4.00D in a front-surface bifocal segment. Lenses come in the same parameters as the MVP.

• ***The Vision Plus 2 MF*** is a bi-aspheric center-distance lens with a large intermediate zone provided by V-Plus aspheric optics and a rapid increase in the up to a +4.00D add power. Lenses come in the same parameters as the EZEyes and MVP lenses.

• ***The Expert Progressive,*** like the EZEyes lens, combines a segmented with a progressive add power that is designed to have less awareness of the prism segment. Lenses come in an add power up to +4.00D, base curves 6.5mm to 8.6mm, diameters 8.0mm to 12.0mm and sphere powers ±25.00D.

Lens Mode

• ***The Hi Rider*** MF offered by this company is unique in that it allows a single-vision lens to be converted to an MF without altering the fit. It's available with up to +3.75D add power.

Metro Optics

• ***The Metro Progressive Aspheric*** is a center-distance lens with a 2mm central back-surface spherical curve surrounded by aspheric peripheral curves and a spherical front surface. It comes in base curves from 5.45mm to 10.55mm, sphere powers ±10.00D and diameters 8.8mm to 9.8mm. The Metro Progressive has an add power of up to +2.00D, while the Metro Enhanced Progressive provides up to +2.75D add power.

• ***The Metro-Seg Crescent Bifocal*** is a translating design that comes in base curves of 5.45mm to 10.55mm (32.00D), sphere powers of +10.00D to -20.00D, diameters 9.0mm to 9.8mm and has available toric parameters. The practically unlimited add power is positioned in a crescent segment that allows near vision to remain stable with mild lens rotation. The optical centers of the distance and near lens are placed close together to minimize image jump when transitioning into the bifocal segment (*Figure 8*). The seg height can be varied from 0.3mm to 1.2mm below the geometric center.

Precision Technology

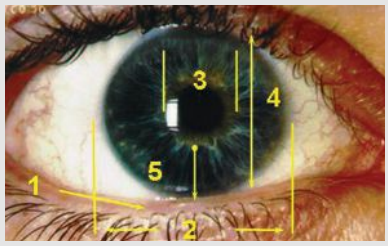
• ***The Apex*** is a center-distance 10.5mm standard-diameter MF that has an aspheric back surface for a comfortable and stable fit based on pupil size, HVID, keratometry and refraction.

• ***The Apex TriAdd*** combines simultaneous vision and translation design

ANATOMICAL CONSIDERATIONS

Evaluate these six anatomical features when sizing up a presbyope for GP lenses:

1. Lid position.
2. Corneal diameter.
3. Pupil size and dynamics.
4. Fissure width.
5. Lower lid pupil edge.
6. Location/amount of astigmatism.



Information and photo: Edward Bennett, OD, and David Hansen, OD

Photo: Metro Optics

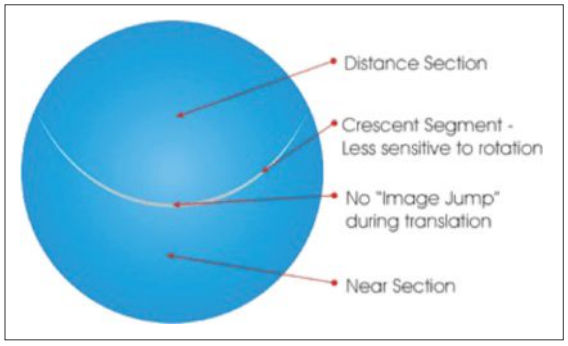


Fig. 8. Metro-Seg Crescent Bifocal is a translating design from Metro Optics. Optical centers of the distance and near lens are close together for an uninterrupted transition from near to distance.

with separate zones of spherical radii that transition using an aspheric filet curve to achieve a progressive power effect and a front-surface add with an adjustable pupil diameter to optimize distance, intermediate and near acuity. The preferred diameter is 9.6mm, and while the distance zone can be adjusted from 2.0mm to 4.0mm, the recommended size is 2.9mm for the non-dominant and 3.2mm for the dominant eye.

The LifeStyle GP Company

• ***The LifeStyle GP*** is a center-distance aspheric MF that allows for additional add power on the front surface (up to +3.75D total). This is a traditionally high-riding lens in primary position that translates in downgaze to allow close vision through an aspheric alignment curve. Lenses come in base curves 7.0mm to 8.9mm, diameter 9.0mm to 10.5mm and sphere powers ±20.00D with an adjustable distance zone from 3.0mm to 6.0mm.

• ***The LifeStyle Marquis GP*** is a center-distance aspheric MF with a large reading zone and a low (≤+1.75D) and high (≥+2.00D) add power. Lenses come in fitting curves 6.6mm to 8.9mm, a diameter of 9.5mm and sphere powers ±20.00D.

TruForm Optics

• ***The Llevations Thin Multifocal*** is a translating trifocal design that uses truncation and base-down prism to stabilize the lens on the lower lid. Two customizable seg heights can be altered to create variable intermediate and near zones with individualized powers.

Valley Contax

• ***The GoldenEye Aspheric Front Multifocal*** is a GP lens with a completely spherical back surface to fit the corneal curvature. It features a highly eccentric front surface to achieve smooth transition across vision distances. Ideal candidates are presbyopes who want to improve their quality of vision or any patient struggling to meet their visual needs with soft MF torics.

• ***The Buckley Bifocal*** is a prism-ballasted, segmented GP bifocal for patients who need quality distance and near vision and don't care for aspheric designs. Add power goes up to +3.50D.

Visionary Contact Lens

• ***The Site-See Bifocal*** is a center-distance lens with concentric intermediate and near zones. It has a spherical or spherocylindrical back and aspheric front surface that allows for a progressive add (up to +4.00D).

X-Cel Specialty Contacts

• ***The Essential and Essential Solution*** multifocal lenses have a center-distance design with an aspheric back surface. The Essential Solution adds to this a translating front-surface bifocal add design providing up to +3.50D add power. The lenses come in a -10.00D to +6.00D sphere power and standard base curves from 7.1mm to 8.2mm and a diameter of 9.3mm.

• ***The Solution Bifocal*** is a prism-ballasted translating lens with one-piece construction and monocentric optics designed to eliminate image jump when moving between the distance and near segment. Add powers go up to +3.00D.

• ***The CV-4 Multifocal*** is a spherical back-surface center-distance progressive aspheric front-surface MF lens that is fit based on pupil size, corneal measurements and spectacle Rx. The lens comes in 6.8mm to 8.55mm base curves, 9.0mm to 10.0mm diameters, ±16.00D sphere powers and add powers up to 3.00D with an adjustable pupil diameter from 3.0mm to 5.5mm.

• ***ProPlus Multifocal*** is a bi-aspheric center-distance lens that is fitted using the patient's HVID and spectacle prescription. The rapid rate of flattening in the near periphery provides clear intermediate vision. The lens comes in 6.9mm to 8.5mm base curves, 8.5mm to 11.0mm diameters, +10.00D to -15.00D sphere powers and add power up to 3.50D with an adjustable distance zone from 3.3mm to 3.9mm.

CONCLUSIONS

There are dozens of lens options to choose from in the hybrid, scleral GP and corneal GP categories, and new designs and materials will continue to join the market. Familiarize yourself with all the brands and parameters available to have the best chance at matching your patients with the most suitable lens. RCCL

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Wave Hello to *Wavefront-Guided* Sclerals

These lenses are a great option for those with residual higher-order aberrations but also can be used to create excellent multifocals.

By John D. Gelles, OD, and Travis M. Pfeifer, OD

Scleral lenses (SLs) are lifesavers! However, some SL wearers, even those with 20/20 vision, report quality of vision still falling short. The most common complaints are bothersome ghosting, smearing, halo and glare. On examination, there are no media opacities, such as cataracts, that could explain the reduction in vision quality. Despite the practitioner's best efforts, the vision quality can't be further improved with a traditional SL (tSL). So what's the reason for the poor visual quality, and is there anything that can be done to improve it further? These patients may be struggling with residual higher order aberrations (HOAs); you can help improve their vision and quality of life, even those with 20/20 vision, by using wavefront-guided scleral lenses (wfgSLs).[1]

BACKGROUND

Rigid contact lenses have long been the mainstay to improve vision caused by irregular corneal astigmatism. As we all know, this type of astigmatism induces HOAs. A rigid contact lens can mask the anterior surface of the irregular corneal astigmatism to reduce HOAs and improve vision. In many conditions, like keratoconus, the posterior cornea is often irregular as well. When the anterior cornea is masked by the rigid lens, the internal aberrations from the posterior cornea can come through; these are residual HOAs.[2] Other factors can be the source of residual HOAs as well, such as the rigid lens itself, fluctuations in pupil diameter, tear film, accommodative status, crystalline lens shape and age.

Wavefront aberrometry can help in cases such as these, as it is an objective method of measuring aberrations of the eye. It works by projecting infrared light into the eye, then measuring the reflected light's deviation from a plane of focus. Wavefront aberrometry is highly sensitive but not specific. Additional combination instruments, such as an aberrometer combined with a topographer, are needed to determine the structure of the eye that is abnormal. Because of its function, wavefront aberrometry is useful for understanding patients' visual complaints. One advantage that wavefront aberrometry presents is the possibility for data to be presented in various forms, including wavefront maps, tables and bar graphs.

One of the most beneficial data displays is the point spread function (PSF), simulating how a patient would see a perfect white point on a black background. Aberrations are measured in microns and defined by a pupil diameter. The three primary HOAs associated with reduced vision quality are coma, trefoil and spherical aberrations. When combined, they blend together, leading to a patient's complex visual complaints. When a contact lens is worn, the lens becomes part of the optical system of the eye that is being measured and residual aberrations are what is left over once a lens is fit.

WfgSLs can reduce these residual aberrations. The process of creating a wfgSL starts with a typical SL

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Fig. 1. Comparison of a PSF from two different patients: one with a normal cornea (left) and the other with keratoconus (right). Using these PSF simulations can be a great way to communicate to patients and show them that you understand the visual issues they are experiencing. This can be very validating and aid in building trust and rapport with patients.

design process. After an ideal SL fit is achieved, a duplicate SL with fiducials (a dot matrix on the front of the lens) is worn by the patient. From there, wavefront aberrometry is used to capture the residual HOA data, the position of the lens and the location of the line of sight. Using this data, a wavefront-guided optical profile is created. WfgSLs work by the principle of destructive interference, similar to noise-canceling headphones, to reduce HOAs. The patient's vision is evaluated by capturing an aberrometry measurement at the follow-up.

Now, let's get to some practical pearls learned over the course of a few years and spanning several hundred eyes at the Cornea and Laser Eye Institute. Many of these tips have been presented as manuscripts, posters or abstracts from our clinic, but others are simply from clinical experience. All of these should help you deepen your understanding of the nuances of aberrometry, HOAs and wfgSLs.

1. DON'T FORGET: WORDS MATTER

Setting expectations is vital to success. It is important to educate the patient that this wfgSL will not entirely eliminate HOAs. They can expect an improvement in visual quality, but not perfect vision. Generally, irregular corneal astigmatism patients at our facility experience an average 50% HOA reduction and one line or more improvement in visual acuity using the Ovitz system.[3] This is similar to the published data.[4-6] It is paramount to iterate to patients, especially those who are already 20/20, that they may or may not gain lines of acuity but should experience an improvement in visual quality. That said, we have seen up to five lines of visual acuity gain in our clinic. We have also seen normal cornea patients go from a best-corrected visual acuity of 20/20 to 20/10.

2. THERE IS A METHOD TO THE MADNESS

Maximizing pupil size is crucial when capturing aberrometry. There are two methods to do so: either pharmacologically dilated or physiologically dilated, each with their pros and cons. Only the pharmacologic method, though, has been primarily reported on in the literature.[4-6] The optic zone of the wavefront-guided optics is only as large as the maximum pupil diameter that was achieved during the aberrometry. When the wavefront-guided optic zone isn't large enough, the adjustment from the wavefront-guided optics patch to the standard optical carrier will encroach into the pupil and be an additional source of aberration.

If your wavefront aberrometer is located in a testing room that has ambient room illumination, pharmacologic dilation is necessary to ensure you capture HOA data through a maximum pupil diameter, as patients will likely encounter darker environments. However, if your aberrometer is located in a room without windows and lighting can be shut off completely, the patient can naturally dilate. In this situation, it is unlikely the patient will experience a darker environment. Which is better? We don't currently know, but our results with the undilated method mirror the published pharmacologically dilated results.

3. RELATIONSHIPS ARE PARAMOUNT

The success of wfgSLs is predicated on the lenses staying in the same position—this makes the fitting relationship paramount. A tSL can have a little bit of movement and still be successful, but for wfgSLs, slight change in position can cause reduced vision.[7] To stabilize the lens, using a non-spherical haptic, whether it be toric, quadrant-specific or free-form haptics is necessary.[8,9] Our experience has shown all these haptic options can work well to stabilize the lens.

4. A MATERIAL WORLD

There are questions that arise about the effect of lens coatings, such as Tangible Hydra-PEG. The effect of lens cleaning also comes with these concerns. Luckily, the literature has a publication for each, and the good news is there seems to be no ill effect from coatings or cleaning, at least when simulated over the course of one year.[10,11]

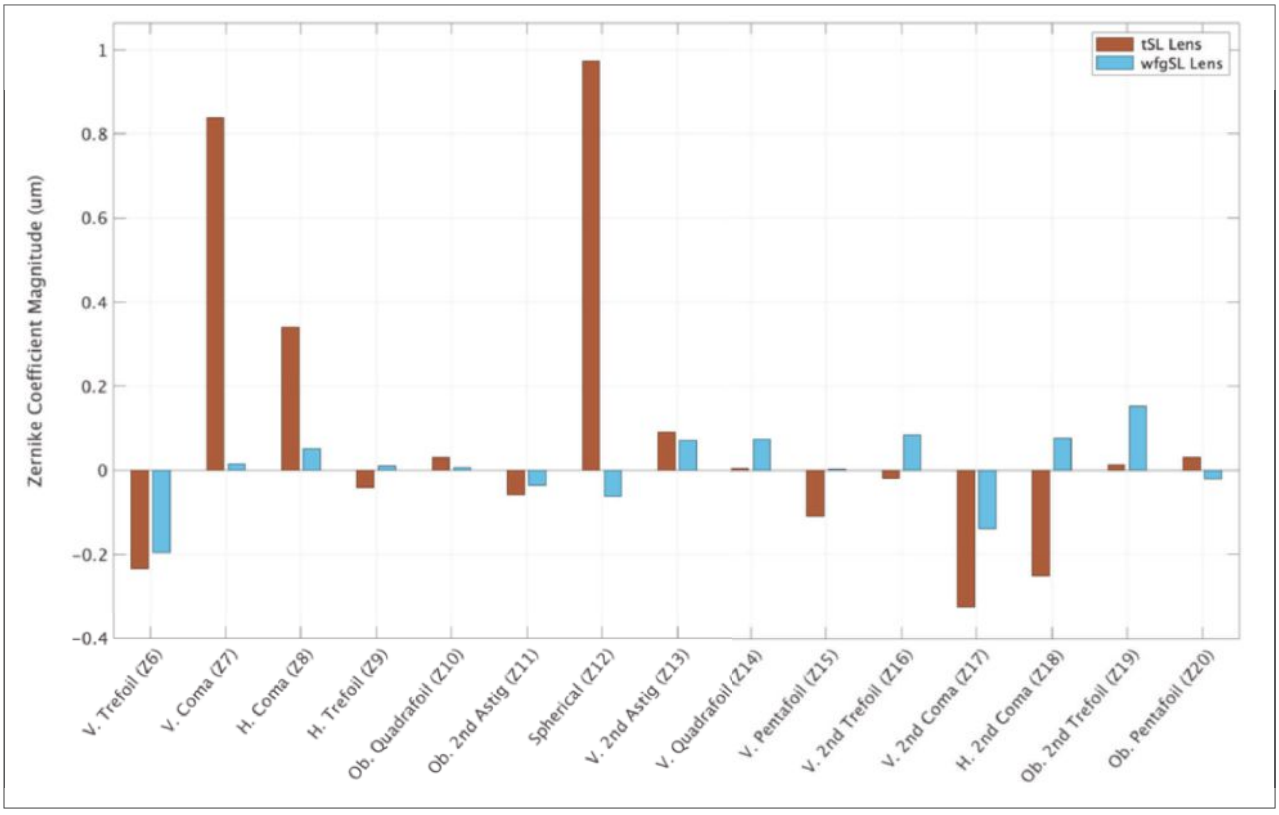

Fig. 2. Bar plot comparing magnitude of individual Zernike coefficients in a keratoconus patient wearing a tSL vs. a wfgSL. All major aberration showed significant reduction with the wfgSL. Higher order root mean square (HORMS) decreased from 1.43µm to 0.41µm. All data is reported at a 7.8mm pupil diameter.

5. ALLOW ADEQUATE TIME FOR THE PROCESS

Good things take time and expense, and wfgSLs are no exception. Patients must understand that the process is longer than prescribing a tSL and is considered a premium option. As such, they will have an increased cost associated with them. In our office, we find the process adds approximately two to three additional lenses (one being the alignment lens) and associated visits to finalize.

6. GET USED TO IT

Neural adaptation is an important aspect of wearing wfgSLs. If you dispense the wfgSL in your office, be sure to educate the patient that there will likely be an adaptation period; this may occur over the course of several weeks. Our clinic saw a minority percentage of patients gain an additional line after a four-week period of wfgSL wear.[12]

7. PLEASE MIND THE OVERREFRACTION

For patients that take large astigmatic overrefractions, if these do not improve the vision as much as expected, do not incorporate them. Instead, create a wfgSL first, then overrefract. In my clinic, I have not yet seen a patient that actually needs a high astigmatic overrefraction after having their HOA reduced with a wfgSL.

8. A DOUBLE-EDGED SWORD

Residual HOAs are often thought of as only negatively affecting vision; however, they can also help presbyopes by creating multifocality. HOAs, specifically spherical aberrations, increase depth of focus. For our presbyopic patients, correcting their residual HOAs will improve their visual quality, but it will come at the expense of reduced intermittent and near vision. In patients wanting best clarity of vision at all distances, HOA correction and a pair of reading glasses will do. For those looking to reduce spectacle use, wavefront-guided lenses can still be used in a monovision set-up.

9. LINE 'EM UP

Many shortcomings of multifocal contact lenses are due to an inability to align the optics to the line of sight. As wavefront-guided optics are inherently placed on the line of sight, accounting for lens rotation and centration, this technology can place multifocal optics exactly in the center of the line of sight. The tech makes it easy to put multifocal optics right where they are needed. This is

the lowest hanging fruit of this technology, creating visual axis aligned multifocals.[13]

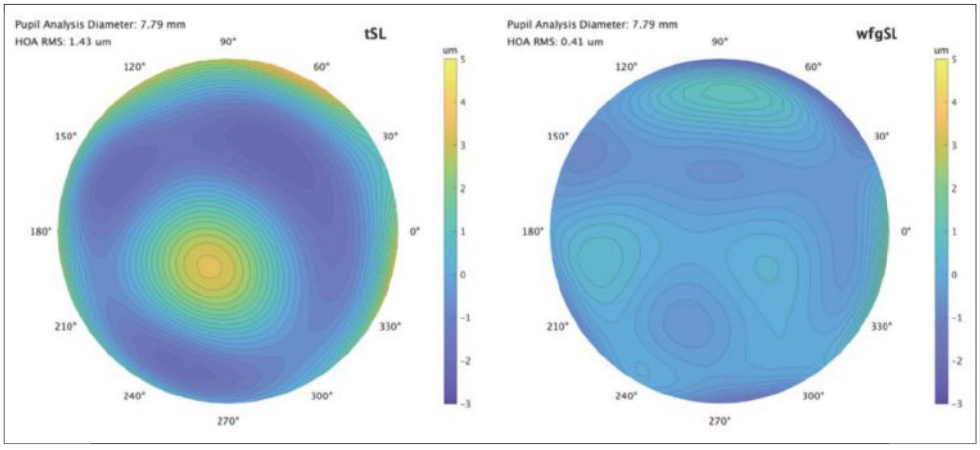

Fig. 3. Comparison of wavefront maps of the patient from Fig. 2. wearing the tSL vs. wfgSL.

10. INDUCE WHAT'S DESIRED

Wavefront-guided optics are primarily used to reduce residual HOAs, subsequently improving visual quality, but they can also be used to induce select aberrations. For example, unwanted HOAs can be eliminated, but with the possibility to add back in the right amount of spherical aberration to create an extended depth of focus (EDOF) and an exceptional multifocal option for patients—especially those with irregular corneal astigmatism. This option is a wavefront-guided EDOF SL. We have observed cases in our clinic where the tSL has more HOA and worse visual performance than the wavefront-guided EDOF SL.[14]

11. AM I MAKING MYSELF CLEAR?

Clear media is important, but not vital. A corneal scar or other media opacity can cause a patient to experience symptoms of smearing, ghosting or glare. Though our experience shows these patients exhibit less improvement with wfgSLs than those with clear media, improvements can still be achieved, so don't entirely rule out these patients. In our practice, a wfgSL will be attempted for a patient with a corneal scar before performing a corneal transplant. For cataracts, though, since the procedure is commonly and successfully performed, we will readily operate on those who are ready. That said, these lenses have worked well on those with intraocular lenses and after penetrating keratoplasty.[15]

12. RAPID CHANGES

One factor that can be difficult to correct with wfgSL is rapid optical changes, such as the echelettes on a diffractive intraocular lens, intracorneal ring segments that are inside the pupil or SL optic zone edge bisecting the pupil. All of these are difficult for a wfgSL to correct, and in several patients, these implants need to be removed or exchanged. Despite this, not all intracorneal ring segments are the same—outside of the US, there are a variety of brands and models with different optic zone sizes available, ranging from 4mm to 7mm. In the US, the brand-name intracorneal ring segments, Intacs (Addition Technology Inc.), are typically used and have a larger optic zone of approximately 7mm. Our experience with patients with Intacs is that wfgSL correction can be achieved with similar results to those without.[16]

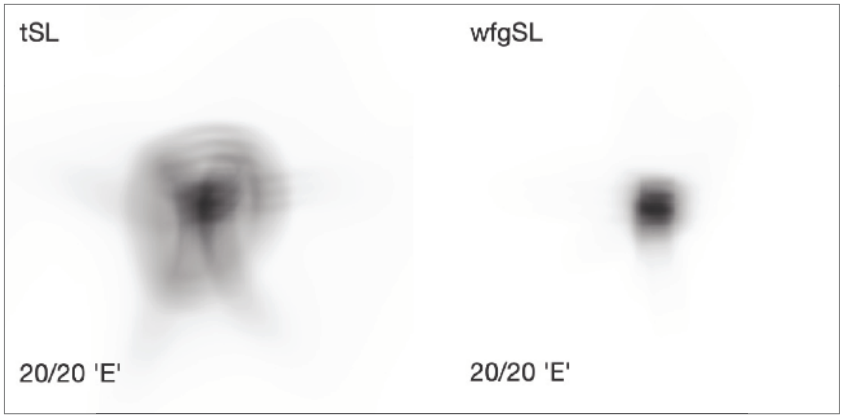

Fig. 4. Comparison of how the same patient would see an 'E' on the 20/20 line on a traditional Snellen eye chart. The patient gained one line of visual acuity wearing the wfgSL compared to the tSL. This is simulated using wavefront aberrometry data using a 7.8mm pupil diameter.

13. TO CUSTOMIZE OR TO OPTIMIZE?

WfgSL vs. eccentricity: what's the difference and when do you use them? WfgSLs are fully customized to the individual's HOA optical profile to correct each individual HOA. Eccentricity differs by not being customized to the individual's profile, but instead is there to optimize spherical aberration only by changing the lens' peripheral optical focus. If a lens with eccentricity control

Fig. 5. Comparison of the PSF of the same patient wearing the tSL (left) and wfgSL (right). This is simulated using wavefront aberrometry data using a 7.8mm pupil diameter.

was perfectly centered on the visual axis, eccentricity would only alter the amount of spherical aberrations present. Do keep in mind, they can still be useful in reducing HOAs, but in our experience, to a much lesser degree.[17] Our clinic uses eccentricity when the lens is not rotationally stable, as eccentricity is rotationally symmetric, so there is no impact from a lens that rotates out of position. We use this simple principle: Stable lens? Use wavefront-guided optics. Unstable lens rotation? Use eccentricity.

TAKEAWAYS

Technology such as wavefront-guided optics and elevation-specific lens design are currently creating more sophisticated lens shapes that may offer superior stability, especially when coupling them with customized optics. We are in a new era of specialty contact lenses, and device-driven technologies such as wfgSLs may serve to better the lives of the patients we care for. RCCL

Adapted from the October 2023 edition of Gas Permeable Lens Institute's publication, The Advisor, titled "Understanding Wavefront Aberrometry and How to Take Vision from Subpar to Super with Wavefront Guided Scleral Lenses." Join the GPLI at gpli.info to read the unabridged version and view their library of resources.

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A Deep Dive on Dropout

The TFOS systematic review on this issue highlights some gaps in our knowledge.

Since the introduction of soft contact lenses over 50 years ago, the number of dropouts each year worldwide has unfortunately remained high. To enhance awareness of the potential lifestyle choices in wearing lenses on ocular health, the Tear Film and Ocular Surface (TFOS) group empaneled a writing committee. The aim was to review critical literature and identify gaps in knowledge to stimulate future direction for novel research.[1] One area of significant interest was lifestyle factors that might impact the number of soft lens dropouts using a systematic review.[1]

SOBERING STATS

The key factors causing dropouts are discomfort and dissatisfaction with vision, especially in patients with significant astigmatism and presbyopia in particular.[1-4] Additional factors contributing to high dropout rates are the patient's inability to handle lenses, cost and convenience/disinterest in continuing lens wear.[1-3] Sobering estimates place the rate of contact lens–related dropouts at about 25% of wearers over a two- to three-year period.[1] Other reports estimated the rate to range from 12% to 27.4%.[2]

The TFOS systematic review attempted to investigate associations between environmental exposures (*e.g.*, climate, temperature, health status, allergies, pollution) and behavioral lifestyle factors (*e.g.*, contact lens handling abilities, wear schedule, adherence, patient motivation, occupation) and the frequency of lens wear dropout.[1] Eligible study designs used for the review were randomized clinical trials (n=15) or retrospective and prospective cohort studies (n=19). The conclusion of the review is a sobering reminder that the rates of dropout are unacceptable. The need exists for future population studies looking at factors for high quality data that might contribute (*e.g.*, lens type/design, material, patient age) to fully capture the reason(s) for dropouts.[1]

DROPOUT RATES BY LENS TYPE AND POPULATION[1]

Let's review this startling information. For more detail, refer to the full TFOS report.

- ***Dropout for multifocal lens wear***: 72% at one month, 42% at three months, 20% to 24% at six months and 26% to 54% at one year of follow-up.
- ***Dropout for children wearing lenses***: 9.5% to 17% at three months.
- ***Dropout for lens wear for myopia control***: 11% to 43% at two years, 36% at six years.
- ***Dropout for astigmatism patients***: 4.5% at one month, 18% at two years.
- ***Dropout for daily disposable wearers***: 2% to 4.3% at four weeks, 11% to 23% at one year, 25% to 29% at two years.

MOVING FORWARD

The question that looms for practitioners: What might we do to reduce this number each year? A joint effort and a shared responsibility among the stakeholders—clinicians, researchers, manufacturers and patients—is essential to reduce the rate of dropouts.[4] We have to remind ourselves that a good number of these patients can be refitted with new lens options; so a second chance is often in order.[2,4] If offered a chance to resume wear after offering a problem-solving option, the success rate in resuming lens wear was 74%.[2]

We certainly welcome new products to help salvage those contact lens patients who have been lost. Practitioners should constantly monitor research, assess new products and be willing to try new options when made available.

We thank TFOS for taking this "deep dive" into the important questions surrounding contact lens dropouts. We end up having more questions than answers, but many of the missing gaps in knowledge have been identified. They have clearly pointed out that further work employing high level studies is needed to provide quality information. For example, they ask whether there is a significant difference among materials and designs, if there is a difference in the rate of dropouts between males and females and different age groups (presbyopes) and what strategies can be employed to reduce the rate of dropouts.

The potential role for daily disposable lenses to ward off dropouts to mitigate the lifestyle challenges posed in wear also requires further study. Remember to closely monitor for patient satisfaction. When previously unsuccessful patients who present are motivated, you should remain tenacious in offering additional options and strategies. RCCL

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By Christine W. Sindt, OD

Rated PG

Though benign, pyogenic granulomas can cause discomfort and aesthetic concern.

A 22-year-old male presented with concerns of a painless mass in his inferior fornix. His medical history was largely unremarkable except for the use of retinoid cream for the treatment of acne. Upon examination, a highly vascularized, pedunculated mass was observed growing from the inferior palpebral conjunctiva. He was diagnosed with a pyogenic granuloma (PG) and started on a course of topical steroids. It had resolved by his four-week follow up.

Conjunctival pyogenic granulomas are benign, non-neoplastic, fast-growing vascular proliferations located on either the palpebral or ocular surface conjunctiva. They often appear as fleshy, red, smooth, polypoidal or pedunculated nodules. PGs may bleed if disturbed. They are associated with chronic trauma (*e.g.*, contact lens or foreign body irritation) pregnancy, viral infections, use of medications such as retinoids, antiretrovirals and anti-neoplastics, and Sturge-Weber syndrome. It has been proposed that tissue injury activates a neovascular pathway, promoting cell proliferation.[1]

There is no ethnic or gender predilection and PG may appear at any age, although it is more common in younger patients. PG resembles granulation tissue; however, histopathology shows branching endothelium-lined vessels with inflammation and edema without granuloma formation. PGs are classified as either a lobular or non-lobular capillary hemangioma. Fibrosis can be observed as the tissue regresses.

If left untreated, conjunctival PG may spontaneously regress; however, depending on the location and patient tolerance of the lesion, therapeutic treatment is recommended. Treatment options include excisional surgery, cryotherapy, electrocautery, laser ablation and topical medical therapy.

Medical therapy is the recommended first-line treatment for conjunctival PG. Options include topical steroids and topical β-blockers. While the anti-inflammatory effects of steroids have been the historical treatment, BID dosing with a nonselective β-adrenergic antagonist such as 0.5% timolol is growing in popularity. β-blockers cause vasoconstriction of blood vessels within the lesion, leading to vascular growth factor inhibition and cellular apoptosis. β-blockers also have a lower adverse event profile compared to steroids. RCCL

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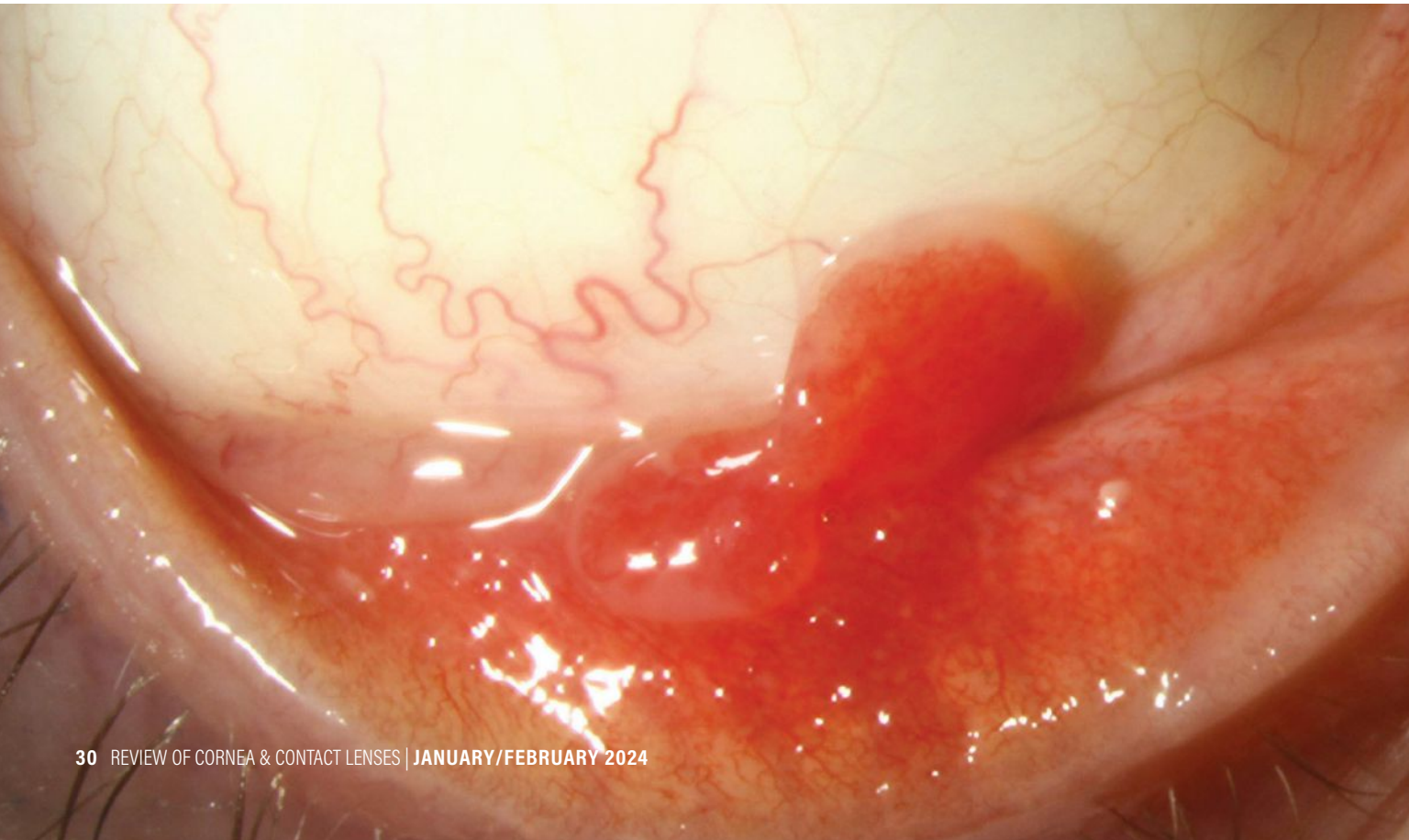

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