You Can Manage Irregular Corneas

Use large-diameter lens designs to offer your patients superior visual acuity and comfort. **By Gregory W. DeNaeyer, O.D.**

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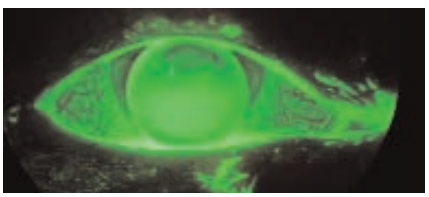
All contact lens fitters at one point or another encounter patients who have irregular astigmatism, which reduces best-corrected visual acuity with glasses or soft contact lenses. Irregular astigmatism may be induced by a variety of causes, including keratoconus, trauma and post-surgical complications. Most of the time, gas-permeable (GP) contact lenses are able to improve the patient's acuity by masking these irregularities. In fact, it is not uncommon for someone who is severely visually disabled to regain near normal vision with a properly fit GP lens.

Modern contact lens practitioners commonly use corneal GP lenses (12mm diameter or less) to fit these patients because they have experience correcting for regular ametropia with this size lens. Sometimes these corneal GP lenses, either standard or specialty, work beautifully and provide the patient with both acceptable acuity and comfortable lens wear. But, in some severe cases, corneal lenses can end up frustrating both the patient and the doctor by causing discomfort or unstable acuity secondary to a poor contact lens fit.

Fitting corneal GP lenses on patients with severe corneal irregularity can be challenging for several reasons. A corneal GP lens tends to center where the cornea is steepest. This works well if the steepest area of the cornea happens to be in the center, but if the steep area is in the mid-periphery or peripheral cornea, the lens will decenter toward this area *(figure 1)*. A decentered corneal lens is less comfortable, can spontaneously expulse from the eye, and reduce acuity by exposing the peripheral non-optical portion of the lens to the patient's visual axis. Another potential instance of corneal GP lens failure may occur when they are used to manage extreme topographical irregularities. Corneal lenses are fit to align with the cornea and are unable to hold a significant tear volume (less than 40µm). When a practitioner uses these lenses to vault and mask extreme irregularities, an air gap is left in the low area *(figure 2)*. A bubble forms at the gap and, if large enough, it can lead to corneal desiccation and visual disruption.

Large Diameter Lenses to the Rescue

Large diameter lenses, which we will define for this article as being



1. Decentered corneal GP lens on a Keratoconus patient.

greater than 14mm in diameter, have many advantages when fitting the irregular corneal patient. The large size allows most of the weight-bearing force to be distributed on the sclera, which is less sensitive than the cornea, making the lens more comfortable to wear. Since these lenses cover the entire cornea, centration is almost never an issue. GP lenses that are greater than 18mm in diameter can hold a large reservoir of tears, which makes it possible to mask extreme corneal irregularity without having to compromise touch and vault, as you must often do with corneal GP lenses. Three large lens designs—hybrid, mini-scleral and scleral lenses—are available to help all practitioners satisfy their toughest irregular corneal patients.

Hybrid Contact Lenses

Hybrid contact lenses consist of a GP center surrounded by a soft lens portion. The idea behind this lens design is that the patient benefits from the central GP optics, but has the comfort of a soft contact lens. The hybrid contact lens was first developed over 20 years ago with the Saturn II lens (Precision-Cosmet) and then a few years later evolved to the Soft Perm design (CIBA Vision). The concept was good and popular among practitioners and patients, but low Dk materials and limited lens parameters have caused many patients to fail with this lens. SynergEyes Inc., has recently released an improved hybrid design, incorporating an 8.4mm high Dk GP center (Paragon HDS 100) and the availability of multiple soft skirt (hemiberfilcon A) radii for each base curve. All lenses have a diameter of 14.5mm. The SynergEyes hybrid lenses come in three different designs that can be used for irregular corneas: SynergEyes A (standard design), SynergEyes KC (keratoconus) and SynergEyes PS (oblate corneas/post-surgical).

SynergEyes Hybrid Designs

SynergEyes A	
Base curves	7.10D to 8.0D
Steps	0.2mm
Skirt curves	1.0mm (steep), 1.3mm (medium)
Powers	-20.00D to +20.00D
SynergEyes KC	
Base curves	5.70mm to 7.10mm
Steps	0.2mm
Skirt curves	steep, medium, flat
Powers	plano to -20.00D
SynergEyes PS	
Base Curves	7.60D to 9.00D
Steps	0.1mm
Skirt curves	8.3mm, 8.6mm
Lift Values	L1(flat), L2(medium), L3(steep)

Fitting the SynergEyes A or KC Hybrid lens

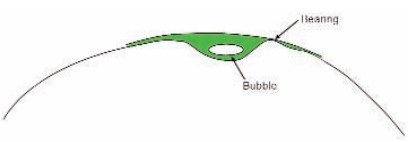
Starting with a trial set will greatly enhance your success with difficult fits because there are too many variables unaccounted for in empirical fitting. The initial lens should have a base curve that is equal to the steepest keratometry reading. A unique property of hybrid lenses, one that is counterintuitive to fitting all other lenses, is that a steeper fitting lens is less likely to seal to the eye. A hybrid lens that is sealed to the eye without movement induces lens intolerance and keratitis. After determining the base curve, select the initial trial lens that has the flattest skirt curve radius. Instill a few drops of high molecular-weight fluorescein to the center of the lens before application. Evaluation is best done with a cobalt light and yellow wratten filter. The ideal fit shows complete corneal clearance of approximately 9mm. Steepen the base curve until this is achieved, and avoid bubbles that are greater than 1mm. There should a feather touch of the lens on the cornea just beyond the 9mm diameter. Heavy bearing at this juncture will cause the lens to tighten and seal to the eye. This can be remedied by choosing a steeper skirt curve. If this change, which essentially lifts the lens, induces a central bubble, then flatten the base curve by 0.1mm. The soft skirt should align with the sclera. Fluting of this skirt can be corrected for by steeping the skirt radius, and conjunctival or scleral impingement can be reduced by flattening the skirt radius.

Once the best trial lens is in place, an over-refraction is all that is needed to determine the final power.

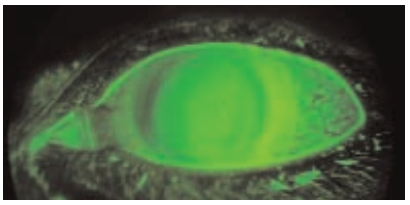
Fitting the SynergEyes PS Hybrid lens

Fitting the PS lens is very similar to fitting the A or KC designs with one exception: This design has a sagittal depth factor (shallow, medium or deep) that allows the practitioner to vary the depth of the lens independent of the base or skirt curve. Adjusting this parameter allows for fine-tuning of the fit after the best base and skirt curve have been selected.

When it comes to lens care for the SynergEyes lens, the manufacturer recommends Optifree Express (Alcon), Complete (AMO), Oxysept (AMO), ReNu Multiplus (Bausch & Lomb), Clear Care (CIBA Vision) and Aquify (CIBA Vision).



2. A corneal GP lens is not able to hold enough tear volume to mask extreme corneal irregularity.

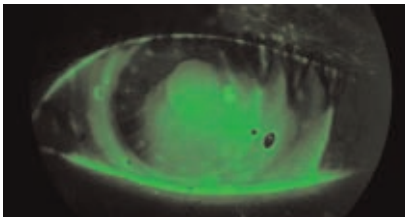


3. SynergEyes KC lens on the left eye of keratoconus patient showing 100% corneal clearance.

SynergEyes Case Example

A 27 year-old male patient with keratoconus, presented for a contact lens fitting for his left eye. His best-corrected visual acuity with glasses was 20/80 O.S., and he previously failed in GP lenses secondary to discomfort. Topography showed moderate to severe keratoconus. The slit lamp exam showed no evidence of scarring. After diagnostically fitting the patient with SynergEyes KC trial lenses, a lens with a base curve of 6.1mm, skirt curve of 8.2mm and power of -9.50D was ordered.

The lens showed complete central corneal clearance and peripheral alignment, and the patient's vision was 20/20. He wore this lens on a daily basis using Clear Care as his care system. The patient returned for a two-week contact lens check with no problems, but showed up for an emergency visit 10 days later with moderate keratitis in his left eye. This was most likely due to late-onset lens tightening of his hybrid lens. The patient was kept out of the lens until resolution. Another lens was ordered with a steeper skirt curve of 7.9mm, which effectively steepened the lens and took pressure off the cornea. The patient has successfully worn this final lens for one year with 20/20 vision and comfortable wear without incident *(figure 3)*.



4. Mini-scleral contact lens on a corneal transplant.

Mini-Scleral Lenses

Mini-scleral contact lenses are GP lenses with a 15mm to 18mm diameter and modern designs utilize hyper-Dk materials. Ideally, the mini-scleral lens rests on the scleral conjuctiva and vaults the cornea, including the limbus. Corneoscleral (12.9mm to 13.5mm) and semi-scleral (13.6mm to 14.9mm) lenses differ in that they may be fit with some corneal support. Just as is the case with Hybrid lenses, fitting mini-scleral lenses is best accomplished with the help of a trial lens set. When vaulting the cornea, the best lens must have a larger overall sagittal depth than the anterior surface that it covers. This is unlike corneal GP lenses, the fit of which are determined by the relationship of the base curve to the corneal curve.

When selecting the initial trial lens, a good place to start is a base curve equal to the steepest corneal curvature plus 1.00D. Remember: You are not fitting the lens based upon curvature; but, the base curve in part determines the sagittal depth (i.e., the steeper the base curve of the lens, the greater its sagittal depth). Also, keep in mind that a patient may have a steep corneal curvature, but a relatively shallow overall anterior segment sagittal depth (i.e., a scleral lens with a 42.00D base curve may clear a cornea with 50.00D keratometry reading). The first lens will offer the best idea of how to proceed.

Start out by putting a drop of fluorescein in the trial lens and place it on the center of the patient's eye. Observe the fluorescein pattern with a cobalt light and yellow wratten filter. Find a trial lens that exhibits complete corneal vault, including the limbus. From this point, selectively try flatter lenses to reduce the vault until any area of the lenses almost touches the cornea. Ideally, there should be 10µm to 30µm of clearance over the entire area of the cornea. If you are above this range of clearance with a mini-scleral lens, bubble formation will most likely be seen. Unlike scleral lenses, mini-scleral lenses are unable to hold large tear reservoirs.

Next, examine the periphery of the lens, which should rest evenly on the scleral conjunctiva. There should be no movement by the lens; if movement occurs, it will cause your patient discomfort. These lenses are designed to be semi-sealed to the eye and to hold a small tear reservoir, and tear exchange slowly occurs secondary to peripheral lens flexure with blinking. If there is movement or edge lift, the periphery will need to be tightened. Conversely, if the lens is too tight, the conjunctival vessels will blanch and the periphery will need to be flattened. An over-refraction with the best trial lens in place will give you the final power.

Case Example Mini-Scleral GP lenses

A 59 year-old male patient with keratoconus had a corneal transplant in his left eye six years prior and now desired to be fit with contact lenses. The patient's transplant was so irregular that the computer was unable to produce a topographical map. We decided to try a mini-scleral contact lens to avoid centration and stability issues. After a trial lens fitting, the patient was dispensed a Jupiter 15.00mm diameter mini-scleral lens (Medlens

Innovations) with a base curve of 46D and power of -7.75D. The lens nicely vaulted the cornea, and his visual acuity was 20/25 O.S., *(figure 4)*. The patient was able to wear this lens comfortably for 16 hours per day.

Scleral Contact Lenses

Scleral GP contact lenses have diameters greater than 18mm (18.1mm to 24mm), and unlike mini-scleral contact lenses, these lenses are able to hold a large reservoir of fluid—40µm to 500µm. The amount of microns can be estimated by turning the slit-beam to the side and comparing the reservoir stained with fluorescein to the cornea *(figure 5)*. This liquid reservoir makes scleral contact lenses superior at masking extreme amounts of corneal irregularity. It also allows scleral lenses to be used as bandage lenses to treat patients who have chronic and severe dryness secondary to systemic conditions such as Stevens-Johnson syndrome or graft vs. host disease. Modern scleral designs are made with hyper-Dk materials. The ideal fit of a scleral lens is when the lens rests on the sclera and completely vaults the cornea, including the limbus. Because scleral lenses also utilize a semi-sealed design that holds a reservoir, no movement should be observed upon blinking. Tear exchange occurs secondary to peripheral lens flexure with blinking, but any lens movement will cause discomfort for the patient. The fitting technique for scleral lenses is similar to that of mini-scleral lenses, except that these lenses need to be filled with a non-preserved saline solution before insertion. Remember to add some fluorescein for diagnostic purposes. Once you have a trial lens that completely vaults the cornea, including the limbus, evaluate the scleral section. Ideally, the lens will align with the scleral conjunctiva without blanching or compression *(figure 6)*. If blanching is observed, the peripheral curves will need to be flattened. The peripheral curves may need to be steepened if there is any lift or movement. Over-refraction of the best fitting trial lens will give you the correct power.

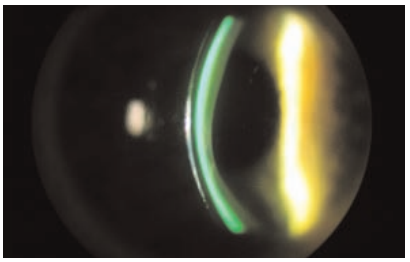
Case of Scleral Contact Lens

A 45-year-old male with keratoconus (greater O.S. than O.D.) came in for contact lens evaluation. His best correction with glasses or soft contact lenses in the left eye was 20/80. Topography showed mild to moderate keratoconus, and slit lamp exam showed a clear left cornea without scarring. After discussing options with the patient, he decided he wanted to try a scleral contact lens in order to maximize stability, comfort and vision of his left eye.

After fitting, he was dispensed an Jupiter 18.2mm-diameter scleral GP lens (Essilor) with a base curve of 48D and refractive power of -5.25D (figure 7). The patient was able to see 20/20 with the lens in place, and wears the lens comfortably 16 hours per day.

Lens Care for Mini-Scleral and Scleral Contact Lenses

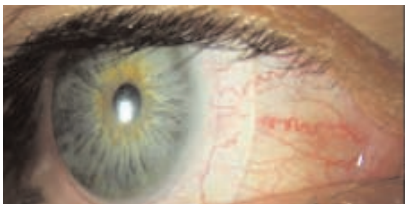
GP or soft lens multipurpose solutions may be used for cleaning and disinfecting mini-scleral and scleral GP lenses. An important point is that tear exchange behind these contact lenses is much slower than that for smaller GP lenses. With this in mind, it is best to rinse the lens with a non-preserved saline solution before application. Soft lens multipurpose solutions are less viscous and rinse away easily.



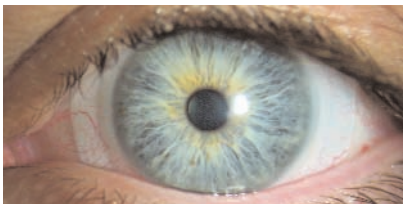
5. Cross section of a scleral contact lens fit on a eye with keratoconus. Fluid reservoir is stained with fluoroscein.

Build Knowledge, Improve Comfort

The use of large-diameter lenses has reached a tipping point in today's modern specialty lens practice. Rather than merely fit the irregularity, these lenses are able to vault it completely, which improves centration, comfort and vision. The concept of large lens fitting and design is different from that of standard lenses, and so it is important to understand these concepts in order to ensure success. Once you are able to comfortably fit large-diameter lenses, you'll find that improving a patient's vision with a lens that they are able to wear with ease is not only a rewarding experience for you, but also a great benefit for your practice. RCCL



6. Alignment fit of scleral section.



7. Scleral lens fitting a keratoconus eye.