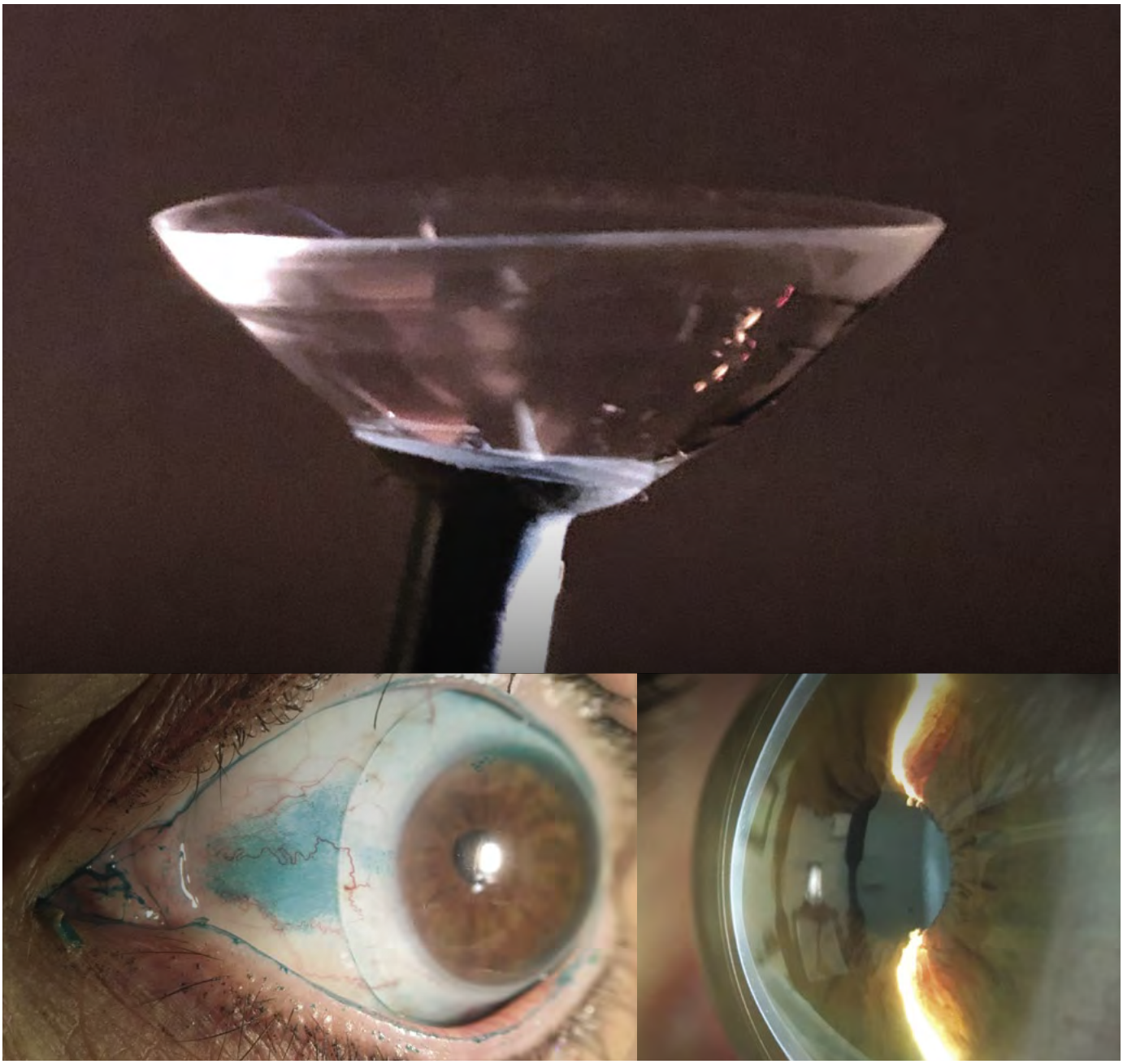
SCLERAL LENSES 2021

# THE SCLERAL LENS

## EDUCATION INITIATIVE



Everything from the history and basics of getting started with scleral lenses to all the information and resources you need when working with them.

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Review of Optometric Business

SCLERAL LENSES 2021

# THE SCLERAL LENS

EDUCATION INITIATIVE

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## ON THE COVER

The main indications for scleral lenses (top) are irregular cornea, such as keratoconus (bottom right) and ocular surface disease (bottom left). Photos by John D. Gelles, OD.


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# Introduction to Scleral Lenses

By Melissa Barnett, OD, FAAO, FSLS, FBCLA, and John D. Gelles, OD, FIAO, FCLSA, FSLS , FBCLA

To our colleagues,

It is an honor for us to curate this comprehensive document on scleral lenses. The goal is to provide a comprehensive scleral lens resource featuring published research, evidence-based clinical recommendations, and expert-backed insights. The information contained is clinically relevant and applicable to practitioners with all levels of experience.

We were fortunate to bring together many of the world's foremost experts to author the various sections of this supplement. Within the supplement, you will find topics on the background and history of scleral lenses, indications for scleral lenses, the importance of collaborative care, how to get started with scleral lenses, modern scleral lens designs, patient management, business management, alternatives to scleral lenses, and resources for continuing education, laboratory partners, diagnostic equipment, and more.

Modern scleral lenses are large-diameter devices made of rigid, gas permeable material used to manage a wide variety of cornea, refractive, and ocular surface disease states. Scleral lenses are applied to the ocular surface with sterile saline, resting on the overlying conjunctiva and sclera while vaulting over the corneal surface. The beauty of scleral lenses is that they provide mechanical protection and continuous fluid immersion to repair the ocular surface under the lens along with refractive improvements by reduction of corneal-induced aberrations. Their application in clinical practice requires a complete understanding of the ocular and systemic disease state.

**We hope you find this supplement useful to augment your scleral lens practice.**

Sincerely,

Melissa and John



**John Gelles, OD, FIAO, FCLSA, FSLS, FBCLA**, is the director of the specialty contact lens division of the Cornea and Laser Eye Institute and the CLEI Center for Keratoconus in Teaneck, N.J. He is an assistant clinical professor at Rutgers New Jersey Medical School, Department of Ophthalmology and Visual Science, and an adjunct clinical professor at State University of New York College of Optometry, Illinois College of Optometry, and New England College of Optometry. He is a PROSE clinical fellow and a fellow of the Contact Lens Society of America, the Scleral Lens Education Society, the British Contact Lens Association, and the International Academy of Orthokeratology and Myopia Control. In addition, he is a board member of the Contact Lens Society of America, an executive board member and the education chair of the International Keratoconus Academy, an advisory board member for the Gas Permeable Lens Institute, the education chair of the Intrepid Eye Society, the chair of Refractive Surgery Alliance's collaborative care section, and he serves on the American Academy of Optometry's innovations council. His clinical work is dedicated exclusively to specialty contact lenses and the management of keratoconus, corneal disease, ocular surface disease, and post-surgical corneal conditions. Additionally, he is an investigator for multiple keratoconus and specialty contact-lens-related clinical trials at CLEI and a consultant for numerous related technology and ophthalmic companies.

**Melissa Barnett, OD, FAAO, FSLS, FBCLA**, is a principal optometrist at the University of California, Davis Eye Center. She is an internationally recognized key opinion leader, specializing in dry eye disease and specialty contact lenses. Dr. Barnett lectures globally and publishes extensively on topics including dry eye, anterior segment disease, contact lenses and creating a healthy balance between work and home life for women in optometry. She is Chair of the American Optometric Association Contact Lens and Cornea Section, a Fellow of the American Academy of Optometry, a Diplomate of the American Board of Certification in Medical Optometry, a Fellow and Global Ambassador of the British Contact Lens Association, serves on the board of the Gas Permeable Lens Institute and the International Society of Contact Lens Specialists, and she is Past President of The Scleral Lens Education Society. Drs. Melissa Barnett and Lynette Johns authored and edited the book *Contemporary Scleral Lenses: Theory and Application* with the unique perspectives and contributions of international experts. Dr. Barnett most recently chaired the CLEAR report on scleral lenses. She is currently serving on the Tear Film & Ocular Surface Society (TFOS): A Lifestyle Epidemic Ocular Surface Disease Workshop. Dr. Barnett was awarded the inaugural Theia Award for Excellence for Mentoring by *Women in Optometry*. She was granted the Most Influential Women in Optical from *Vision Monday* in 2019. Dr. Barnett and Dr. Tom Arnold are co-hosts of the popular podcast GlobalEyes and are co-chairs of ICSC, solely dedicated to scleral lenses.

# Scleral Lenses: The Early Days and Beyond

By Lynette K. Johns, OD, FAAO, FSLS, FBCLA

PHOTO CREDIT: MELISSA BARNETT, OD, FAAO, FSCS, FBCLA; GETTY IMAGES/ MALERAPASO

**Figure 1: Glass scleral lens handmade by Josef Dallos from the Ezekiel/Caroline Collection.**

Scleral lenses have come a long way since their infancy. Many believe that Leonardo da Vinci was the first to theorize a contact lens. When viewing his illustration of a man's head face down in what appears to be a bowl of water in his Codex D, folio 3, of 1508, several assumed it was the early conceptualization of a contact lens. However, a translation of the Codex by Robert Heitz suggested that it was discussing neutralization of the optics of the eye.[1,2] René Descartes, more than 100 years later in 1637, published his Discourse of La Dioptrique, which illustrated a fluid-filled tube held against the eye that would enlarge the size of the retinal image. Unfortunately, the sealed elongated glass tube would have to be filled with water and held up to the eye for it to work, which is clearly not practical, especially if the tube had to be lengthened to increase the retinal image size.

In the 1800s, ocularists were using glass for prosthetics. In 1859, William White Cooper utilized glass as an early symblepharon ring. This shell mimics a scleral lens without a central optic zone. Later that century in 1887, ocularist brothers, Fredrich A. and Albert C. Müller fit a patient who was missing the lower lid due to carcinoma and had a partial upper lid. This patient wore a clear glass cover shell without optical power on an extended wear basis to protect the ocular surface until his death in 1907.[1,4] This is similar to the current utilization of scleral lenses to support and protect the ocular surface.

Early scleral lens animal studies were performed by Adolf Gaston Eugene Fick in which he fit rabbits with scleral lenses, then himself, and eventually on volunteers. These lenses were not powered, but one subject experienced improved vision. Fick was the first to publish on scleral lenses in 1888.[5,6] Eugène Kalt was the first to correct keratoconus with a scleral lens; however, sadly, he never went on to pursue these lenses.[6,7] In 1889, a medical student, August Müller (not related to the Müller brothers), ordered a lens with a front and back optic zone to correct his own -14.00 diopter refractive error.[8,9] Interestingly, August Müller inserted his lenses underwater to prevent bubbles; whereas Fick found that the bubbles increased the time before the onset of "Fick's phenomenon," also known as "Sattler's veil," which causes visual rainbows and a slow gray clouding of vision that indicates corneal edema.[1] This is not unlike issues with corneal hypoxia and endothelial dysfunction with scleral lenses, particularly in patients with corneal transplants.

The first diagnostic fitting sets were created in 1911 by Zeiss, as well as a keratoconus trial set created in 1916.[1] These sets were made of ground glass, which had better optics but poorer comfort than blown glass. The first molded or impression-based lenses were designed by Fick on cadaver eyes. He also found that the sclera and cornea had two different radii of curvature and that the conjunctiva flatted peripherally from the cornea. The first "hybrid" lens was created in 1927 by Adolf Wilhelm Müller-Welt (again, not related to the other Müllers). Glass was blown over toric castings for the scleral portion of the lens, and ground glass was used for the central optic portion.[1]

PHOTO CREDIT: CONTACT LENS MUSEUM

**Glass scleral lens diagnostic set manufactured by Philip Beilby, Australia, circa 1938.**

**Molding on living subjects occurred in 1929 by Josef Dallos.**

Molding on living subjects occurred in 1929 by Josef Dallos. He used a scleral lens as a tray for Negocoll seaweed-derived molding agents. From those molds, brass molds were created in which softened glass was pressed onto the mold to create the scleral portion while the central glass was ground and polished for the optical portion.[1] Figure 1 shows one of Dallos' glass scleral lenses. Many materials were used as molding materials, and today, impression-based scleral lenses and molding material evolved into an optimal option for patients, especially those with complex ocular surfaces.

Scleral lenses played a role in the Royal Air Force in World War II. A survey of the 1850 patients fit between 1935 and 1945 was returned by 875 patients. These patients were mostly fit in glass scleral lenses because of keratoconus, irregular astigmatism, aphakia, mustard-gas keratitis, neuroparalytic keratitis, pemphigus, myopia, hyperopia, and high astigmatism. Only a few were fit in polymethyl methacrylate (PMMA). Of these patients, 39 percent inserted the lenses dry. When asked about midday removal, they removed the lenses throughout the day because of blurring/fading vision, pain, cleaning and refreshing fluid.[10] It is probably safe to assume that the fading of vision was due to corneal edema, but patients still refresh their lenses midday today for various reasons.

Many designs evolved through the years since the late 1880s with many innovators, scientists, and eye care practitioners. These designs

include: a series of conics (Zeiss), molded (Dallos, Obrig), tangential (Feinbloom), fenestrated (Dallos, Bier), and lens notching;[1] these methods are still used in various capacities today. PMMA was developed in the 1930s, and many scleral lenses transitioned to this material; however, Dallos continued to use glass well into the 1970s.[1] Scleral lenses fell out of favor with the advent of soft and corneal gas permeable contact lenses.

Fast forward to the breakthrough utilization of gas permeable materials in 1983 by Don Ezekiel in Australia. He designed scleral lenses with Boston II material that has a Dk of 16.4 in a fenestrated design. He fit 37 eyes for visual rehabilitation, and one was protective in nature.[11] This development revolutionized scleral lenses and marked the beginning of the modern-day gas permeable scleral lens. The usage of gas permeable materials also inspired the modern-day pioneers Ken Pullum from England, Rientz Visser from the Netherlands, and Perry Rosenthal from the United States. During the 1980s until the early 2000s, the fitting of gas permeable scleral lenses was predominantly performed among these practitioners. The first scleral lens to be approved by the FDA in 1994 was the Boston Scleral lens by Dr. Rosenthal. In the late 1990s, commercially available scleral lenses were launched.

Many of today's commercially available scleral lenses include design features of the original glass lenses such as conical series, toric and tangential scleral landing zones which have since evolved to quadrant specific and multi-meridional peripheries. Fenestrations are rarely used in the United States yet have their role in specific cases.[12] Impression-based fitting has also evolved with new molding materials and technology that scans the molds to design lenses. Scleral lens profilometry that measures scleral shape has taken empirical scleral lens design and fitting to a whole new level.[13] Recently, commercially available scleral lens optics have significantly transformed and include front toric, multifocal, decentered, aspheric, and wavefront-guided optics. It is an exciting time to see how scleral lens fitting and technology will advance. ■

**Lynette Johns, OD, FAAO, FSLS, FBCLA**, is a research associate at Harvard Medical School Department of Ophthalmology. She is an investigator at Massachusetts Eye and Ear Associates, where she also fits scleral lenses. Dr. Johns received her optometry degree from the New England College of Optometry, where she also completed a cornea and contact lens residency. She is a fellow of the American Academy of Optometry, Scleral Lens Education Society, and the British Contact Lens Association. She is an author and co-editor of *Contemporary Scleral Lenses: Theory and Application*. Dr. Johns received the Founders' Award from the AAO section of Cornea and Contact Lenses and Refractive Technologies in 2017, the EFCLIN award in 2018, and the Scleral Lens Society Fellow of the Year award in 2020. She has published and speaks internationally on scleral and specialty contact lenses and severe ocular surface disease.

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# Review of Indications for Scleral Lens Wear

By Muriel M. Schornack, OD, FAAO, FSLS

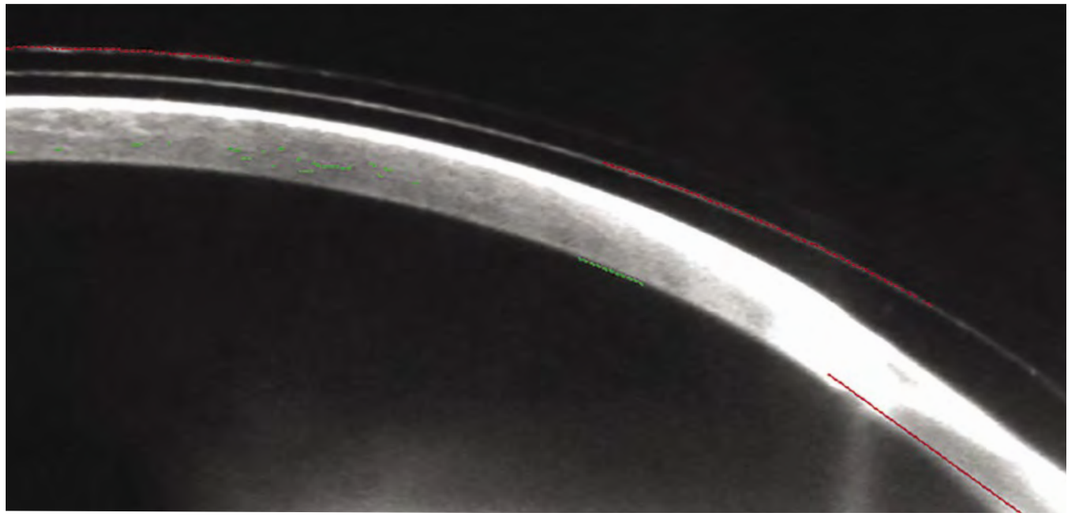

PHOTO CREDIT: MURIEL SCHORNACK, OD, FAAO, FSLS

**Figure 1: Scheimfplug image shows appropriate central clearance with significantly more limbal clearance in a patient who has undergone penetrating keratoplasty.**

The three major indications for lens wear are corneal irregularity, ocular surface disease, and correction of uncomplicated refractive error. The relative proportion of patients wearing lenses for each of these indications has been examined in several studies. A review of scleral lens-related literature summarized indications for scleral lens wear in 12 retrospective case series representing over 2,400 patients. Corneal irregularity was the predominant indication in the studies reviewed, accounting for approximately 76 percent of these patients. Approximately 22 percent wore scleral lenses for management of ocular surface disease, and only 2 percent wore lenses for correction of refractive error.[1] Respondents to the 2015 SCOPE study were asked to estimate the percentage of their patients with each of these indications. Averaged estimates of the distribution of patients across these indications were similar to those determined from literature review. An estimated 74 percent of patients wore lenses for corneal irregularity, ocular surface disease was the primary indication for 16 percent, and lenses were prescribed for correction of uncomplicated refractive error in 10 percent of patients.[2] In a third study, scleral lens practitioners were asked to provide information (including indication for lens wear) for a single patient. Of the 292 patients included in this study, indications for lens wear were distributed as follows: 87 percent for corneal irregularity, 9 percent for ocular surface disease, and 4 percent with refractive error. Multiple indications were identified for 1 percent of patients in this study.[3] Consistency between multiple studies of differing designs provides a level of confidence that these estimates of the distribution of scleral lens wearers across the three major indications for lens wear are reasonably accurate.



## Corneal Irregularity

Corneal irregularity was described as an indication for one of the earliest published accounts of the use of blown glass shells in the late 1800s, and it remains the most common indication for scleral lens wear today.[4] Although corneal rigid gas permeables (RGPs) have traditionally been considered the "gold standard" for management of conditions that cause irregular astigmatism, 34 percent of practitioners surveyed in 2015 indicated that scleral lenses were their first lens of choice for patients with corneal irregularity, compared to 44 percent of respondents who reported that corneal RGPs were their preferred first mode of optical correction for this indication.[5]

Scleral lenses may mitigate some of the issues associated with corneal RGPs. Rather than approximating alignment with the corneal surface,[6] a scleral lens simply vaults over the irregular tissue. Lack of contact between the posterior surface of the lens and anterior corneal surface should eliminate the potential for epithelial compromise and could potentially reduce the risk of scarring, which has been reported to be associated with corneal staining in patients with keratoconus.[7] Scleral contour may be mildly atypical in patients with corneal irregularity,[8,9] but it is usually possible to achieve adequate alignment between the lens and ocular surface, especially as scleral lenses with toric, quadrant-specific, or scanning- or impression-based landing zones have become more widely available. Scleral lenses tend to exhibit minimal movement on the ocular surface; lenses with specialized landing zones are also extremely rotationally stable. This stability facilitates incorporation of optical correction for residual astigmatic refractive error or even higher order aberrations onto the anterior lens surface. Because scleral lenses rest upon relatively sparsely innervated conjunctival tissue, and because the edge of the lid does not come into contact with the edge of the lens during blinking, patients who have been unable to tolerate corneal lenses due to discomfort may find scleral lenses considerably more comfortable.

**Keratoconus is the most common condition for which scleral lenses are prescribed.**

Keratoconus is the most common condition for which scleral lenses are prescribed, and use of lenses in patients with pellucid marginal corneal degeneration has also been reported.[2,3,10-13] Patients with corneal irregularity resulting from refractive surgery, keratoplasty, corneal trauma, or corneal infection have also been fit with scleral lenses.[14-20] Given the predominance of keratoconus as an indication for scleral lens wear, it is not surprising that a fairly robust body of literature related to this indication now exists. Positive visual outcomes have been reported.[10, 21-24] Several studies have suggested that scleral lenses may delay the need for penetrating keratoplasty.[25-27] The effects of scleral lens wear on corneal parameters have also been studied.[28] Recent publications have examined patient response to both corneal and scleral lenses and have reported that patients can achieve success with either option.[29,30]

When fitting patients with corneal irregularity with scleral lenses, several issues should be considered. Many patients with keratoconus have concurrent atopic[31] or ocular surface disease,[32] and patients may also experience symptoms of dry eye disease following refractive surgery. While scleral lenses may provide symptomatic relief, successful wear may depend upon active treatment of dry eye or ocular surface disease in addition to lens prescription. When fitting patients who have undergone penetrating keratoplasty, practitioners must appreciate the potential for hypoxic challenge to corneal endothelial cells.[33,34] It has been suggested that fitting relatively thin lenses with even and minimal clearance could best deliver oxygen to the cornea,[35] but high degrees of corneal irregularity may make this fitting goal difficult. Variations in post-lens fluid reservoir thickness vary even in eyes with regular corneal contour.[36, 37] (See Figure 1) Another fitting option may be to intentionally design lenses to facilitate tear exchange. Regardless of the fitting strategy employed, these patients require careful monitoring.

## Ocular Surface Disease

Scleral lenses provide distinct and unique benefits for patients with ocular surface disease. Unlike bandage soft contact lenses, the large diameter of a scleral lens covers a majority of the ocular surface, offering protection to both corneal and conjunctival tissue. The post-lens fluid reservoir maintains continuous hydration of corneal epithelial tissue, and the rigid

lens also prevents mechanical damage to the ocular surface due to shear forces from the blink. Neither punctal plugs nor placement of an upper lid weight maintain corneal hydration as effectively as a scleral lens. While surgical options (conjunctival flap or tarsorrhaphy) can provide comprehensive corneal protection, these procedures significantly impair vision. Scleral lenses provide excellent ocular surface protection and may actually yield an improvement in visual acuity.[38]

Broad categories of ocular surface disease that have been successfully treated with scleral lenses, along with specific conditions within each of those categories, include those identified here.

| |
|---|
| **Tear Film Insufficiency** |
| Sjögren syndrome[39-41] |
| Chronic graft versus host disease[42, 43] |
| S/P lacrimal gland resection[44] |
| **Exposure Keratopathy** |
| CN VII palsy[45, 46] |
| S/P lid surgery[47] |
| Graves ophthalmopathy[48] |
| **Neurotrophic Keratopathy[49-51]** |
| CN V neuropathy |
| Diabetes-related neuropathy |
| S/P refractive surgery |
| HZO/HSV-related neuropathy |
| **Cicatrizing Conjunctivitis** |
| SJS/TEN[52-54] |
| OCP[55] |
| **Corneal Dystrophy[38]** |
| **Other Conditions** |
| Limbal stem cell deficiency[38] |
| Neuropathic pain[38] |
| Undifferentiated dry eye disease[38] |

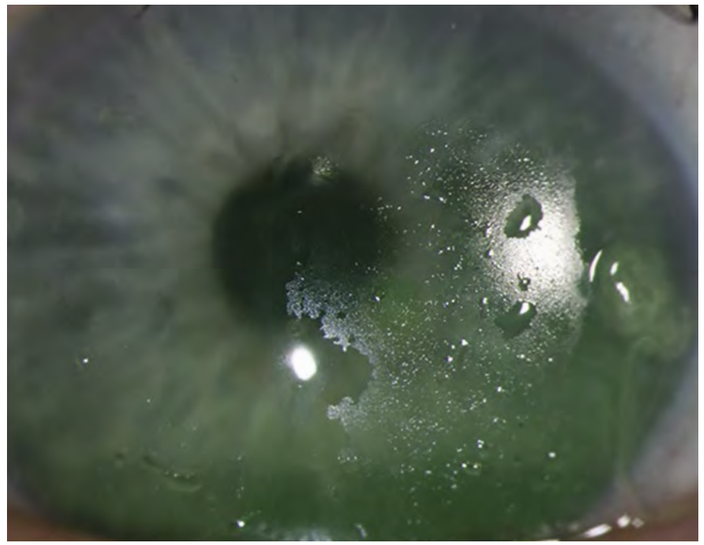

PHOTO CREDIT: MURIEL SCHORNACK, OD, FAAO, FSLS

**Figure 2: Surface deposits on a lens with Hydra-PEG coating in a patient with severe Sjögren's syndrome.**

The use of scleral lenses for management of ocular surface disease requires attention to the overall quantity and quality of the tear film. In patients with severe aqueous deficiency, placement of punctal plugs prior to scleral lens fitting, along with setting the expectation that the patient may require the use of preservative-free lubricant drops while wearing lenses, may be necessary to maintain the surface of the lens. Likewise, aggressive management of pre-existing Meibomian gland dysfunction may help to limit the deposition of lipids on the lens surface. While surface coatings may be helpful in reducing lens deposits for some individuals, other patients may find that they prefer lenses without the surface treatment so that they can use an alcohol-based cleaner to remove deposits. (See Figure 2)

Careful instruction on lens application and removal, along with detailed explanations on cleaning and care products, are critically important for patients with fragile corneas. Handling error or improper use of cleaning products represented the largest single category of scleral lens complications reported in a survey of scleral lens practitioners.[56] Use of a viscous solution to fill the bowl of the lens may be necessary to avoid entrapment of air bubbles in the post-lens fluid reservoir. Application aids, such as a lighted plunger, may reduce the risk of lens-induced corneal abrasion during application. In patients with extremely fragile corneas, it may be reasonable to place a bandage soft contact lens on the eye for application training and practice, with the understanding that the bandage lens will be removed when facility is achieved. Nutrifill, a solution containing electrolytes, may be a more appropriate solution with which to fill the bowl of the lens than saline for these patients, although there are currently no studies that demonstrated improved corneal epithelial integrity with this novel solution.



At present, patients with ocular surface disease represent a relatively small percentage of the entire scleral lens-wearing population. Fostering relationships not only with corneal specialists, but also with oculoplastic specialists, rheumatologists, hematologists, neurologists, and oncologists, could help raise awareness of the benefits of scleral lens wear for their patients' ocular comfort and quality of life.

## Refractive Error

Correction of uncomplicated refractive error with scleral lenses compared favorably to the use of soft toric lenses, according to a study published in 2018.[57] Despite this, patients with uncomplicated refractive error make up a relatively small percentage of patients wearing scleral lenses. A cross-sectional study published in 2017 suggests that patients who wear scleral lenses primarily for this indication may have relatively high refractive error or mild ocular surface disease.[3] Although patients may appreciate better visual quality with scleral compared to soft lenses, use of scleral lenses certainly introduces a more substantial burden of care and may be considerably more expensive than soft lenses. Many patients may find that the balance between cost, care, clarity, and comfort does not currently favor the scleral modality. However, as advancements in optical designs (such as multifocal lenses or correction of higher order aberrations) become more readily available, improvements in visual quality may shift that balance. Additionally, offering scleral lenses as one of several options for refractive correction could increase demand for the lenses among patients with uncomplicated refractive error. Improved quality of vision may justify increased care and handling time when a patient needs the best possible vision. When pristinely clear vision is not required, the patient could potentially utilize a less time-consuming option for refractive correction. ■

**Muriel M. Schornack, OD, FAAO, FSLS**, received her OD from the Illinois College of Optometry in 1998, and she completed a residency in primary eye care at the Illinois Eye Institute in 1999. Upon completion of her residency, she joined the staff of the Mayo Clinic in Rochester, Minn., where she is currently a consultant in the department of ophthalmology and an Associate Professor in the Mayo Clinic College of Medicine. She is a founding member of the Scleral Lens Education Society and the SCOPE (Scleral Lenses in Current Ophthalmic Practice Evaluation) research team. Dr. Schornack remains active in scleral lens-related research activities.

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Figure 1a

# Getting Started with Scleral Lenses

By Brooke Messer, OD, FAAO, FSLS

As the applications for scleral lenses continue to grow, so has the number of practitioners and patients interested in this technology. While no written article can substitute the experience of hands-on training, this supplement can serve as a guide to getting a clinic prepared to provide the exceptional service of prescribing scleral lenses. As with any successful endeavor, preparation is the first step. Consider the following tips when planning to introduce scleral lenses to your practice.

Scleral lenses were initially developed to manage the same conditions that we use them for today. They were initially difficult to replicate and had poor oxygen transmission, so they were discontinued for use until better production techniques and materials were developed. Now that we have computer-driven lathes and lens materials that are hyper-permeable to oxygen, scleral lenses are providing a "new lease on life" to many patients with many different conditions. According to the SCOPE study, there are three main groups of scleral lens wearers: patients with irregular corneas make up 74 percent of wearers, followed by those with ocular surface disease at 16 percent of users, and patients with regular corneas with complex prescriptions making up the last 10 percent of scleral lens wearers. Identifying great scleral lenses candidates is the first step in building a successful scleral lens practice.

## Who Are Scleral Lens Patients?

Patients with irregular corneas utilize the gas permeable (GP) lens optics of scleral lenses for the correction of their irregular astigmatism. Patients with keratoconus, pellucid marginal degeneration, corneal scars, or post corneal transplants, as well as patients who have had corneal refractive surgeries can make excellent

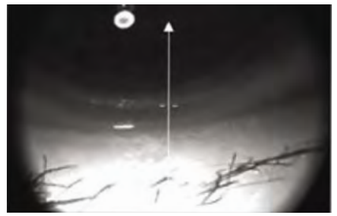

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**Figure 1b: Using an anterior segment OCT in the area of the limbus can help identify lens bearing, excessive clearance, and conjunctival prolapse (Fig. 1a).**

candidates for scleral lens wear. Since scleral lenses have nearly an unlimited sagittal depth, even the most advanced cases of corneal ectasia can be successful with scleral lens wear.

Those with ocular surface disease (OSD) from any etiology including a systemic and iatrogenic condition, are another group that has much to gain from scleral lens wear. Patients in this group might be diagnosed with Sjögren's syndrome or another auto-immune condition, or they might have medication-induced dry eye. Other causes could include lagophthalmos, post-surgical dryness or advanced meibomian gland dysfunction. Those patients who experience eye pain, burning, and light sensitivity will experience a significant improvement in their symptoms and daily function due to the corneal protection provided by the lens and preservative-free saline filling solution. This solution continually bathes the ocular surface, allowing for surface healing and protection from the environment.

The final 10 percent of scleral lens wearers are those who struggle with their quality of vision with other forms of vision correction and are pursuing improvement in their contact-lens-wearing experience.[1] Many of these patients have high refractive error and/or astigmatism. Some patients with regular astigmatism and active lifestyles may get frustrated with vision inconsistencies from their soft toric lenses. They will appreciate the sharp and consistent vision gained with their use of scleral lenses.

## How Will Your Practice Evolve When Prescribing Scleral Lenses?

When a clinic begins to offer scleral lenses to patients, the demographics of the patient base will change over time. The shift from a primary care focus to a medical patient base is a rewarding one, but it does require a higher level of staff knowledge and patience. From an emotional standpoint, most patients with irregular corneas have struggled with their vision for the majority of their adult life, and they are seeking answers. They will have many questions during their initial visits. It is important that the staff acknowledges these day-to-day struggles with compassion and respect to build patient trust and confidence. Staff should be trained on what life might be like for someone with corneal ectasia, painful dry eye, and visual fluctuations. On the medical side, every staff member should be made aware of common questions patients wearing scleral lenses may have about the use of solutions and artificial tears, how often lenses are replaced, and resources for application and removal techniques. Technicians who will be working closely

**There is a need for significant testing and conversations among the patient, doctor, and team.**

with the doctor should be trained on how to teach a patient to apply and remove their lenses as well as troubleshooting lens discomfort. They should also be trained on all special testing and what a good vs. poor quality image on diagnostic imaging looks like. General knowledge about insurance questions can be beneficial for all staff, however, the billing team members especially must be well versed in the process. There are a number of in-person and virtual training resources to help bring a team up to speed on scleral lenses. Many national meetings have technician courses to help educate office teams in addition to in-office training sessions offered by contact lens manufacturers.

From an outsider's view of the scleral-lens-prescribing process, the initial fitting and follow-up visits for a patient wearing scleral lenses do not seem as if they should take significantly more time than any other time of contact lens fitting. However, even in a case of straightforward keratoconus, there is a need for significant testing and conversations among the patient, doctor, and team. Patients will have a detailed ocular history, and the technician and doctor will provide a significant amount of education at both the initial evaluation and dispense visits.

Baseline testing should include uncorrected acuity, manifest refraction, best-corrected visual acuity with a scleral lens, and biomicroscopy. Additional diagnostic imaging testing such as corneal topography or tomography, scleral profilometry, ocular photography and/or anterior segment ocular coherence tomography (OCT) may be performed.

After all the initial data is gathered, some doctors proceed with the scleral lens diagnostic fitting on the same day, while others schedule a second visit. During the diagnostic fitting, the initial diagnostic lens is selected based on the manufacturer's recommendations combined with the information provided by the diagnostic imaging. After allowing the lens to settle on the eye, an over-refraction and fit evaluation should be performed. Consider taking anterior segment photography during the first few fittings, as they can be great teaching tools and assist your laboratory consultant in helping you design the lens.

### What Will You Need to Prescribe Scleral Lenses?

The available instrumentation around the scleral contact lens industry has exploded in the last many years. While some are nice to have in the clinic because they can increase the efficiency of the prescribing process, most are not absolute "must-haves" in order to begin fitting scleral lenses. One piece of instrumentation that should be considered essential in every specialty contact lens clinic is a corneal topographer. A corneal topographer can help with contact lens design but, more importantly, is used for monitoring the corneal condition for which the scleral lens is indicated. For those with progressive conditions, such as ectasia, a baseline corneal topography or tomography scan is a must. Remember you are not just fitting a lens, you are managing a disease.

Other excellent tools for scleral lens analysis include an anterior segment OCT to quantify the depth of the fluid reservoir over the cornea and limbus. (Figure 1a & 1b) An anterior segment camera can be very helpful, as previously mentioned, for documenting the relationship of the lens haptics to the ocular surface, especially for those who are new to scleral prescribing. Scleral profilometry, otherwise known as scleral topography, can help create a free-form scleral lens based on elevation maps, rather than using a diagnostic lens on the eye to determine the fitting relationship between the lens and eye. These are excellent instruments to increase the efficiency of the fitting process and can limit the number of troubleshooting visits needed to complete the lens design.

Another valuable tool is our trusty retinoscope, which can give us insight into the vision quality and potential acuity based on the appearance of the reflex when performing retinoscopy over the scleral lens. After fully correcting the lens over-refractions, some patients will have persistent vision quality complaints due to their higher order aberrations (HOA). There are instruments available that can quantify HOA correction and implement it into the scleral lens optics to provide the best vision quality your patient has ever seen.

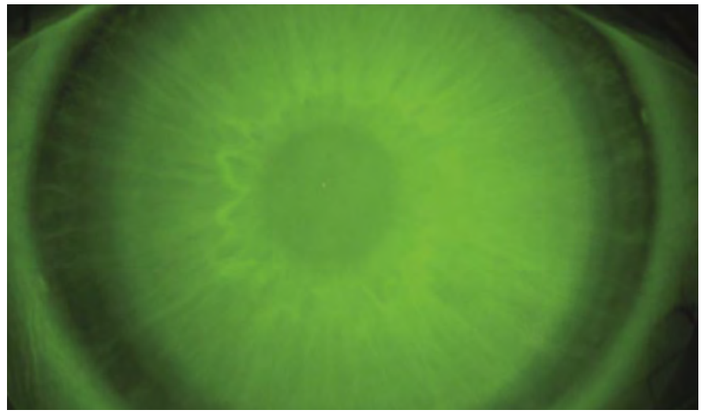

PHOTO CREDIT: BROOKE MESSER, OD, FAAO, FSLS

**The use of a Wratten filter with diffuse cobalt blue illumination can help identify areas of thinner or minimal corneal clearance under a scleral lens, as seen by the dark areas.**

When it comes to the clinic flow, there are some nuances that can increase the efficiency of the fitting process. The diagnostic equipment should be set up in a way that allows for easy image gathering and limiting the need for the patient to move to more than one room for data collection. The equipment should also be in a space that allows for more than one assistant to help with gathering quality images. When it comes to testing such as scleral profilometry or anterior segment imaging, at times there is a need for an additional technician to assist by holding open eyelids or instilling fluorescein dye. Ensuring there is space for an additional assistant will help the imaging process go smoothly. In the exam lane, consider reserving counter space for lens handling, rinsing and filling of scleral lenses if there is not a sink in each room. Since there is a moderate amount of saline used at each encounter, there should be space to keep items such as computer keyboards or encounter documents aside and dry. Lastly, there should be a place to store and organize the lenses that are ordered and prepared for dispensing. Consider a tray or bag system to organize lenses prior to the dispensing appointment.

Since scleral lenses are part of the gas-permeable (GP) lens category, most of the supplies are similar to those needed when fitting corneal GP lenses, with the addition of a few others. For lens care and cleaning, the practice should have a solution that can condition the lens surface prior to

application, preservative-free saline for lens filling, and a hydrogen peroxide solution for complete disinfection of diagnostic lenses after use. Most scleral lenses can fit in a traditionally sized hydrogen peroxide disinfection case for contact lenses. However, there is a larger case size available for larger diameter scleral lenses. To properly handle scleral lenses, there are also a number of tools, commonly referred to as "plungers," that can be used to apply and remove the lenses.

Follow-up lens evaluations are important to ensure a proper lens-fitting relationship and the lens is not negatively impacting the eye. During the lens evaluation, traditional GP lens tools such as sodium fluorescein strips and Wratten filters will assist in lens-on and lens-off evaluation, such as assessing corneal and limbal vault when under the lens, haptic alignment when applied on top of the lens, and ocular surface health when applied without the lens. At every visit, the lens should be removed to evaluate the ocular surface.

The previously mentioned suggestions will help prepare a practice to provide scleral lenses to their patients. However, all would be for nothing if the provider fails to prepare through education. Sorting through the many resources available to train new scleral lens providers can be overwhelming. A nice first step in scleral lens training would be to attend a scleral lens wet lab. The Scleral Lens Education Society provides a number of in-person wet lab trainings around the country during national meetings. At a wet lab, attendees will learn how to apply and remove lenses with the proper tools and acceptable solutions. They will also learn scleral lens terminology and basic evaluation techniques with a number of diagnostic sets from various laboratories. Another great resource is the Gas Permeable Lens Institute. GPLI provides monthly webinars on fitting GP lenses, and many focus on scleral lenses. There is also contact information for many custom contact lens laboratories as well as the lens designs they provide. Other tools on the GPLI website include service fee calculators, billing and coding tips, and fitting scales demonstrating appropriate lens appearances. The manufacturers of scleral contact lenses also have a number of educational resources, as well.

Finally, in order to be a successful scleral lens provider, you must be comfortable and proficient in managing the conditions for which scleral lenses are provided. This would include skills such as topographical analysis for progression of patients with corneal ectasias and confident management of complex corneas, such as full-thickness corneal transplants and their potential for graft rejection and steroid-induced intraocular pressure spikes. Partnering with a local corneal specialist is a great way to learn more about managing these complex cases.

Preparing your office to deliver the service of scleral lenses can be time consuming and challenging. Empowering your staff through training, developing an efficient exam flow, and continuing to educate yourself as the doctor will quickly escalate your practice to a place that builds patient loyalty and professional fulfillment. ■

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PHOTO CREDIT: GETTY IMAGES/ANDRESR

# Co-managing Scleral Lens Patients

By Karen S. DeLoss, OD, FAAO, FSLS

Scleral lenses have provided some exciting opportunities for eye care providers. They have been instrumental in expanding our ability to offer alternatives to patients with corneal ectasia and/or ocular surface disease. The advent of scleral lenses has led to a great expansion in co-management of these complex patients with other optometrists, ophthalmologists of different specialties, and other providers of an array of medical subspecialties.

While many optometrists like to practice full scope optometry and enjoy specialty lenses, other optometrists prefer to refer scleral lens fits to other practitioners. Some practitioners may start a scleral lens fitting and refer for a second opinion or a new fit due to fitting challenges. Regardless of the type of management, this provides an opportunity for teamwork among colleagues. Communication is key to both the practitioner receiving the referral and the referring practitioner; once the fitting is complete, a summary of the outcome is helpful to share with the referring practitioner. For those referring out a scleral fit, useful information includes a brief reason for the referral, ocular history, past ocular treatments, and pertinent ocular data such as prior refractions, best corrected visual acuity, and if possible, past keratometry or topographical data. It is helpful to include the type of scleral lenses that were previously attempted unsuccessfully to avoid "reinventing the wheel." Once the fitting is complete, the practitioner can send a letter back with a summary of fitting, acuity, and if any additional treatments were started or stopped. It is beneficial for the practitioner to include a recommended timeline for following up with the referring optometrist and when the patient is to return for their next scleral evaluation.

Optometrists may also choose to collaborate with other optometrists sheerly on demographics. Perhaps the referring provider lives out of state, so optometrists can co-manage a patient by using over-refraction data, fitting concerns, and ocular health changes that may impact the fitting relationship. Many of us need to collaborate with fellow practitioners for patients who spend part of their time of the year in a different location or if the patient is relocating. Other forms of intra-professional collaboration may be combined forms of treatment such as in-office treatments for meibomian gland dysfunction that only one of the practitioners may offer.

Finally, scleral lens patients are commonly medically complex. Their condition may benefit from scleral lenses for treatment of ocular surface disease, however, vision may not improve. This would warrant collaboration with a low vision specialist who may be able to offer an improvement in vision or quality of life with adaptive equipment such as magnifiers, a bioptic telescope for driving, computer-aided technology that can enlarge print, and up-to-date information on the latest apps with assistive technology. Some of these patients may need an occupational therapist who specializes in low vision and can help with day-to-day activities and in-home consultation on how to improve their home environment for their visual needs. The low vision specialist can also recommend if the patient would benefit from orientation and mobility training.

**Corneal specialists comprise the bulk of the co-management opportunities.**

## Scleral Lenses for Ophthalmology

Ophthalmologists collaborate extensively when using scleral lenses. While the biggest collaborators are likely to be corneal specialists either as co-managers or as referral sources, other specialties such as oculoplastics, glaucoma, retina, pediatrics, and even those providing comprehensive care are sources of referrals and contacts for long-term management of scleral lens patients.

Early adopters of scleral lenses were corneal specialists. Corneal specialists even played an integral role in both development of scleral lens technology and also fostering the utility of scleral lenses within the ophthalmology community. This led to further awareness in the role of scleral lenses for management of complex patients, and it also led to acceptance by many in the profession of the importance of collaboration with the optometric community.

Nonetheless, corneal specialists comprise the bulk of the co-management opportunities of scleral lens patients. For starters, corneal colleagues are instrumental in managing corneal ectasia patients. Optometrists who identify and diagnose keratoconus patients initially can consider referral for corneal collagen cross linking or a baseline evaluation by a corneal specialist if cross linking is to be considered. Conversely, corneal specialists who perform cross linking may have to refer a patient with no history of contact lens wear or reinitiate treatment on existing scleral lens patients. Thus, a timeline will need to be provided and discussed or newly diagnosed keratoconus patients who warrant a scleral lens after treatment will be referred. Therefore, communication of co-management becomes essential.

Corneal transplantation rates based on indication such as ectasia or corneal scars have been changing and shifting due to scleral lens availability.[1] Referral for a corneal transplant to a corneal specialist if a cornea is too steep for a scleral lens, or if desired visual acuity outcomes are not achieved (typically less than or equal to 20/40), is inevitable. Patients who undergo corneal transplants, whether full thickness or partial thickness, are likely to be referred back to the

optometrist for visual rehabilitation, which may include a scleral lens. It is critical for the entire team to understand the treatment timeline in terms of suture removal and possible long-term topical medication dosing. Further collaboration with a corneal specialist may be needed if the status of the graft is changing. This may include graft rejection or graft failure. In some cases, the cornea responds to treatment. However, in other cases, a corneal graft will not last over time, and the patient will need a re-graft or an endothelial graft in their lifetime.

Corneal specialists can also be fundamental in co-management of scleral patients for a variety of reasons. Some corneal dystrophies are monitored over time by a specialist (but in many cases also by the optometrist). In some cases, these dystrophies warrant genetic testing and/or research to gain additional perspectives, and some medical centers play a key role for these patients. Medically complex patients, such as those with Stevens-Johnson Syndrome (SJS), are often co-managed by a corneal specialist and the optometrist as they can be susceptible to corneal melting or perforation due to the nature of their condition. The inflammation and long-term course of the disease may also warrant a corneal specialist. With many patients who wear scleral lenses, their underlying condition may make them susceptible to infection due to a weakened immune system and thus prone to corneal ulcers, herpetic reactivation, or long-term monitoring due to corneal anesthesia. Finally, corneal specialists can also play a role in helping manage dry eye patients whose symptoms exceed signs and might fall into the neuropathic category. This patient population may warrant pain management with oral systemic medications, which may require long-term blood and liver monitoring.

### Oculoplastic Referrals

The second most common ophthalmology referral source or co-manager is the oculoplastic specialty. Patients who suffer from thyroid eye disease (TED) may require surgical management. Recent FDA approval of teprotumumab for thyroid-associated ophthalmopathy is promising, but it has been shown to reduce proptosis only by about 2 mm.[2] Orbital decompression is indicated to reduce proptosis but more importantly to relieve sight-threatening pressure on the optic nerve. Patients may benefit from eyelid surgery to lift or tighten the upper eyelid in order to eliminate areas of exposure. Patients with TED may need scleral lenses depending on the severity or course of their disease. Commonly, these patients stabilize after two years, but intervention with scleral lenses may be indicated either during an "active" phase or long term.[3] Some oculoplastic specialists may not feel patients can benefit from scleral lenses due to the improper function of the eyelids to interact with the cornea for eyelid wiper-type movement. Once they are "exposed" to a happy TED patient, they will quickly become a scleral lens supporter.

> The second most common ophthalmology referral source or co-manager is the oculoplastic specialty.

Another area in which oculoplastic specialist collaboration may be needed in a scleral lens patient is SJS. These patients have high levels of inflammation that can lead to the development of symblepharon, which can impede scleral lens fitting. SJS patients also have significant eyelid swelling due to the course of the disease. Oculoplastic specialists can become integrated into the care of a scleral lens patient by offering certain injections into the lids or conjunctiva to reduce swelling or symblepharon formation.[4] Although not ideal, these surgeons may agree to lysing the symblepharon to assist in scleral lens fitting. This is uncommon because this could risk reigniting the inflammatory process and possibly make the conjunctiva more reactive and worse long term. Patients with SJS may also warrant mucous membrane grafts for repair or reconstruction of the eye and orbit due to the destructive nature of the disease. Intervention with mucous membrane grafts can be beneficial for continuing help to preserve the architecture of the eye and orbit.

Oculoplastic surgeons are also a referral source for exposure keratopathy patients of various etiologies. Facial nerve paralysis can lead to weakness of the orbicularis oculi. While for the short term patients may only need palliative treatments, long term some patients may not

PHOTO CREDIT: GETTY IMAGES/METAMORWORKS

regain full strength and function and can benefit from a scleral lens to protect the ocular surface.[5]

Finally, trauma can be yet another reason the scleral lens patient benefits from more than one subspecialty. Burn victims, or those who have suffered a motor vehicle accident or any other trauma that leads to destruction of the lids or orbital tissue, may require a scleral lens. In the long term, these patients benefit from a scleral lens. In the short term, an oculoplastic surgeon can be highly beneficial in reconstruction of orbital tissue or help in stabilization of tissue surrounding the orbit.

Medically complex scleral lens patients often have glaucoma or are referred for a scleral lens fitting due to ocular surface disease from the use of long-term topical glaucoma medications. Patients who are referred for a scleral lens fit can benefit from a discussion of topical medications that may improve their condition. For patients who warrant surgical intervention for glaucoma, it is important to discuss the long-term, post-surgical conjunctival changes if the surgeon opts for a trabeculopasty or glaucoma tube shunt. These types of procedures can drastically impact scleral lens success. Although new technology supports methods to counter conjunctival obstacles, if the discussion with the surgeon is done preoperatively, problems may be circumvented altogether.

Last but not least, pediatric ophthalmologists also play a vital role. Our pediatric colleagues are often key players in thyroid eye patients, in management of strabismus cases, and also for co-management of the pediatric population.

Any and all subspecialties in ophthalmology will eventually encounter a scleral lens patient who needs cataract surgery. Communication is key for a post-surgical management timeline.

### Systemic Co-management

The optometric profession is very familiar with communicating and co-managing with primary care physicians for diabetic and hypertensive patients. However, within the medical community, scleral lens patients can warrant discussion, communication, and co-management with many subspecialties.

If an optometrist does choose to start or add any oral medication such as for herpetic disease management in a scleral lens patient, it is helpful to bring this to the primary care provider's attention. Rheumatology co-management for Sjögren's

patients is another area in which collaboration may be indicated. Rheumatology may be a referral source for Sjögren's-related dry eye because scleral lenses can provide significant relief to their patients. Another area in which scleral lenses are commonly beneficial is for patients who suffer from ocular surface disease due to graft versus host disease (GvHD). These patients suffer dry eye as a result of stem cell transplantation treatment due to an underlying hematological malignancy. Oncologists who specialize in this patient population quickly discover the benefits scleral lenses offer to their patients. Both Sjogren's and GvHD patients may suffer from inflammatory events that wax and wane and may cause issues with an existing scleral lens fit. Communication regarding the status of their ocular condition can lead to systemic medication adjustments. Although not common, endocrinologists may be a beneficial source of referrals for patients with TED.

Finally, dermatology will most likely be a key player for several types of scleral lens patients. Dermatology is certainly effective and helpful for patients suffering from atopic conditions who are not getting relief from traditional treatments. Dermatologists are instruments in the diagnosis and systemic management of ocular cicatricial pemphigoid (OCP). They are often the specialists who biopsy the conjunctiva of OCP suspects to confirm diagnosis and help manage their inflammation. Dermatology may also be consulted in the management of a scleral lens patient with respect to SJS. In some cases, they will be involved in managing their systemic status and systemic medications as they are likely to be highly sensitive to many systemic medications.

Overall, while this is not a complete synopsis in co-management of scleral lens patients, it is clear that these patients are challenging from both a fitting perspective and for long-term systemic management. Scleral lenses have allowed optometry to play a positive role in changing the lives of complex patients with ocular surface and ectatic disorders.■

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# Scleral Lens Design and Troubleshooting

By Sheila Morrison, OD, MS, FSLS, and Daddi Fadel, DOptom, FSLS, FBCLA, FAAO

The ocular shape has been widely studied, leading to the development of new scleral lens designs in recent years, achieving more optimal fitting with a proper vault over the cornea and limbus and a balanced distribution of lens weight on the conjunctiva. As early as 1966, Mariott described the ocular surface as asymmetrical.[1] The introduction of new diagnostic instruments to measure the anterior surface shape confirmed the scleral shape intuited years ago. Evidence showed that most scleras are rotationally asymmetric[2,3] and that scleral shape varies considerably between subjects.[4–6] It is also known that the horizontal visible iris diameter (HVID) is different than the vertical visible iris diameter (VVID) by about 1.1 mm.[7] All of this data has led to the development of novel scleral lens designs with an improved fitting relationship. Scleral lenses may be fit using diagnostic lenses or empirical fitting. Practitioners need to know the benefits and limitations of both methods. (See "Design / Fitting Methods" below.)

## New Scleral Nomenclature

Before discussing different scleral lens designs, it is crucial to highlight the importance of proper scleral nomenclature. To improve standard communication between practitioners and manufacturers, the Scleral Lens Education Society established standardized terminology for scleral lenses (Table. 1).[8]

| sagittal height | SAG | µm |
|---|---|---|
| scleral lens | SL of x diameter | SL of x mm |
| corneal diameter in each meridian (horizontal, vertical, or the axis) | CD; CD-H; CD-V; CD-@ axis | mm; mm-degree |
| visible iris diameter, horizontal or vertical | HVID; VVID | mm |
| sagittal height | SAG | µm |
| sagittal height of the cornea; or lens at a specific chord | SHC @ chord; SHL @ chord | µm @ mm |
| overall sagittal height of the ocular surface | OSHO | µm |
| fluid Reservoir | FR | µm |
| back optic zone radius | BOZR | mm |
| back vertex power | BVP | D |
| back optic zone diameter | BOZD | mm |
| front optic zone radius | FOZR | mm |
| front optic zone diameter | FOZD | mm |
| transition zone radius | TZR | mm |
| landing zone radius | LZR | mm |
| toric peripheral curves | TPC (curve – width @ axis ) | mm-mm-degree |
| front surface toricity | FST (sphero – cylindrical @ axis) | D-D-degree |
| center thickness | CT | mm |
| prolate | PRL | |
| oblate | OBL | |
| primary functional sagittal depth of the lens | PFSD (vault @ chord) | µm @ mm |
| primary functional diameter of the lens | PFDL | mm |
| localized vault | LV (length – width @ axis) | mm-mm-degree |
| stabilization process | SP | Specify PB, DSO, APCS, or TR |
| venting channels | VC (length – width @ axis) | mm-mm-degree |
| notches | NT (length – width @ axis) | mm-mm-degree |
| edge thickness; maximal edge thickness | ET; MET | mm |

**Table 1: Scleral Lens Education Society official terminology**



PHOTO CREDIT: DADDI FADEL, DOPTOM, FSLS, FBCLA, FAAO

## Review of Scleral Lens Designs

In general, all scleral lenses comprise three separate zones — the optical zone, transition zone, and landing zone; however, they differ in the parameters. Scleral lenses vary in a wide range of diameters. Scleral lenses may have a range of sagittal depths, lens back optical zone shape may be prolate or oblate, oval, present a localized vault to overcome corneal pathology and contain one or more fenestrations; lens periphery may be spherical, toric, quadrant specific design, or customized; and the anterior surface may include toric and multifocal optics, high order aberrations (HOAs) compensation, and prism.

## Scleral Lens Diameter

The scleral lens diameter may be up to 23.00 mm and depends on different factors such as (1) HVID; (2) palpebral aperture; (3) ocular surface condition (lenses may need to be larger in some cases for ocular surface protection); (4) sagittal height (the higher the corneal sagittal height, the larger the lens diameter should be to allow for a balanced distribution of the pressure on the conjunctiva); (5) toric or asymmetric sclera (small diameter scleral lenses may be spherical as they land on a more likely spherical sclera near the limbus); (6) irregular conjunctiva (if the irregularity is far from the limbus, small lenses are indicated); (7) limbal height (the greater the limbal height, the larger the scleral lens diameter).

## Lens Shape

Recently, new designs have emerged with an oblate back surface design and oval corneal and limbal zones. These latest designs may also include a localized corneal vault or a fenestration.

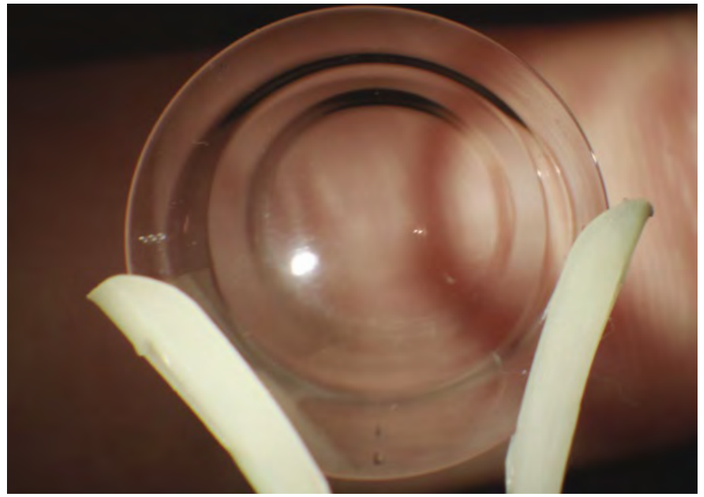

**Figure 1: An elliptical scleral lens with an oval shape in the corneal and limbal areas. Note that the vertical landing zone is larger than the horizontal landing zone. This design represents one of the two available designs. The other design consists of a full elliptical lens, with the landing zone of the same width in both meridians, which may allow improved lens stability.**

***Oblate design:*** The fitting relationship of a prolate scleral lens design on an oblate cornea is not ideal, as the lens may have optimal central clearance yet bear peripherally. An overall increase in sagittal height of the lens could correct the mid-periphery but would likely result in excessive central clearance; an oblate scleral lens design may be preferred in this case to achieve the best fit. Oblate designs may also be indicated in prolate corneas, in cases of advanced corneal ectasias, or high myopia. The oblate back surface may reduce the steepening of the back optic zone radius (BOZR) and the convexity of the post-lens tear layer, resulting in a less minus-powered scleral lens. This will alter image magnification and ameliorate oxygen transmission for myopic corrections.[9,10]

***Oval corneal and limbal zones:*** Generally, HVID is 11.7 mm, while VVID is 10.6 mm on average. These may be about 0.1 mm less in females.[7] When fitting a "round" lens on a significantly oval limbus, the lens may land close to the limbus in the horizontal meridian and far from the limbus in the vertical meridian. The large clearance created inferiorly may cause midday fogging, lens decentration, conjunctival prolapse, discomfort, and limbal stem cell breakdown. A reduction in lens diameter would likely result in landing near the limbus in the vertical meridian but touch the limbus and peripheral cornea in the horizontal meridian. Peripheral corneal or limbal touch may cause microcysts and bullaes.[11] For an equal clearance distribution in the corneal and limbal areas, an elliptical design lens is needed (Figure 1).[12]

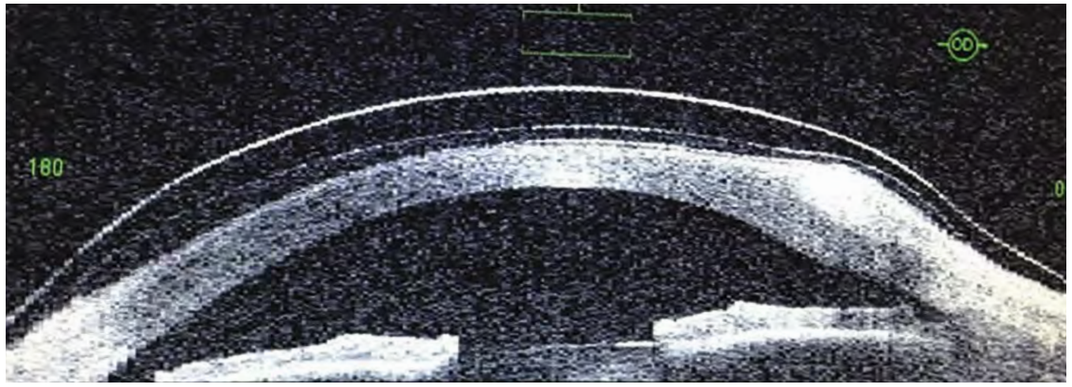


PHOTO CREDIT: DR. BRIANNA RYFF

**Figure 2. Cross section scan with optical coherence tomography (OCT) of an anterior eye with scleral lens custom designed with a localized custom vault over a corneal nodule (located at about 0 degrees/right side of image) to avoid discomfort, touch, and further scarring.**

*Local corneal shape:* In the case of peripheral corneal ectasia, a scleral lens may exhibit a peripheral touch. Increasing the overall sagittal depth, the central clearance will appear excessive, which may cause visual disturbances,[13] an accumulation of debris in the post-lens fluid reservoir,[13] and which can adversely affect oxygen transmission,[9,13] lens stability[9,13] and centration. [9,13] In these cases, it is necessary to increase the peripheral clearance, where the lens is touching, or include a localized vault peripherally in the corneal area[13] (Fig. 2).

*Fenestration:* A fenestrated scleral lens may be indicated to overcome several issues that occur with sealed scleral lenses, such as lens handling, corneal edema, microcysts, lens suction, lens instability, conjunctival compression, and alteration of IOP.[14] The approach when fitting fenestrated scleral lenses is different compared to non-fenestrated lenses:[14]

- They are generally large, up to 23.00 mm in an adult.
- The lens back surface area should relate as closely as possible to the corneal contour.
- The central vault should not exceed 100-150 µm.
- The limbal vault needs to be of 75-100 µm.
- A mobile air bubble is essential; a stationary bubble will lead to tissue desiccation.
- The fenestration diameter should be 0.5-1.0 mm and needs to be positioned in the limbal area.

## Lens Periphery

Studies showed that most scleras are rotationally asymmetric.[2,3] Thus, most scleral lens fits should have a toric, quadrant specific design, or customized peripheral design.

In cases with conjunctival irregularities, a notch or localized vault in the scleral zone may be necessary. Modern scleral mapping tools can provide precise measurements about ocular shape, allowing practitioners to increase efficiency of scleral lens fitting.

*Toric:* Visser et al. showed that scleral lenses with toric periphery provided better comfort and overall satisfaction.[15] In 2013, Visser et al. confirmed the findings of the initial study; lenses with bi-tangential peripheries provided good lens movement and position, visual acuity, and patient satisfaction.[16]

*Quadrant-specific design:* Almost 41% of scleras are asymmetric.[2] A toric haptic may resolve issues between the two principal meridians; however, problems along the same meridian may remain. Quadrant-specific designs allow a modification to the landing zone in all quadrants independently, to improve overall alignment, comfort, and tear exchange.

*Customized lenses:* Impression-based techniques and digital mapping tools facilitate the creation of highly customized scleral lenses to match the precise curvature of the ocular surface.

*Notch or Localized Vault :* When the scleral lens edge interacts adversely with a conjunctival irregularity, a notch or a localized vault may be beneficial. This modification requires rotational stability of the lens on-eye. When communicating with a manufacturer about placement of a notch or vault, it is necessary to communicate the position, size, and depth of the irregularity to the laboratory. Profilometry with the use of specific software is highly recommended to empirically design a customized lens periphery. Video 1 illustrates how to include a notch and fenestration to the scleral lens.

## Anterior Surface

Anterior surface optics can be modified to include toric, multifocal, or prismatic power. To apply any front surface optics the scleral lens should be rotationally stable. Lenses with toric or customized periphery and those with quadrant-specific designs stabilize themselves and return to their original orientation rapidly if rotated (this location needs to be recorded and submitted to the laboratory).[17] When the scleral is more likely spherical, scleral lenses are more likely to rotate and may require prism ballasting, double slab off prism, dual thin zone, or truncation.

*Front surface toricity:* Anterior toricity may be indicated in case of residual astigmatism caused by internal astigmatism, lens decentration, lens flexure, and implanted toric IOL.[13]

*Multifocal:* Multifocal scleral lenses are available in a variety of designs to provide simultaneous vision optics including center near, center distance, a combination of both, or with an aspheric anterior surface. Aspheric designs, which may be center near and center distance, allow a gradual change in power.

*HOAs:* It is common for irregular corneas, particularly post-surgical corneas, to present with HOAs, which may compromise vision.[18–22] Adding a front surface eccentricity up to 0.8 showed a reduction in HOAs (by 69–77 percent),[23] improvements in visual acuity (VA) and quality,[24] better high and low contrast VA,[25] reductions of other HOAs, particularly coma,[25] and decrease of total trefoil.[26]

**Knowledge and proficiency with all scleral lens design/ fitting methods is helpful.**

Several studies have shown promising results in the neutralization of HOAs by incorporating wavefront-guided optics.[27–29] This technology provides an optical correction by 3.1 times in higher-order root mean square, improving visual performance and contrast sensitivity;[27] gain of high contrast VA of 1.5 lines; reduction of higher-order RMS within 1 SD;[28] and decrease of halos, glare, and shadowed images.[29]

*Prism:* Scleral lenses may correct up to 10 Δ, 5 Δ in each eye, either vertically or horizontally (or a combination of both). Bragg and Sindt described a case where an EyePrintPRO scleral lens was customized with a 3.5 Δ base-up prism correcting diplopia with VA 20/20.30 A multifocal EyePrintPRO with 3.75 Δ split between the eyes was presented by Parker to correct the vertical deviation in a 55-year-old male.[31] Frogozo presented a case where an EyePrintPRO lens with 2 Δ BO was applied in the right eye and a 4 Δ BO in the left eye, resulting in 6 Δ between both eyes.[32] Another case reported customized scleral lenses designed with 5 Δ BO in the optic zone in each lens resulting in a total of 10 Δ between both eyes.[13]

## Design / Fitting Methods

The history of scleral lens fitting precedes all other modalities, dating back to the early 1900s and includes the use of both diagnostic fitting sets and eye impressions to fit scleral lenses. Modern scleral lens fitting incorporates advanced materials and lathing technologies, as well as a better scientific understanding of comprehensive anterior ocular shape. The art of fitting with both diagnostic lenses and eye impressions has been refined through these scientific and technological advancements; both methods are commonly used to fit scleral lenses in clinical practice. Digital lens design is relatively new compared to diagnostic fitting and eye impressions; however, within the last decade, digital lens design has rapidly become the focus of research and development by industry, academics, and early adopting clinicians, to more efficiently design and manufacture scleral lenses (Figure 3). Each method is potentially effective, but knowledge and proficiency with all scleral lens design/fitting methods is helpful in ensuring that clinical

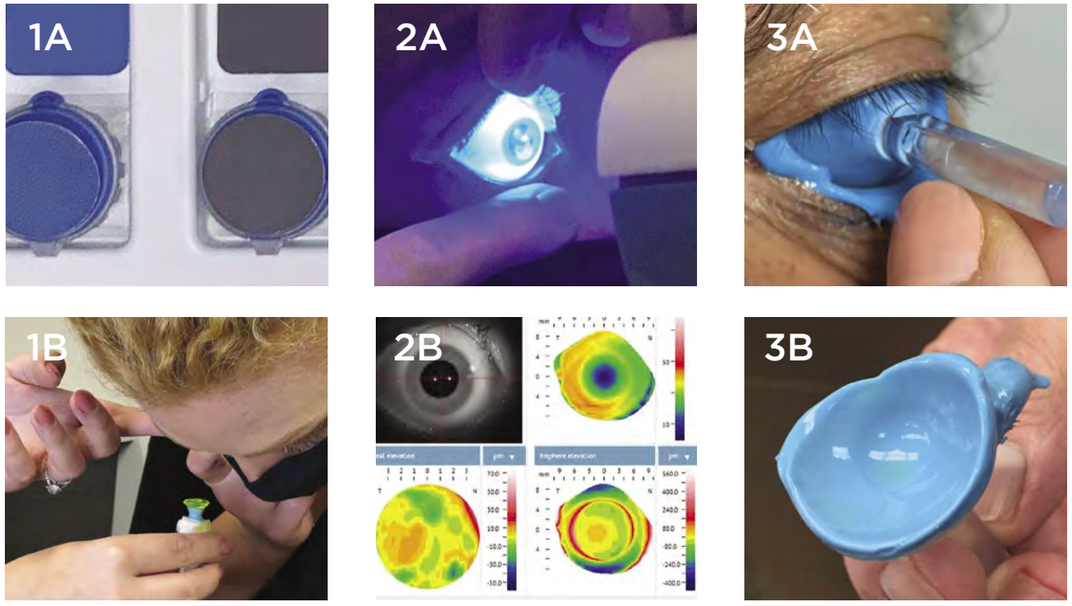


PHOTO CREDITS: SHEILA MORRISON, OD, MS, FSLS

**Figure 3. Primary design/fitting techniques for scleral lenses are as follows: 1. Diagnostic (1a) trial lenses from fitting set and (1b) a trial lens being placed on the right eye of a patient; 2. Digital (2a) mapping being performed on the right eye with anesthetic and sodium fluorescein applied to the eye (2b) a screenshot of the ocular shape data out to greater than 17.0mm that was obtained; 3. Impression Mold (3a) taken of the left eye of a patient with no anesthetic and (3b) a finished impression mold from an eye to use to design a customized scleral lens.**

decisions best achieve efficient, safe, and comfortable fits. Important patient considerations when starting a new fit include, but are not limited to, a review of ocular and health history, physical ocular shape and structure, risk factors for scleral lens wear, and patient expectations.

## Patient Considerations

Whenever possible, a comprehensive work-up of physical structure of both eyes (even when planning a monocular fit) is best prior to making recommendations about candidacy for the various scleral lens design/fitting methods. It is not uncommon for patients to request a fellow eye to be fitted, following success with an initial monocular fit; this strategy of initially measuring both eyes can save time and provide insight to the overall visual potential and function of the patient. Asking patients what aspects of their vision or eye health are not satisfactory is useful for practitioners to help set realistic expectations about how scleral lenses may or may not achieve their goals. Some patients may have preferences related to money, time, and travel that could impact scleral lens design and fitting style.

Identification of non-cornea-related etiology for any decreased vision (i.e. macular degeneration or cataract) prevents confusion or frustration about best corrected visual acuity with scleral lenses. A review of any pre-existing diagnosis and/or indication(s) for scleral lens fit should be verified in-office with special attention to corneal shape and pathology. Corneal topography may be useful in assessing corneal shape and obtaining other eye shape characteristics, which can influence lens design choices (i.e. prolate versus oblate corneal shape; HVID versus VVID) because it is most optimal to select an initial lens design that can accommodate these individual ocular shape characteristics. Safety with any contact lens is of paramount importance. Recognizing relevant risk factors allows the practitioner to explain to a patient why a particular lens design/fitting method is recommended (i.e. "fitting obstacles" such as blebs may be at risk for failure if under lens bearing and may likely be best with a free-form digital or impression-based scleral lens design). Hygiene, dexterity, surgical history (especially procedures that could result in low endothelial count or compromised cornea), and prior contact lens failures (ask about these failures to avoid them) are all also useful considerations.

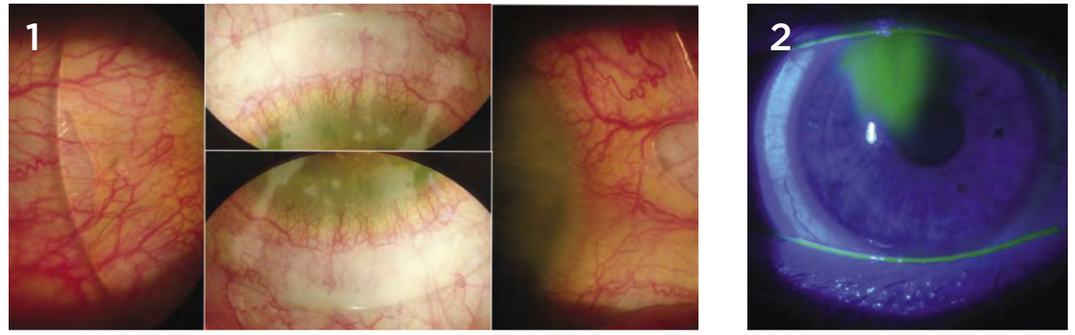


**Figure 4. Deduction of ocular shape can be achieved by evaluating the fitting relationship between a known lens shape and an unknown anterior eye shape. Image 1 depicts an against-the-rule sclera, evident by a spherical lens bearing in the flatter vertical meridian, and fluting over the steeper horizontal meridian. Image 2 is a reverse technique of NaFl application on top of a lens to evaluate loose edges for bleed-through; the superior scleral lens landing appears loose based on superior bleed-through.**

## Fitting with Diagnostic (Trial) Lens

*Trial Lenses:* Diagnostic lenses may be used through a process of trial and error. However, if possible, it is generally more successful to gain an understanding of comprehensive anterior ocular shape, first through data collection and measurement, and then subsequently select a starting lens based on the data or by following the manufacturer's fitting guide. Fitting scleral lenses with diagnostic lenses usually utilizes a slit lamp, and occasionally anterior segment optical coherence tomography (OCT), to evaluate the fitting relationship of the lens and eye.

***Sodium fluorescein (NaFl) and lissamine green deduction of ocular shape with diagnostic lenses:*** The ability to deduce a patient's ocular shape based on the fitting relationship between a known shaped scleral lens and the eye is an essential skill for scleral lens fitters. NaFl can be added to the filling solution in the lens reservoir at application and evaluated with the biomicroscope. For lens alignment on the conjunctival tissue, NaFl or lissamine green may be used with a scleral lens already applied; the dye pooling under the lens edge or influx into the post-lens reservoir highlights edges that are lifted-off. The assessment of clearance and lens alignment allow practitioners to deduce eye shape based on that fitting relationship (Figure 4).

***Reasons to continue using diagnostic lenses:***

- demonstrate comfort to the patient
- ensure application and removal is trainable with trial lenses prior to placing any order
- test visual acuity potential; rule out corneal cause for vision loss
- determine lens power
- test for pain relief (try alcaine first; if no relief from alcaine, scleral lenses may not relieve symptoms)
- test for corneal evaporative hypalgesia (CEH) by instantly and completely blocking corneal surface evaporation (if relief with application, scleral lenses may relieve symptoms)

***Options for Empirical Fitting Impression molds:*** Impression-based fitting provides a close alignment result of a scleral lens to the anterior ocular profile. Impression molds are taken by applying a soft plastic material to the eye, allowing it to harden into a printed eye shell. Then it is digitally scanned to create the shape of a customizable free-form scleral lens. Topical anesthetic is not needed during this process. Impressions are particularly useful for fitting eyes with highly irregular ocular geometry, such as those presenting steep/proud grafts, glaucoma drainage devices, blebs, and pinguecula, but normal ocular shapes can wear impression-based scleral lenses too. Impression-based scleral

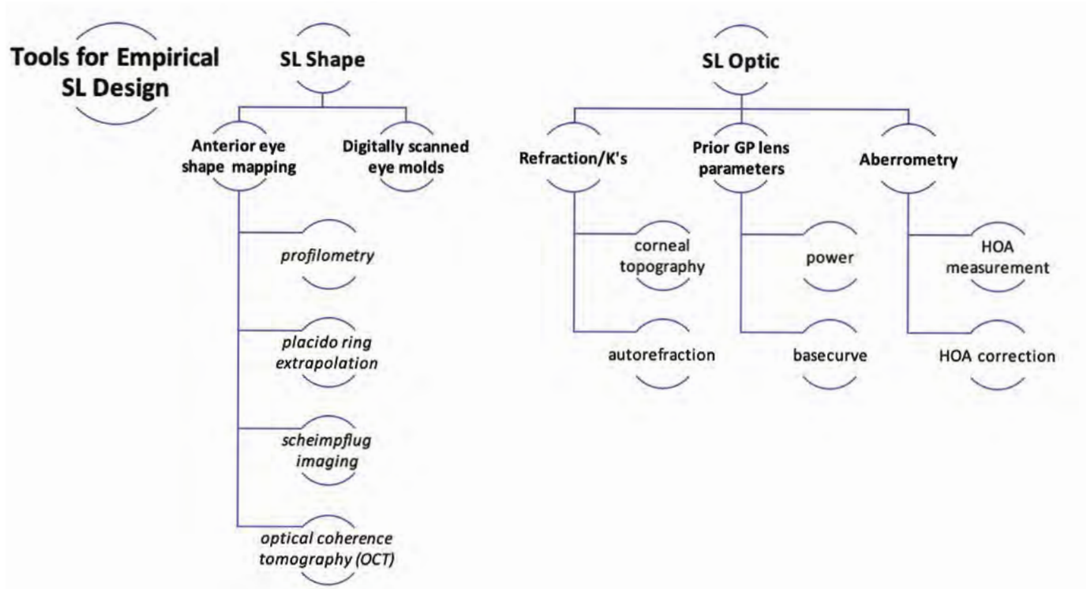


**Table 2. Summary of tools that are commonly used and combined to empirically design scleral lenses.**
**Note: Always utilize one tool for determining lens shape (comfort and safety) and one tool for determining optical power (vision).**

lenses may be considered for patients who prefer fewer office visits. Another distinguishing advantage of impression molds is that they are mobile and can be helpful in serving special populations. Advancements in technology have made free-form lenses based on impression molds highly predictable and reproducible.

***Digital:*** Digital lens design is the newest of scleral lens fitting techniques (about a decade old). There are currently several ocular-surface-mapping devices on the market that can measure accurate data characterizing anterior eye shape. Patient candidacy for digital mapping is broad, as the technology is easily incorporated by technicians or fitters into baseline testing for scleral lens fits. The use of the data itself is also broad and can be used to understand a patient's unique ocular shape to best select diagnostic trial lenses, empirically design a scleral lens using manufacturer-specific software, or send mapping data to the laboratory for a consultation to directly design a scleral lens. A number of manufacturers have created custom software to integrate mapping data directly with digital scleral lens design. Capabilities to translate digital data into lens design vary greatly between laboratories.

## Future of Empirical Digital Lens Design

Currently, there is no single tool that can objectively measure and automatically combine all required parameters to design a scleral lens. Digital scanning devices and impression molds are effective in designing lens shape, but the lens optic still usually relies on diagnostic lenses (or prior habitual GP lens power) or keratometry and refraction. The irregular cornea is particularly challenging to empirically predict power of a GP lens because of the variability of irregular corneal curvature over the pupil. In the absence of a reliable refraction yielding satisfactory visual acuity for irregular eyes, axial length and average keratometry over the pupil, when calculated with a reduced eye model, may be useful for digitally scanning an eye to determine a fully empirical scleral lens including both the lens shape and optic. The future of empirical digital lens design is bright.

## Conclusion

Every scleral lens design is different and requires unique and specific approaches for fitting and troubleshooting. A rapidly growing global evidence base has demonstrated, consistently, that most eyes have both intra and interocular differences. Each human eye has its own unique ocular fingerprint, and this understanding has

perhaps been one of the most relevant findings that has shaped scleral lens design today. The partnership among industry, academics, and clinicians has driven research and development over the past century. The process of scleral lens fitting and designing has evolved to produce highly sophisticated and customizable scleral lenses. These improvements in fitting and design have also steadily improved patient outcomes in all areas, including safety, comfort, and vision. The current, best clinical practice for scleral lens design should always consider each of the following tools to fit scleral lenses: diagnostic fitting lenses, impression molds, and digital scans. The future may move toward fully digital technology for empirical design.

For more, listen to Dr. Barnett interview Dr. Fadel about The Global Experience in Specialty and Scleral Contact Lenses in this episode of *WO Voices*. ■

| Method | Pros | Cons |
|---|---|---|
| Diagnostic Set Fits | • Used For Acuity Testing<br>• Demonstrates Lens On Eye<br>• Assess Patient Abilities | • May Be Slower<br>• Usually More Office Visits |
| Impression Mold | • No Use Of Dye/Numbing<br>• Fewer Office Visits<br>• Mobile For Special Populations<br>• Less Fogging<br>• Better Comfort | • No Refractive Data<br>• Cost Slightly Higher |
| Digital Scan | • Fewer Office Visits<br>• Most Modern/Trending<br>• Best Use Of Technicians<br>• Less Fogging<br>• Better Comfort | • Able To Use Software To Apply Refractive Data<br>• Cost Slightly Higher |

**Table 3. Advantages and disadvantages of scleral lens design tools.**

**Daddi Fadel DOptom, FSLS, FBCLA, FAAO**, is a contact lens designer, a pioneer of modern lens designs, and a specialist in contact lenses for irregular cornea, scleral lenses, myopia control, and orthokeratology. She studied optometry at Istituto Superiore di Scienze Optometriche (ISSO) in Rome (1998-2001). She runs an optometric practice specializing in contact lenses in Italy where she personally designs and fits special customized contact lenses. Dr. Fadel is the author of the book *Scleral Lens Complications: Their Recognition, Etiology, and Management*, and she and Dr. Barnett are co-authors of the *Clinical Guide for Scleral Lens Success*. She is Editor-in-Chief of the *Journal of Contact Lens Research & Science.* She is the first Certified EyePrint Practitioner outside the USA and Canada. Dr. Fadel is Fellow of the Scleral Lens Education Society (SLS), British Contact Lens Association (BCLA), and American Academy of Optometry (AAO). She is the Founder and Immediate Past President of Accademia Italiana Lenti Sclerali (AILeS), Co-founder and President of Euro & Austral-Asia Scleral Lens Academy (EASLA), Council of the International Society of Contact Lens Specialists (ISCLS), Global Ambassador of the BCLA, member of the GPLI Advisory Board, member of the medical advisory board of the International Keratoconus Academy (IKA), Program & Education Chair of The Summit of Specialty Contacts (SSC) and of the Global Ophthalmic Women (GLOW), Board Member of the International Forum for Scleral Lens Research (IFSLR) and of the International Congress of Scleral Contact (ICSC), Clinical Advisor of Myopia Care, International Relations Chair of the Scleral Lens Education Society (SLS), and Member of the International Association of Contact Lens Educators (IACLE).

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# Effective Communication for Laboratory Consultation

By John D. Gelles, OD, FIAO, FCLSA, FSLS, FBCLA, and Melissa Barnett, OD, FAAO, FSLS, FBCLA

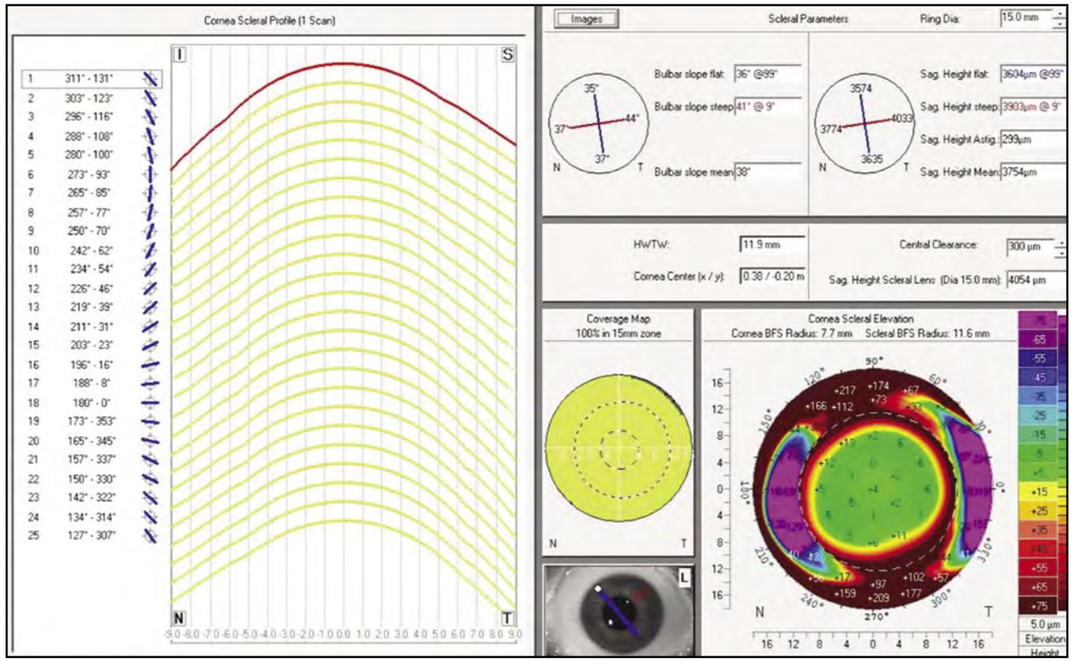


**Figure 1: Profilometry map of a toric scleral shape**

Laboratory consultants are critical for scleral lens success. Even the best scleral lens practitioners work with consultants on a daily basis. They are infinitely helpful in understanding lens parameters, material choices, and of utmost importance, scleral lens troubleshooting. However, all consultants rely on the information that you as a practitioner provide them. Effective communication is key. A consultant's primary purpose is to partner with practitioners to help make their patients successful while increasing the practitioners' confidence in lens fitting. Note, the consultant is there to provide guidance, not to do the entire scleral lens design and fitting process for you. It is critical to provide accurate information when working with a consultant to order a lens. This information includes patient history, previous lenses tried and the outcome with these lenses, a thorough description of the fit, imaging such as corneal topography, corneal tomography, scleral profilometry, photography, videos, optical coherence tomography, refraction, and horizontal visible iris diameter. It is unacceptable to submit keratometry measurements and a refraction and ask for a scleral lens.

Identifying which disease state is being managed with a scleral lens will aid in the consultant's guidance as to the lens profile, such as a prolate or oblate geometry. Describe the

condition, "This patient has keratoconus with a 62 diopter maximum keratometry, located 2 millimeters inferior temporal from the central cornea. The horizontal corneal diameter is 12.1 millimeters."

Describing the fitting relationship should include accurate quantitative values in addition to detailed qualitative descriptions. When a consultant asks, "What is the apical clearance?" Answer with the estimated clearance in microns, "It's approximately 200 microns over the corneal apex." When they ask, "What is the limbal clearance?" Tell them, "50 microns over the nasal and temporal limbus, with 150 over the inferior limbus and touch at the superior limbus." An answer of, "It looks good," is not helpful.

Use very specific descriptions of the landing zone including the lens marking positions in degrees (clock dial positions can work as well, however, this is significantly less accurate), the edge position, the conjunctival vessels underneath the entire lens landing zone, and vital dye interaction with the landing zone. Highlight the problem areas, but also inform them of the regions that are well aligned. For example, "The lens markings are located at 0 and 180, at the 0-degree quadrant the landing zone shows alignment without conjunctival vessel compression and no vital dye seepage, at the 90-degree quadrant the landing zone shows misalignment with approximately 100 microns of edge lift, vessel compression is present near the inner 1 mm of the landing, vital dye seepage is present…" (repeat for each primary quadrant, i.e. 0, 90, 180, 270).

Additionally, remove the lens and describe in detail the problematic clinical observations. For example, "After lens removal, there is a prominent, grade 2, nasal and temporal conjunctival lens impression ring. On the nasal and temporal conjunctiva, there is 90-degree arcuate sodium fluorescein and lissamine green staining with grade 2 conjunctival injection" or "After lens removal, the nasal and temporal perilimbal cornea shows grade 2 microcystic edema with adjacent limbal injection."

**Even the best scleral lens practitioners work with consultants on a daily basis.**

If visual performance is fluctuating, a consultant can aid in finding the root cause. It may be as simple as selecting an alternative material for a lower wetting angle, adding a polymer encapsulation to lower friction and retain more moisture on the surface, or increasing the material oxygen transmissibility to reduce hypoxia. The consultant will be able to address the problem and assist in the material selection of the available lens polymers.

Consultants need the following information about the lens in a static resting position (primary gaze, with the eyelids held open so the entire lens is in full view) and a dynamic evaluation (lens position and movement with eyelids held open, lens movement on blinking, multiple gazes with and without holding the eyelids). Below is a list of what is important to communicate and which specific terms to use:

**STATIC EVALUATION**

**Position:**
***Quantitative:***
**location:** millimeters
**rotation:** degrees
***Qualitative:***
**centration:** inferior, superior, nasal, temporal
**rotation:** stable or unstable

**Corneal zone:**
***Quantitative:***
**clearance:** microns
**location:** millimeters
**width:** millimeters
**arc length:** degrees
***Qualitative:***
**apical:** bearing, touch, alignment, clearance
**mid-peripheral:** bearing, touch, alignment, clearance
**peripheral:** bearing, touch, alignment, clearance

**Limbal zone:**
***Quantitative:***
**clearance:** microns
**arc length:** degrees
**width:** millimeters
***Qualitative:***
bearing, touch, alignment, clearance

**Landing zone:**
***Quantitative:***
**edge:** microns
***Qualitative:***
**vessel compression:** impingement (large

and small vessels compressed), blanching (small blood vessels compressed)
**aligned:** aligned without vessel compression
**too steep:** edge compression, vessel compression at the lens edge (toe-down)
**too flat:** edge lift, vessel compression at the inner or mid landing zone (toe-up)

### DYNAMIC EVALUATION

**Lens translation:**
***Quantitative:***
**movement:** millimeters
**rotation:** degrees
***Qualitative:***
**rotation:** stable, unstable

**Tear film on lens surface:**
***Quantitative:***
**tear break up:** seconds
***Qualitative:***
**lens surface:** tear film is stable or unstable, deposits are light or heavy, deposits are lipid or protein, areas of non-wetting.

Additionally, photos and videos can be very helpful. The quality should be the same as what you see at the slit lamp. Poor quality images are not beneficial. A few 10-second videos can be extremely helpful. There are a variety of ways to capture photos and videos such as slit-lamp cameras, adapters that can connect a smartphone or table to the oculars of a slit lamp, and even some corneal topographers.

For a landing zone and evaluation without a lens, use a stationary diffuse white light at 20 degrees with low magnification. Ask the patient to look in primary gaze, blink a few times, hold the lids open, change the gaze to each primary position, blink a few times, hold the lids open, then add sodium fluorescein or lissamine green stain, and repeat.

**Consultants can make recommendations about how to improve the fit.**

For a lens surface evaluation, use a stationary direct 5 mm white beam at 20 degrees, focused precisely on the lens surface with low magnification. Ask the patient to look in primary gaze, blink a few times and then hold the eyes open, then add fluorescein or lissamine green stain and repeat to show any deposits.

For a limbal and corneal zone evaluation, use an intense white light optic section at 45 degrees, with moderate to high magnification. Slowly sweep from nasal to temporal with the beam at 45 degrees, then sweep temporal to nasal. Ask the patient to look in primary gaze, blink a few times, and hold the lids open.

Additionally, the use of advanced devices, such as anterior segment OCT or scleral profilometry can be helpful to share with your consultant. Profilometry maps of the ocular surface contour can be helpful to understanding the scleral shape when modifying a lens. (Figure 1) Anterior segment OCT is capable of providing cross-sectional images of the lens on the eye to understand clearance over the cornea and limbus as well as haptic alignment. (Figure 2) Remember, media assets are helpful, but do not expect to have a perfect lens delivered to you without a conversation with the consultant.

**Figure 2: Anterior segment OCT of a scleral lens on a eye with keratoconus with 100 microns of apical corneal clearance.**

Scleral lens fitting is a process, takes time and effort and generally a few revisions. Consultants can make recommendations about how to improve the fit or provide other troubleshooting guidance to help optimize patient success.

Creating a successful scleral lens on eye-fitting relationship is a collaborative effort and requires a commitment from both practitioner and consultant. Take the time, provide excellent information, make the effort, and the input from consultants can aid in your scleral lens fitting success. ■

# Scleral Lens Patient Management and Follow Up

By Karen Lee, OD, FAAO, FSLS

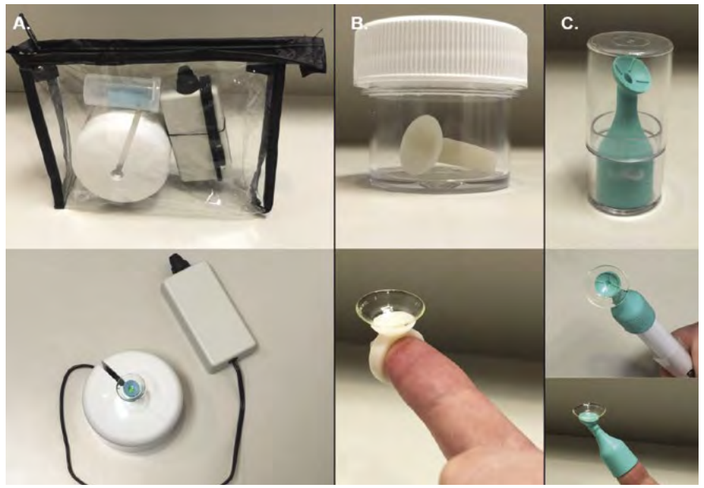


**Figure 1. A.) See-Green Light and Stand B.) EZi lens applicator C.) DMV scleral lens applicator**

Successfully fitting a patient into a scleral lens is one of the most rewarding parts of a specialty contact lens practice, checking off that "finalized" box. It can be tempting to release the patient until their next annual eye examination. However, most scleral lens patients are suffering from complex conditions that require extensive management and treatment to maintain ocular health and comfortable scleral lens wear. Furthermore, the care and handling of scleral lenses can be daunting for those new to this modality and usually requires additional patient education and monitoring.

## Scleral Lens Handling

Difficulty with scleral lens handling continues to be the main reason for scleral lens dropout.[1] At each visit, make it a point to ask all of your scleral lens patients the number of attempts and the time needed to apply and remove their lenses each day. Offer an additional application and removal (A&R) training session if a patient reports needing three or more attempts or is spending more than 10 minutes per eye to apply or remove a scleral lens. Studies have found that with proper training, all patients regardless of age or condition should be able to apply and remove their scleral lenses in less than five minutes by week five of consistent scleral lens wear.[2] Watch how your patient handles their scleral lens, and pinpoint areas that can be improved prior to giving feedback. One common error is aggressive lens application, resulting in tight lens syndrome where the eye becomes injected, the landing zone will appear tight, and the lens will be difficult to remove. There are a myriad of in-office scleral lens application and removal tools available that may benefit your patient (Figure 1). The See-Green Light and Stand from Dalsey Adaptives are exceptionally helpful when patients struggle with ocular fixation, finger dexterity, or eyelid control. The green LED light gives patients a target to focus on while the stand can allow the patient to use both hands to hold lids and lower the eye to the lens. Additional helpful tools are the EZi lens applicator and the DMV scleral lens applicator. Both can be worn to balance a lens on a finger (Figure 1). The DMV applicator can be placed on a pen light to create a lit target. Patient Online resources and videos on scleral lens handling from The Scleral Lens Education Society (sclerallens.org) are great at-home patient resources.

PHOTO CREDIT: KAREN LEE, OD, FAAO, FSLS

## Scleral Lens Hygiene

In addition to the traditional cleaning and soaking solutions required for gas permeable lenses, scleral lenses also need a rinsing and filling solution. Unsurprisingly, scleral lens hygiene is a frequent source of patient confusion; this is especially evident in online patient forums where solution-related questions are extremely common. Patient non-compliance is generally unintentional and can easily be corrected with detailed verbal and written discharge instructions. Each patient's care regimen should be tailored to their specific needs. Hydrogen peroxide-based solutions are a great choice for patients with preservative sensitivities. Heavy depositors may benefit from incorporating a periodic extra strength cleaner. Consider coating scleral lenses in Tangible Hydra-PEG for ocular surface disease patients with poor lens wetting, and recommend Hydra-PEG compatible solutions to prevent early coating deterioration (Table 1).

| SOLUTION NAME | MANUFACTURER | PURPOSE |
|---|---|---|
| Boston Simplus | Bausch + Lomb | cleaning and overnight soaking |
| Unique pH | Menicon | |
| Clear Care Original | Alcon | |
| Clear Care Plus | Alcon | |
| Tangible Clean | Tangible Science | |
| Tangible Boost | Tangible Science | re-build coating |

**Table 1. Tangible Hydra-PEG compatible solutions.**

Patients must only use sterile preservative-free products for scleral lens filling to prevent corneal toxicity. Subjective comfort between patients varies greatly and requires much trial and error. Some patients prefer a buffered solution, while others prefer combining artificial tears with an increased viscosity into the fluid reservoir prior to lens application. A specialty scleral lens filling solution manufactured with electrolytes to mimic the tear film is also available. Great patient handouts reviewing scleral-lens-compatible solutions and care can be found at Association of Optometric Contact Lens Educators (AOCLE) AOCLE.org and sclerallens.org.

Monitor the supplies and solutions used by asking your patients to bring their entire scleral lens care regimen to every visit. Lens cases along with application and removal plungers should be replaced every three months at a minimum. Even veteran scleral lens wearers may switch to a non-compatible solution due to financial savings or confusion over products with similar marketing messages. This may be the key to solving your patient's persistent staining, poor surface wetting, or lens discomfort of unknown etiology.

## Scleral Lens Patient Follow Up

Straightforward scleral lens patients, such as those wearing scleral lenses for refractive error or a stable irregularity, such as from corneal scars, can be followed every six months to one year once the fitting is complete. For progressive corneal ectasias, such as keratoconus or post-refractive cornea ectasia, these individuals must be monitored at three to six-month intervals to ensure the conditions are not progressing. Should progression be found, these patients should be referred for corneal crosslinking to stabilize the disease. Dry eye disease (DED) patients should continue their dry eye treatment to be successful in scleral lenses. Monthly follow-ups may be needed until DED signs and symptoms are controlled, then monitoring every three to six months is required. Patients with complicated conditions such as Stevens-Johnson Syndrome, persistent epithelial defects, high-risk corneal transplants, or graft-versus-host disease necessitate more frequent follow-up, from three months in stable cases to daily with acute issues. Patients suffering from autoimmune conditions must be educated to return immediately if a decrease in vision, worsening ocular comfort, or ocular injection is experienced, as this may be an early sign of systemic decline and often requires co-management with a corneal specialist, rheumatologist, and even an oncologist. Regular communication with outside medical providers establishes comprehensive patient management treatment and also leads to greater patient referrals.

## Scleral Lens Evaluation and Lens-Induced Complications

At every follow up, the lens fitting relationship, the ocular condition that the lens is managing, and the condition of the lens itself, must be evaluated. Starting with the lens itself, evaluation should include a review of the lenses under magnification for surface scratches, material crazing,

edge chips, or cracks. Minor surface scratches are part of the normal wear and tear of a lens over time as is light crazing. Lens polymer encapsulation will break down with time as well. Chips, cracks, and heavy scratches require a new lens to prevent damage to the ocular surface tissues. The use of a radioscope can determine if the lens is warped while a lensometer will check that lens power is correct. As lens condition is variable due to each individual's care, handling, and ocular conditions, lenses will last variable amounts of time and should be replaced as needed.

The lens fitting relationship can be evaluated by splitting the lens into three zones, the cornea, the limbus, and the landing zones. In the cornea and limbal zones, ensure that the lens is not in contact with the underlying tissue, however, also ensure there is no excessive clearance. A typical target of approximately 200 microns over the corneal apex and 50 microns over the limbus are ideal targets. The landing zone should show alignment without underlying conjunctival vessel compression.

Finally, the lens should be removed at every visit to ensure the underlying tissues are in stable condition without complications. A poor-fitting relationship that is not correct will lead to complications over time. The use of vital stains such as fluorescein and lissamine green is vital to the evaluation, with and without the lens. Landing zones with a steep fit will dig into conjunctival tissue, causing conjunctival blanching or impingement with limbal vessel engorgement. Over time this may create severe arcuate conjunctival staining and lead to conjunctival hypertrophy and even pyogenic granuloma formation. Landing zones with an excessively flat fit may contribute to mechanical trauma to the palpebral conjunctival inducing giant papillary conjunctivitis. Landing zones that are too narrow may create deep impression rings with rebound hyperemia with lens removal, a wider landing zone may improve this by spreading the force of the lens over a greater surface area. Lenses with corneal bearing may cause epithelial disruption, corneal molding, and bulla. Over time, mechanical interaction may lead to scarring and neovascularization. Lenses with inadequate limbal clearance may cause limbal staining, epithelial bullae, and microcystic edema at the peripheral cornea, over the long term this may develop into limbal stem cell deficiency. Excessive limbal clearance may contribute to conjunctival prolapse (conjunctival tissue being pulled under the lens). Excessive corneal clearance may cause hypoxia, leading to neovascularization and corneal edema. In eyes with reduced endothelial function, such as post corneal transplant, care should be taken to evaluate for corneal edema by use of corneal tomography for monitoring global corneal thickness. Edema may be mitigated by the use of higher DK material, reduction of corneal clearance, reduction of lens thickness, and the addition of fenestrations. In all cases, a refitting or adjustment to the lens parameters to improve the fitting relationships may resolve the issues over time. In some cases, lens wear may need to be temporarily discontinued while steroids are used to calm the ocular surface tissues prior to refit. When refitting to a profilometry or impression-based design it is important to discontinue wear so the ocular tissues can recover to their natural positions. In some cases, scleral lens wear should be discontinued in favor of alternative designs such as corneal GP lenses. ■

**Karen Lee, OD, FAAO, FSLS**, received her Doctor of Optometry degree from Indiana University School of Optometry and completed a cornea and contact lens residency at Southern California College of Optometry. Prior to joining the University of Houston as a Clinical Assistant Professor, Dr. Lee served as director of the specialty contact lens clinic at the University of California, San Francisco Ophthalmology department. In her free time, she enjoys exploring Houston with her husband and her two sons. Dr. Lee is a Fellow of the American Academy of Optometry and the Scleral Lens Education Society, Past President of the Scleral Lens Education Society, and a GPLI advisory board member.

1 Macedo-de-Araújo RJ, van der Worp E, González-Méijome JM. A one-year prospective study on scleral lens wear success. Cont Lens Anterior Eye. November 13, 2019.
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# Scleral Lens Business Management

By Stephanie L. Woo, OD, FAAO, FSLS


PHOTO CREDIT: GETTY IMAGES/KATLEHO SEISA

Learning how to fit and manage scleral lenses is incredibly exciting and rewarding. Helping patients achieve improved vision and healing their ocular surface is very impactful to both practitioners and patients. Equally as important as patient care is the business side of scleral lenses.

Proper paperwork, authorizations, and billing are critical to maintaining a scleral lens practice.

## Authorizations

Being prepared for a scleral lens patient consultation can not only expedite the entire process but provides a sense of clarity for both the business and the patient. If a patient has an appointment for a scleral lens consultation or evaluation, it is important to have these items ready:

- diagnosis or diagnoses codes with descriptions
- CPT codes
- V codes
- usual and customary fees
- global period (if applicable)
- medical and vision insurance information

Before a patient arrives at the office, the staff should obtain this information and contact the insurance company (or pull the authorization online). The conversation between the staff member and the insurance company will go something like this.

Insurance company: Thank you for calling ABC insurance, how may I help you?

Staff member: I would like to find out if certain codes are covered for my patient John Smith, DOB xx/xx/xxxx. The member ID is ____ and the group number is ____. The ICD-10 codes are _____. The CPT codes are ____. The V codes are _____. The usual and customary fees are _____.

Based on this information, the insurance company will advise if the codes are in fact covered, and if so, the expected reimbursement. They will also inform you of the patient's copay and deductible if applicable.

Then, the staff member will input this information into your practice management system. This way, everyone is aware of what is covered and not covered, the expected fees, and the global period (if any). It is best when everyone involved in the scleral lens fitting is on the same page. When the front desk staff, the doctor, the patient, and the billing team all know what to expect, it makes the scleral fitting process much smoother.

PHOTO CREDIT: GETTY IMAGES/ROB DALY

## Billing Codes

The billing codes for scleral lenses are straightforward:

**Fitting codes:**

92072: Use this when fitting scleral lenses for keratoconus.

92313: Use this when fitting scleral lenses for all other conditions.

**Material codes:**

V2531: Use this code for scleral lenses (may need an RT or LT modifier if insurance requires eye specificity).

## Contracts

After you've determined a patient to be a good candidate, it is imperative that everyone understands what services and products are included for the entire process. Items to include:

- cost of services
- cost of materials
- number of visits
- global period (if applicable)
- refund policy
- material warranty (if a lens breaks, chips, or gets damaged)
- fitting start/end date
- lens remake policy
- shipping costs
- cancelation costs
- payment plan information/schedule
- anything else you want the patient to be aware of

It is critical that someone within the office explains all portions of the contract and has the patient sign and date the contract before they begin with the fitting process. Too many practitioners forget about this important step, which can negatively impact them if things don't go entirely as planned. For instance, what happens if a patient is unhappy with the scleral lenses or they just simply don't work for them? Is there a refund? If so, exactly how much can they expect to receive back?

**Equally as important as patient care is the business side of scleral lenses.**

## Insurance and Vision Plans

When you decide to become part of an insurance network, you need to understand everything you are signing up for and fully understand the patient's plan in regards to specialty contact lenses. Answer these questions in advance: What are the requirements of medically necessary contact lens benefits? What does the manual say about pre-authorization? Are specific forms necessary? Is there an online portal? What diagnosis modifiers are necessary?

When calling the companies to discuss this, do not take the word of the representative because they may not know all the nuances of the plans. Instead of asking them about the plan, ask where in the manual can it be found?

Understand what's included: all visits? fitting only? lenses? remakes? shipping? add-ons? solutions? How are emergency visits billed?

With medical insurance, every follow-up visit is billed independently as an office visit, and all diagnostics testing must be billed. Materials are generally either not covered or are minimally covered

### Cash Pay Model

For offices not using insurance for specialty contact lens billing, it is easy to set up a fee structure that is aligned with the unique usual and customary fees. Make sure you are accurately accounting for the amount of time allotted to each patient for each visit (example: one hour for the fitting, one hour for dispensing, 30 minutes for each follow up). Calculate the amount of doctor time and staff time along with equipment and supplies to formulate a cost that is in line with your practice needs. If you are unsure where to start, here are some free resources to help guide you: GP Lens Institute Professional Fee Calculator and Dr. Stephanie Woo Fee Calculator.

### Marketing

Even with all the knowledge, equipment, and skills, without marketing your abilities, patients won't be able to find you. Your website is the primary tool for marketing your abilities. Ensure your website prominently displays your skillset and achievement related to scleral lenses. SEO, which stands for search engine optimization, is the single most important investment, as it drives patients to your practice. Target the terms you want with the goal of being on the first page of Google. A strong social media presence can be very helpful as well, and boosted posts will certainly be helpful in gaining reach. Remember, a strong social media presence takes time to cultivate, you must be consistent and informative, and interesting.

### Networking

Establishing strong networks with colleagues is an important part of practice building. Meet with eye care providers to explain the indications and benefits of scleral lenses. It is particularly important to establish good relationships with corneal specialists. Network with other providers including rheumatologists, oncologists, hematologists, and pain management specialists. This can also increase the awareness of scleral lenses as an alternative to other medical and surgical interventions.

> It is particularly important to establish good relationships with corneal specialists.

Open communication is essential when coordinating care. It is critical to communicate with the referring practitioner to explain the findings including best-corrected vision with scleral lenses, future recommendations, the time frame for follow-up appointments, as well as when the patient will return to the referring practitioner. Correspondence should be detailed, yet succinct and to the point.

Oftentimes patients will see both the scleral lens practitioners and referring practitioners for multiple visits. Thus, status updates are pertinent to ensure that information is shared and patient care is optimized. This open communication can also help develop referrals.

### Utilize Patient Testimonials

Patient testimonials are often the best and often least expensive form of advertising. Testimonials are a long-standing marketing technique that can be easily done in the practice. Ask patients if they agree to give a 30- to 60-second video testimonial in the practice. Inform them that they will not be identified by name or condition. Utilize relevant props such as scleral lenses, imaging devices, or images if applicable. The positive emotions and overall satisfaction of scleral lenses are quite impactful. With permission, these video testimonials can be used in the examination room, played in the waiting area, on a website and/or distributed via social media platforms.

### External Advertising

Identify the target patient group and create a message that is most relevant to them. For example, is the goal to obtain patients with dry eye who are looking for other management solutions? Is the objective to recruit patients with keratoconus? The target group of interest may be more receptive to certain methods of advertising. There are multiple methods of advertising including print (newspapers, magazines, and journals), electronic (radio and television), public

(billboards and posters) and social media (websites, blogs, Facebook, Twitter, and LinkedIn, among other platforms). There are different costs associated with these different methods; investment decisions need to be made in accordance with predicted returns.

The specific message and type content may be more appropriate for one method of advertising compared to another method. For example, a new or enhanced scleral lens product may be shared on the practice website or via a blog. The importance of an eye examination for children may be shared via Facebook, Twitter, or LinkedIn. Topics shared may be diverse, including a new technology or innovation in contact lenses, topic relating to ocular health or the expertise of practitioners and staff within the practice. Different topics will grow the practice, which in turn can generate more scleral lens referrals.

To grow your scleral lens practice, create a list of keywords, and claim your web pages. Use SEO to make your practice website straightforward for both patients and search engine robots to understand. Google is one of the largest search engines, and hits can be obtained by typing in specific words. In order to draw potential patients to your site, it is critical to optimize certain keywords. For example, the word scleral lens or keratoconus could draw business to your scleral lens practice. Specific keywords of products, services, location and/or practice details will enable the right audience to find your practice.

### Internal Marketing

Internal marketing is often the best form of advertising. Trained staff can initiate the discussion about scleral lenses, which will complement point-of-purchase materials within the practice, such as brochures, videos, literature, or patient testimonials. Staff members can identify appropriate patients to enthusiastically recommend unique scleral lens technologies and the expertise of the practice.

Establishing a scleral lens practice can be time consuming yet rewarding and worthwhile both for the patient and practitioner. A scleral lens practice can be both financially and personally rewarding with the development of a loyal patient base. By putting patients first, always doing what is best for the patient, expressing compassion, empathy, passion, and enthusiasm for scleral lenses, your practice will thrive. An investment in advertising and networking can aid in referrals and practice growth. Staying current with scleral lens designs, research, and technology can streamline the scleral-lens-fitting process and optimize success.

For more, listen to Dr. Barnett interview Dr. Woo about The Thrill of a Specialty Lens Practice in this episode of *WO Voices*. ■

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**Stephanie L. Woo, OD, FAAO FSLS**, graduated magna cum laude from the University of Arizona with a degree in Biology Science Education. She graduated with honors from the Southern California College of Optometry and completed a cornea and contact lens residency at the University of Missouri, St. Louis, where she trained to fit highly irregular corneas. A recipient of the Gas Permeable Lens Institute Award for Clinical Excellence and the John R. Griffin Award for Excellence in Vision Therapy, Dr. Woo is a Fellow of the American Academy of Optometry and a Fellow of the Scleral Lens Society. She authored the Gas Permeable Lens Expert column in Review of Contact Lenses. She is a frequent author for publications such as *Contact Lens Spectrum*, the Contact Lens and Cornea section of the American Optometric Association, *Review of Cornea and Contact Lenses*, and *Review of Optometric Business*. She is an active GPLI advisory board member. Dr. Woo is a past president of the Scleral Lens Education Society, a non-profit organization committed to teaching the art and science of scleral lenses to practitioners, and she is an adjunct professor at Midwestern University. She lectures around the world on the subjects of contact lenses and anterior segment ocular disease. Dr. Woo owns the Contact Lens Institute of Nevada, a clinic dedicated entirely to custom contact lenses. She also owns an optometric coaching and consulting program and is the founder of Woo University, an array of educational resources to help practitioners improve their practices and their personal lives.

# Alternatives to Scleral Lenses

By Tiffany Andrzejewski, OD, FAAO

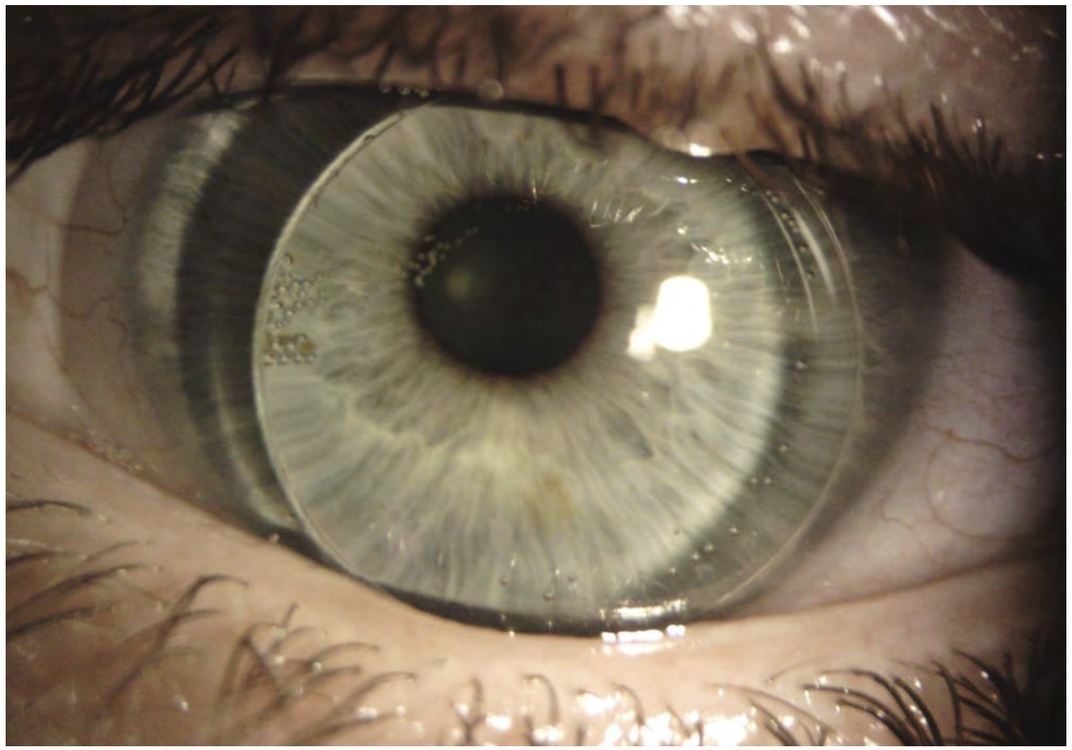

PHOTO CREDITS: TIFFANY ANDRZEJEWSKI, OD

**Figure 1. A GP lens sitting in the recess of a soft lens helped improve centration and comfort for this patient with keratoconus.**

Scleral lenses can be challenging for patients and practitioners alike. For patients, the main reasons for scleral lens discontinuation are handling issues (35 percent) and discomfort (19 percent).[1] For practitioners, the intricacies in fitting scleral lenses can be a challenge, and there is a definite learning curve.[2] As practitioners, we're aware of the life changing benefits scleral lenses offer for patients, however, there's no "one size fits all" contact lens solution for each patient. Scleral lenses are not the perfect choice for everyone, which is why whether it's due to corneal health, cost, the patient's dexterity, the patient's ocular anatomy, or the patient or practitioner's apprehension, it's important to be aware of other available management and treatment alternatives.

## Expanding Your Vision Correction Options

The best way to assess a patient's vision capabilities after checking visual acuities is to perform a manifest refraction. In the case of routine ametropia as well as mild corneal irregularity, spectacles can provide adequate vision. In cases of marked corneal irregularity, spectacle correction can have limited use. However, spectacle correction can still be beneficial in comparison to uncorrected vision for those who are reluctant or who have other barriers that keep them from being able to be successful with contact lenses, as well as for back-up correction when contact lenses cannot be worn.



### Soft Contact Lenses

Soft contact lenses are the primary contact lens option that comes to mind when correcting basic ametropia as well as in cases where adequate vision is achieved in glasses with minimal, or in some cases tolerable, optical distortion. Soft contact lenses are known for their comfort, centration, and corneal protection. Standard soft contact lenses are mass produced and are readily available in a multitude of materials and parameters by multiple contact lens manufacturers. Similar to spectacles, standard soft lenses have a very limited application for irregular corneas, thus lathe-cut custom soft lenses are available for those with irregular astigmatism, in particular keratoconus. Custom soft lenses offer better initial comfort, vision, and centration when standard lenses fail. They can be manufactured in virtually any parameter including steep base curves and almost any conceivable sphere power, cylinder, and axis down to a single degree. Some of these lenses are designed to fit specific corneal profiles such as oblate or post-refractive surgery patients, or distinct pathologies such as keratoconus or pellucid marginal degeneration.

They can also incorporate peripheral curves that can be steepened or flattened and individual sectors that can also be adjusted to improve fit and comfort like today's GP lens designs. The designs available are all unique, and they're different from standard soft lenses in that they follow one of two fitting premises: 1) they have an increased center thickness (CT) to mask irregular astigmatism, or 2) they utilize an aspheric design to reduce aberrations.

It's important to be aware of other available management and treatment alternatives.

Oxygen transmissibility should be considered before fitting corneas with reduced function or high hypoxia concerns as they can be quite thick. These custom soft lenses often do not correct the vision quite as sharp or to the same Snellen acuity level as GP optics do. However, for patients who have an irregular cornea and cannot wear another type of lens comfortably, this may be an acceptable compromise, while still being better than that of glasses.

In addition to correcting refractive error, soft lenses can also be therapeutic and used in the management of ocular surface disease (OSD). Indications include pain relief, enhanced corneal healing, corneal protection, corneal sealing, and drug delivery.[3] They are used in a variety of corneal conditions including bullous keratopathy, corneal erosions, persistent epithelial defects, and post-surgical conditions such as penetrating keratoplasty (PK) and photorefractive keratectomy (PRK). A few mass-produced soft silicone hydrogel lenses are approved for extended wear and have a therapeutic indication from the U.S. FDA. Of these three lenses, two are approved for 30-day continuous wear and the third for seven days.[3] These are readily on hand and easy to fit on average corneal contours. In certain conditions such as irregular corneas, keratoprosthesis, and bleb leaks where a more customized lens is required, the use of off-label custom soft lenses may also be employed.[4,5] Due to the risk of infectious keratitis with overnight wear, prophylactic antibiotics should be used.[6]

**Patients who have Stevens-Johnson Syndrome need constant corneal protection. This example is a patient who wears a scleral lens by day and a soft lens overnight for protection and to avoid pain from lid margin keratinization.**

### Corneal GP Lenses

Corneal gas permeable (GP) contact lenses have been the traditional choice for vision rehabilitation for the irregular cornea and continue to be the primary GP application at 36 percent, followed by scleral lenses at 28 percent, according to a 2020 survey.[7] Corneal GPs are also beneficial for those patients who have critical vision needs and experience poor or unstable vision in soft lenses compared to their glasses due to their

reliance on the tear film for vision correction. Fitting a GP lens on a cornea with mild corneal irregularity is similar to fitting a normal cornea for refractive error. However, this task becomes more difficult as the cornea becomes more irregular and as elevation differences exceed 350 microns, a significant factor influencing GP fitting success.[8] When fitting corneal GP designs, it's important to avoid an apical bearing fitting relationship, which can result in complications of epitheliopathy and scarring.[9] Along with lens discomfort, flatter fits were associated with an increased likelihood of penetrating keratoplasty in keratoconus.[10] Therefore, apical alignment on the normal cornea or a clearance/three-point-touch approach is crucial to maintain corneal health.

Corneal GP lenses are extremely customizable and can be made in any diameter, virtually any prescription, and different geometries, depending on the corneal profile (i.e. reverse geometry designs for oblate or peripherally steep corneal profiles and prolate designs for centrally steep profiles). Their peripheral curves can also be altered to include toric or quadrant-specific changes, which can enhance edge lift configuration with the ocular surface and improve lens centration and patient comfort. They're also advantageous in those patients who suffer from poor vision due to corneal opacification and may obviate the need for surgical intervention.[11] Orthokeratology is another custom GP option worth considering for normal cornea patients with mild OSD because they're worn overnight and do not affect ocular surface dryness during the day.

## Piggyback Lens Systems

Piggyback lenses are best utilized when a patient is experiencing decreased comfort or epitheliopathy despite a best fit corneal GP. Piggyback systems leverage the optics of the corneal GP, while the soft lens helps improve comfort, provides corneal protection, and can also be used to improve GP centration. This modality often seems to be overlooked as the utilization is around 2 percent for those with keratoconus patients,[12] yet it can be a viable problem solver.

**Corneal GP lenses are extremely customizable and can be made in any diameter.**

There are two main fitting approaches for this modality. When trying to enhance patient comfort, it's best to optimally fit the corneal GP then use a low powered, low modulus, hyper-Dk soft CL underneath, which will minimally affect the fitting relationship. When seeking to utilize piggybacking to assist in the fitting process, the best option is to fit the soft CL to artificially change the contour of the cornea first. Topography over the soft CL maps the new contour and guides the fit of the GP lens on top. Corneal GP lenses will tend to center on the steepest area of the cornea, therefore a moderate-plus powered (approximately +6.00D) soft lens with a thicker center can be beneficial in patients who have decentered irregularities or who have oblate corneas to bulk up the central area to aid in GP lens centration.[13] A mild minus soft lens (approximately -3.00D) may be more appropriate in the case of central abnormalities or scars as they have an artificial flattening effect and will allow for a flatter and lower power GP lens to be used.[14] The power effect from the soft lens will be much less than predicted by just adding the powers of the two lenses together—the result would be about 21 percent of the labeled soft lens power.[15]

A successful piggyback fit is largely determined by the patient's comfort and tolerability of the lens system. It's important that the soft lens and GP move independently of one another, and the GP periphery should align nicely with the soft lens to avoid both adherence and excessive edge lift.

Additionally, custom soft lenses sometimes need to be employed when a commercially available soft lens flutes or will not align with the corneal contour. There is also the option of employing a custom soft lens with a recess in the center in which the GP lens can settle to enhance centration (Figure 1). This recess is made larger and deeper than the diameter and thickness of the GP lens to facilitate some movement while keeping the lid interaction minimal and the lens stable on the eye.

## Hybrid Lenses

Hybrid contact lenses have a GP center hyper-bonded to a soft skirt.

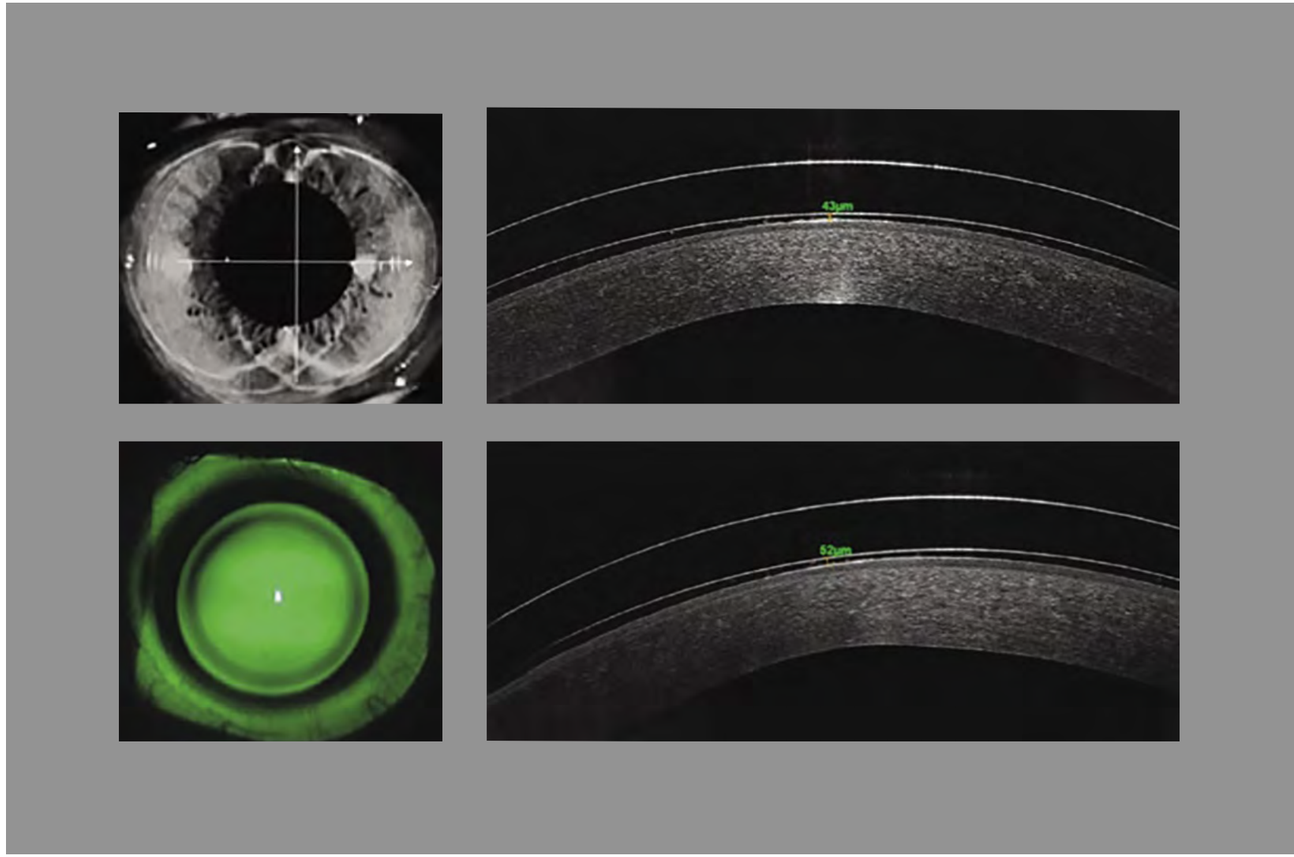


**Figure 2. 50um of central clearance on OCT over a hybrid lens settled on a keratoconic eye is optimal. The fluorescein pattern shows clearance throughout the central portion of the lens with feather touch inside the junction of the GP and soft lens (ILZ) with bearing on the peripheral cornea where the bulk of the soft lens lands (OLZ) and supports the weight of the lens.**

In the United States, there is only one manufacturer that offers multiple designs and geometries to accommodate a variety of corneal shapes, however the OAD and GP diameter is fixed. Outside of the United States, a different hybrid contact lens is available in multiple countries. The GP portion of the lens uses variable base curves or sagittal depths to align with or vault the cornea, while the soft skirt has different base curve radii that help facilitate movement, centration, and tear exchange.

The newer generation designs are available in higher oxygen permeable materials for both the soft and GP lens portion. All hybrid designs only come in spherical powers and cannot correct lenticular astigmatism. Normal cornea designs are available with an enhanced profile design to mitigate flexure on highly toric corneas as well as multifocal optics for correction of presbyopia. Clinical studies support some key advantages of hybrid lenses: they provide improved vision compared to soft toric lenses[16] and improved comfort in comparison to corneal GP lenses.[17]

For the normal cornea, the GP portion is expected to align with the central cornea and exhibit a halo of fluorescein with a slight lift at the soft/GP junction. The design for the normal cornea has recently been revamped to allow for the skirt to land tangentially to the sclera to prevent tightening and easier removal while the GP and soft lens BC parameters have been recently expanded to allow for a more customized fit.

For the irregular cornea, the GP portion is designed specifically for vaulting the irregular cornea and will exhibit approximately 100µm clearance at insertion, as the lens may settle 30 to 60µm after several hours of wear. The central GP portion should clear the cornea with light touch on the mid-peripheral cornea at the GP soft lens junction (the inner-landing zone or ILZ) and land evenly on the soft skirt without fluting or impingement (Figure 2). The soft skirt (the outer-landing zone or OLZ) bears 80 percent of the weight of the lens system making it more comfortable than corneal GPs.[17] Initially, movement should be observed upon blink; after a few hours of wear, movement may not be perceptible, although there is still tear exchange. Hybrids work well for centrally located irregularities of mild to moderate severity.

## Surgical Correction

Even with all the fantastic contact lens options available, there is still a place for surgery. We must consider the comprehensive visual needs of the patient, both with and without contact lens correction. Although vision may be excellent while wearing contact lenses, vision with glasses may not be functional.

Surgical options for correcting the irregular cornea depend on the patient's presentation, ocular history and surgeon preference. Intrastromal corneal ring segments (ICRS) is an additive supplemental procedure intended to make an irregular cornea more prolate by a space-occupying implant to mechanically move the apex closer to the visual axis, thereby flattening the corneal apex and reducing irregularity. The ability of corneal collagen cross-linking (CXL) to strengthen the cornea has opened a new realm of procedures aimed at decreasing corneal irregularity. Topography-guided laser corneal ablation can help re-sculpt the cornea to reduce corneal irregularity, which, when combined with CXL to increase tissue strength, can improve corneal curvature as well as both corrected and uncorrected acuities by several lines.[18,19] This is especially exciting as these combined procedures have additional implications when utilized either with phakic IOLs[20] or before cataract extraction[21] to further improve vision for irregular cornea patients of all ages.

**Even with all the fantastic contact lens options available, there is still a place for surgery.**

Cornea transplantation for the irregular cornea patient should only be explored when all non-surgical options have been exhausted. Transplant surgery might be considered when a patient is no longer able to tolerate their lenses either from a comfort or mitigating complication issue (i.e a decompensating cornea), when a successful contact lens fit is no longer possible, or when vision is poor despite a well-fitting contact lens (i.e. central corneal scar). The primary cornea transplant procedures for irregular corneas are penetrating keratoplasty (PK) and deep anterior lamellar keratoplasty (DALK).

For the normal cornea patient, refractive independence can be surgically achieved by a variety of different procedures such as LASIK, PRK, SMILE, phakic IOLs, clear lens exchange, as well as cataract surgery. Sometimes removing the iatrogenic cause of dry eye disease, the contact lens itself,[22] can be an effective outcome given 16 percent to 30 percent of all CL wearers each year report dry eyes as a main reason to discontinue contact lens wear.[23,24] A study by Price et al. demonstrated less dryness in patients who underwent LASIK compared with patients who stayed in contact lenses.[25] However, a recent meta-analysis found a significant reduction (Figure 2) in postoperative tear production, as well as TBUT time, was seen with LASIK, and a non-significant reduction in postoperative tear production and TBUT was seen with SMILE and PRK.[26] This is important to keep in mind when making a referral for a patient with underlying dry eye disease.

## The Bottom Line

Scleral lenses are amazing tools for both the regular and irregular cornea. However, in certain cases, a scleral lens may be less than ideal or there may be a simpler option for the patient. Ultimately, it's important to be aware of alternative options to scleral lenses and consider the patient's goals and limitations when deciding upon which lens design might be most appropriate for the patient. ■



**Tiffany Andrzejewski, OD, FAAO**, graduated from the Illinois College of Optometry and completed a residency in cornea and contact lens at Indiana University before moving back to Chicago to work for Chicago Cornea Consultants, a private OD/MD group practice. Dr. Andrzejewski's special areas of interest include the management of keratoconus, ocular surface disease, peri- and post-operative care, and other cornea and contact lens-related issues, as well as scleral contact lenses. In addition to caring for her patients, Dr. Andrzejewski also lectures on various contact lens topics and is actively involved in the clinical training of optometry students and residents. She serves as an adjunct assistant professor at the Illinois College of Optometry as well as the Chicago College of Optometry. She is a member of the Illinois Optometric Association, the American Optometric Association, and the Scleral Lens Educational Society, a Fellow of the American Academy of Optometry, and an advisory board member of the gas permeable lens institute.

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# Resources: Everything You Need to Know About Scleral Lenses and Where to Find It

John D. Gelles, OD, FIAO, FCLSA, FSLS, FBCLA, and Melissa Barnett, OD, FAAO, FSLS, FBCLA

The most critical part of scleral lens application in clinical practice is a complete understanding of the disease you choose to manage with a scleral lens. Practitioners are not simply fitting a scleral lens. Rather, they are managing corneal and ocular surface pathology with a medical device that provides mechanical protection, continuous fluid immersion, and optical aberration reduction.

Many of the diseases managed with scleral lenses are commonly encountered in clinical practice, such as irregular and ectatic corneal disease, while others are rare, such as a genetic or immune-mediated ocular surface disease. The commonality is that all require a deep understanding of the appropriate management of the disease state.

Once comprehensive management of the disease state is understood, appropriate follow-up with indicated testing established, and the collaborative care partners identified, it is essential to understand the possible complications that can be caused by scleral lens wear and how to overcome them.

Before 2005, very few scleral lens resources were available to practitioners, but in the last 15 years, there has been a massive influx of research and education. Today, there is a cornucopia of options for clinical education on disease management of a scleral lens. ■

## PEER-REVIEWED JOURNALS

Vital to practicing evidence-based medicine and applying what's new, each of these peer-reviewed journals contains information relevant to contact lenses, corneas, ocular surface disease, and experimental research.

- ***Contact Lens and Anterior Eye***
- ***Cornea***
- ***Eye & Contact Lens***
- ***Investigative Ophthalmology and Vision Science***
- ***Journal of Cataract and Refractive Surgery***
- ***Journal of Contact Lens Research and Science***
- ***Optometry and Vision Science***
- ***The Ocular Surface***

## BOOKS

We consider these books to be vital literature to aid in your clinical success.

***Contemporary Scleral Lenses: Theory and Application***
**By Melissa Barnett and Lynette K. Johns**

Providing the most comprehensive and in-depth information about scleral lenses, this should be required reading for all practitioners using scleral lenses.

***Scleral Lens Issues and Complications: Their Recognition, Etiology, and Management***
**By Daddi Fadel**

Every practitioner, at some point in their clinical use with scleral lenses, will experience a complication or issue that needs troubleshooting. This book will aid in understanding why and offer solutions to overcome them.

***Cornea, 2-Volume Set, 5th Edition***
**By Mark Mannis and Edward Holland**

This most comprehensive corneal disease manual available is relevant to nearly all ocular disease states that could be managed with a scleral lens. Additionally, surgical procedures are covered that will give a deeper understanding of surgical co-management.

***Clinical Manual of Contact Lenses, 5th Edition***
**By Edward S. Bennett and Vinita A. Henry**

A classic among contact lens practitioners, this book covers all modalities of contact lenses. This is helpful for not just scleral lenses but also for alternatives to scleral lenses.

## NEWSLETTERS/ BLOGS

Short snippets of relevant topics and a glance at current research. Generally under five-minute reads.

- ***I-Site***
- ***Mastering Keratoconus Blog***
- ***Scleral Lens Monthly***

## SOCIAL MEDIA GROUPS

A great way to connect with other practitioners on a variety of topics related to scleral lenses and related disease states.

- ***Business of Scleral Lenses***
- ***OSDocs***
- ***Scleral Lens Practitioners***

## PROFESSIONAL SOCIETIES

These societies, academies, and associations provide excellent continuing education opportunities and organized resources for practitioners. Many have archives of webinars available for viewing any time.

- ***Accademia Italiana Lenti Sclerali***
- ***American Academy of Optometry: Cornea, Contact Lens, and Refractive Technology***
- ***American Optometric Association: Cornea and Contact Lens***
- ***British Contact Lens Association***
- ***Canadian Contact Lens Academy***
- ***Contact Lens Society of America***
- ***Euro & Austral-Asia Scleral Lens Academy***
- ***Eye and Contact Lens Association***
- ***Gas Permeable Lens Institute***
- ***International Association of Contact Lens Educators***
- ***International Keratoconus Academy***
- ***International Society of Contact Lens Specialists***
- ***Optometric Cornea, Cataract and Refractive Society***
- ***Scleral Lens Education Society***

## SCLERAL LENS GUIDES

A quick reference for practitioners, these guides aid mostly in the clinical application of scleral lenses.

***A Guide to Scleral Lens Fitting, 2nd Edition***
**By Eef van der Worp**

This first comprehensive guide to scleral lenses is in its second edition.

***Clinical Guide for Scleral Lens Success***
**By Melissa Barnett and Daddi Fadel**

A comprehensive guide to scleral lenses, this resource is available in English, Italian, Portuguese, Spanish, and Russian.



## SYMPOSIA

Attendance at these meetings will ensure collegial interaction among peers and offer many opportunities to ask questions and interact with the experts. For auditory, visual, and hands-on learners, this is the best way to gain valuable education in a compressed time frame.

***Global Specialty Lens Symposium***

The premier symposium focused entirely on specialty contact lenses of all varieties features research and clinical applications, industry innovations, and practical, hands-on wet labs.

***International Congress of Scleral Contacts***

Focused on all aspects of scleral lenses with international reach, the first meeting is dedicated exclusively to scleral lens practice.

***International Forum for Scleral Lens Research***

Academic fisticuffs at its finest, this research-focused scleral lens meeting is where controversial topics in scleral lens theory and application are introduced, challenged, and debated.

***Summit of Specialty Contacts***

Based in Europe, historically in Rome, this international conference is more intimate and covers all topics related to specialty contact lenses.

***British Contact Lens Associations Annual Meeting***

Based in the United Kingdom, this meeting is a comprehensive contact lens meeting covering all aspects of contact lens management.

***American Academy of Optometry Annual Meeting***

Though the meeting covers all topics relevant to clinical practice, scleral lenses and associated diseases are frequent presentations. Typically the Scleral Lens Education Society hosts a wet lab to teach a practical hands-on application of scleral lenses.

***American Society of Cataract and Refractive Surgery Annual Meeting***

Though an ophthalmology meeting with a primary focus on refractive and cataract surgery, a large amount of research and lectures are presented on corneal treatments and management relevant to the scleral lens practitioners.

***CXL Experts***

This is primarily an ophthalmology meeting focused entirely on novel applications and innovation of crosslinking and novel treatment and management of keratoconus and cornea ectasia.

***The Association for Research in Vision and Ophthalmology Annual Meeting***

This research-based meeting brings together researchers and practitioners alike. It's a great way to understand the evolution from research bench to clinical application.

## PROFESSIONAL PUBLICATIONS

Professional publications are a great way to learn from key opinion leaders about scleral lens applications. These are generally more conversational and provide a distilled and sometimes opinionated view of the peer-reviewed research.

- ***Contact Lens Spectrum***
- ***Review of Cornea & Contact Lens***

## PROFESSIONAL PODCASTS

These can give insights into innovations and applications of scleral lenses, adjunct technologies, and care tips from practitioners in a conversational, non-CE, format.

- ***Global Eyes***
- ***Specialty Lenses Unplugged***
- ***Try Not to Blink***

## SCLERAL DEVICES

Profilometry devices generate data to describe the geometry beyond the cornea, aiding in the design of scleral lenses by understanding the shape and depth of the ocular surface. Wavefront aberrometry devices generate data to evaluate residual aberrations with scleral lens wear and create wavefront-guided, higher-order aberration correcting scleral lens optics.

***Eaglet ESP***

Rasterstereography based, fluorescein needed, export data to multiple external lens design software, multiple labs, data derived from a single image.

***SMap3D***

Rasterstereography based, fluorescein needed, export data to laboratory-specific lens design software, single lab, data derived from three images stitched together.

***Oculus Pentacam***

Scheimpflug based, no fluorescein, export data to multiple external lens design software, multiple labs, data derived from five images stitched together.

***Ovitz X-Wave***

Hartman Shack based wavefront aberrometry system, export data to select labs.



## CORNEAL AND OCULAR SURFACE DISEASE DIAGNOSTICS

Having the right devices to manage these diseases is vital. Many of the ectasias, such as keratoconus, are progressive in nature and have treatments available to halt progressive change. It's important to monitor for changes and take action when necessary. Since there are so many manufacturers of devices, we will discuss applicable devices and their utility.

***Topography***

Anterior corneal curvature measurements. Placido ring analysis for the tear film.

***Tomography***

Comprehensive corneal metrics providing global corneal pachymetry, curvature and elevation of the anterior and posterior cornea as well as advanced algorithms for monitoring disease progression and ectasia detection.

***OCT***

Ability to analyze scleral lens fitting relationships. Applicable to early diagnosis of keratoconus and ectasia by analysis of corneal layer (currently epithelial layer) thickness. Additionally, OCT may be used for retinal evaluation.

***Aberrometry***

A non-specific proxy for identifying irregularities in the optics of an eye or an eye plus lens. Ideal for understanding residual aberrations during scleral lens wear. New clinical applications are entering the market to incorporate wavefront-guided optics on scleral lenses.

***Genetic Testing***

A method to aid in risk analysis for keratoconus and confirmation of TBGFI corneal dystrophies.

***Aesthesiometer***

Corneal sensitivity testing to confirm and quantify neurotrophic cornea of various etiologies.

***Specular Microscopy***

Analysis and visualization of endothelial cell layer health can be helpful in assessing risk. Corneas with increased polymorphism, polymegathism, and numbers should be more followed more frequently.

***Confocal Microscopy***

Analysis and visualization of corneal nerves. Useful in patients with corneal neuropathy.

## SCLERAL LENS MANUFACTURING LABORATORIES

To manage a wide variety of conditions, it is important for practitioners to learn several lens designs. Each design has unique features that can be useful for different management solutions. Learning various designs will help to understand multiple ways to modify a lens. Choosing a manufacturing laboratory is based on practitioner preference. The manufacturing laboratory is a partner that is invested in the success of your practice and patients. Consultants are vital to the fitting process and offer years of experience to aid scleral lens fitting and modification choices. Additionally, many have created resource libraries complete with webinars to teach the specifics of their scleral lens design.

- ***ABB Optical Group***
- ***Accu Lens***
- ***Advanced Vision Technologies (AVT)***
- ***Art Optical Contact Lens***
- ***Bausch + Lomb SVP, Alden Optical***
- ***BostonSight***
- ***CooperVision SEC, Blanchard Lab***
- ***Custom Craft Lens Service***
- ***Essilor Custom Contact Lens Specialists***
- ***EyePrint Prosthetics***
- ***Metro Optics***
- ***SynergEyes***
- ***Tru Form Optics***
- ***Valley Contax***
- ***Visionary***
- ***Visionary Optics***
- ***X-Cel Specialty Contacts***

## SCLERAL LENS CARE PRODUCTS

Care products are just as important as design and material. Understanding the differences can aid in finding what works best for your patients and what to troubleshoot should your patient develop signs of toxicity or intolerance.

### FLUID RESERVOIR/RINSE STERILE SALINE

- ***B+L ScleralFil***
  non-preserved, borate-buffered
- ***Contamac Nutrifill***
  non-preserved, electrolyte supplemented with potassium, calcium, and magnesium, phosphate-buffered
- ***Lifestyle Company PuriLens***
  non-preserved, borate-buffered
- ***Menicon LacriPure***
  non-preserved, unbuffered
- ***VibrantVue Scleral Saline***
  non-preserved, unbuffered

### POLYMER DEPOSIT REMOVAL

- Boston One Step Liquid Enzymatic Cleaner
- Menicon Progent
- Sereine Extra Strength Daily Cleaner

### DISINFECTION PRODUCTS

- ***Hydrogen Peroxide***
  - Alcon Clear Care and Clear Care Plus
  - CooperVision Refine
- ***Multi-Purpose***
  - Boston Simplus
  - Menicon Unique PH
  - Tangible Clean
- ***Two-Solution Systems***
  - B+L Boston Advance Conditioning Solution and Cleaner
  - B+L Boston Original Conditioning Solution and Cleaner
  - Sereine Wetting and Soaking Solution and Cleaner

### POLYMER ENCAPSULATION MAINTENANCE

- Tangible Boost

## SCLERAL LENS APPLICATION AND REMOVAL DEVICES

These devices are critical to lens handling and patient success. These devices can be purchased and sourced directly from the companies or through your lens manufacturing laboratory of choice

***Dalsey Adaptives See Green***

LED-based illumination inside the recess of a lens application device gives the patient a target to view while applying the lens and comes with a lens applicator stand to aid with application.

***DMV Corporation***

Classic lens applicators and removers in a variety of shapes and sizes.

***EZi Lens Application Ring***

Fingertip ring with a platform to aid with balancing a scleral lens on one finger for lens application.

## SCLERAL LENS POLYMERS

Material matters, and understanding the differences in the gas permeable polymers you choose will have a direct impact on lens performance and ocular health. Each has advantages and disadvantages. Your laboratory can aid selection.

- ***Acuity Polymers***
- ***Boston***
- ***Contamac***
- ***Menicon***
- ***Paragon***

## POLYMER ENCAPSULATION

***Tangible Hydra-PEG***

# **ABB Optical Group** – Largest Specialty Lens Portfolio with a Unique Scleral Lens System

ABB Optical Group is a leading provider of optical products, services, and business solutions in the eye care industry. ABB operates through three business pillars: ABB Contact Lens, ABB Labs, and ABB Business Solutions. ABB is focused on the future of eye care professionals (ECPs), helping them succeed by making practices more efficient and assisting providers to effectively navigate market changes.

ABB Specialty Vision Products, a division of ABB Contact Lens, offers ECPs the largest portfolio of specialty lenses (gas permeable and custom soft) in the industry, designed to meet each patient's unique ocular needs. But it's not just about the breadth of ABB's portfolio. It's how ABB's experienced and knowledgeable team of specialty contact lens consultants and advisors work with ECPs to grow their specialty business. ABB Specialty Vision Products helps ECPs take their specialty business to a whole new level with the resources and educational tools such as Wet Labs, Scleral Lens Bootcamps, and Lunch & Learn opportunities for practitioners and their staff. ABB Specialty Vision Products' team of consultants have years of expertise in a wide range of specialty areas and can guide ECPs in selecting the right product for even their most challenging GP or custom soft patients.

The ICD FLEXFIT is a unique scleral lens system offering an all-in-one solution for both irregular and normal corneas. Available in both 16.3 mm and 14.8 mm diameters, this advanced scleral lens design allows ECPs to "FLEX" in 0.1 mm increments across a wide diameter range for a custom fit. The ICD FLEXFIT is designed as a 4-Zone lens featuring Auto-FLEX technology to easily make increment adjustments to the vault or landing, while auto-adjusting the sagittal depth exactly to the patient's cornea. Even the most challenging patients can look forward to receiving a perfect fit with ICD FLEXFIT.


For more information about ICD FLEXFIT and to discover more about ABB Specialty Vision Products, please visit www.abboptical.com/specialty-vision-products or email specialtysales@abboptical.com.

ABB Contact Lens
Specialty Vision Products

ABB Optical Group | 800-772-3911 | abboptical.com

## **ACCULENS** – Focus on Innovation

Located in Denver, Colorado, Acculens is recognized for its advanced designing capabilities, quality, and service. Founded in 1970, AccuLens offers over 50 years of experience as a premier manufacturer of scleral and custom GP lenses. In 1981, current CEO and owner Bill Masler purchased the company and made it his goal to invest in people, innovation, and equipment. Over the last four decades and with the help of Bill's business partner, Troy Miller, AccuLens is a leading manufacturer of specialty contact lenses. With a focus on quality and innovation, AccuLens currently sells and distributes contact lenses worldwide.

AccuLens' Maxim Scleral lens has gained international recognition and was one of the first scleral lens designs on the market. In addition to being a manufacturer and fitter, Bill was the clinical instructor of contact lens education and training at the University of Colorado Health Sciences Center. This unique hospital affiliation gave AccuLens access to patients with ocular surface disease and paved the way for the development of the Maxim and EasyFit scleral designs and newly released Maxim 3D free-form.

In January 2019, AccuLens launched patent pending OnPoint Alignment Technology to meet the industry's need for enhanced presbyopic correction in scleral lenses. OnPoint is a laser-marked grid that precisely measures the amount of offset needed for multifocal alignment. In a multi-center study, OnPoint was evaluated in 90 patients (MOOVES Study by SALUS University) and proved to be a precise tool in the evaluation of scleral decentration and offset optics. The study concluded a reduction in remakes as well as increased patient satisfaction. The average patient score was 8.7 out of 10 distance acuity and 9.0 out of 10 for near acuity. In addition, to offset near optics, Acculens offers a dual-aspheric AMF, center near progressive, and alternating near and distance zone designs.


In July 2021, Acculens launched its most advanced scleral design, the Maxim 3D. This free-form design flawlessly mimics the shape of the cornea and the asymmetrical shape of the sclera at 360 degrees. Maxim 3D is available by trial fit or empirically via ESP or CSP data transfer. Lens designs are calculated and interpreted to the micron for a precise fit. The Maxim 3D has four sections that can be arranged at any angle on the haptic, allowing total control over the fit. The free-form change starts 1mm inside the limbus. This is called advanced geometry CEL (Contour Enhanced Landing), which allows accuracy in the vault from the cornea onto the sclera. Maxim 3D is without design limitations and offers efficiency for practitioners. Multifocal options, AccuVault, and high-definition (HD) optics for higher-order spherical aberrations are available on all Maxim 3D designs.

Acculens continues to focus on innovation to help practitioners improve patient's lives with advanced products and offers a six-month, industry-leading warranty. Acculens is a partner in custom lens designs.

**To contact AccuLens, please email info@acculens.com**

AccuLens
THE CLEAREST CHOICE IN SIGHT®

Acculens | 800-525-2470 | acculens.com



## **Art Optical Contact Lens, Inc.** – An Independent Focus on Specialty Lenses

Art Optical began rigid lens manufacturing in 1958, making us the longest-running custom contact lens laboratory in operation today. Thanks in part to our loyal team and their extensive specialty lens experience, we continue to enjoy exciting growth and are proud to be an independent and family-owned company.

To stay at the forefront of the specialty lens industry, we pursue new technology, adhere to the highest manufacturing standards, and have attained MDSAP qualification. With this level of measurable compliance and consistency in our production, practitioners can trust in the safety, reproducibility, and quality of our lenses.

With more than six decades of service to the ophthalmic professions, our solitary focus on specialty lenses has allowed us to build a portfolio of category-leading brands, backed by a team of experts who understand every aspect of contact lens design, fitting, manufacturing, and customer support. From point of order through final dispensing, we strive to deliver the best possible patient outcomes in the least amount of time, which ensures practitioner success.

Within our extensive line of high performance lens options, practitioners will find a customizable design for almost any patient, including Renovation®, the nation's leading GP multifocal.

Ampleye® is our fully vaulting, 4-zone scleral lens design that quickly became the go-to scleral for specialty fitters and general practitioners alike. Supported by an efficient 9-lens fitting set appropriate for both oblate and prolate corneas, Ampleye offers a simplified approach to scleral fitting for reduced chair time and excellent clinical outcomes. Ampleye is ideal for patients with irregular corneas, lens stability issues, and corneal GP intolerance,

and it is FDA indicated for the management of dry-eye and ocular surface disease.

To address the growing myopia epidemic, we have introduced MOONLENS®, a progressive lens design that helps manage and temporarily correct myopia. Featuring customizable optical zones to maximize the treatment area for each individual patient, MOONLENS® is a safe and healthy vision correction option available to a broader range of patients – from children to adults.

Other leading brands include ROSE K®, and Intelliwave® PRO, our lathe-cut SiHy series available in virtually unlimited parameters for patients with unique visual demands and prescriptions that fall outside of inventory range of stock soft lenses.

Today's custom lenses are becoming the lens of choice for practitioners interested in personalizing patient care, retaining control of their practice, and improving their bottom line. At Art Optical, we are committed to investing in the programs, processes, and products that will help them meet those goals. To learn more about the benefits of specialty lenses, or to access our full product portfolio visit www.artoptical.com. We look forward to partnering in your specialty lens practice far into the future!

ART Optical contact lens, inc.

Art Optical Contact Lens, Inc. | 800-253-9364 | artoptical.com

## **Advanced Vision Technologies (AVT)** – A Small Company with a Big Vision Thinking Anything Is Possible

Advanced Vision Technologies, also known as AVT, manufactures customized scleral, GP, and soft lenses for almost any type of cornea. AVT's designs include lenses for normal, irregular, presbyopic, post-surgical, pediatric, and diseased corneas as well as modalities for corneal reshaping and myopia management.

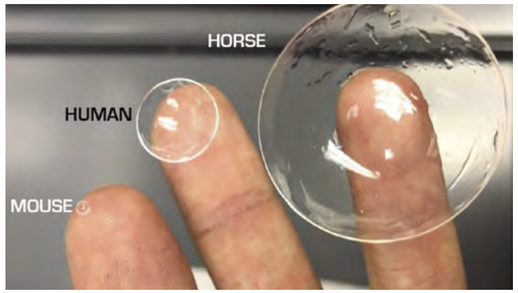
AVT was founded in 2004 by Keith Parker and Janine Bugno, the co-owners of AVT. The company has organically grown even throughout a period of decline in the GP marketplace.

In 2012, AVT was one of the few laboratories to receive a 510K for lathe-cut customized soft contact lenses. NaturaSOFT is a quarterly replacement modality with the Contamac high-DK Definitive 74% silicone hydrogel material for all types of corneas, including normal, astigmatic, multifocal, pediatric, myopia management, and irregular corneas, including post-surgical and keratoconus. Getting the soft lens approval added more options for AVT to offer its customers to be the "go-to lab" for customized contact lenses.

AVT received its FDA approval in 2013 and is now also ISO 13485 Certified. AVT has customers all over the U.S. and distributors throughout the world.

In March of 2018, AVT acquired Continental Soft Lens, Inc. With this transaction, AVT obtained an additional 510K for the hefilcon A 45% soft lens material. This enables AVT to offer a more traditional modality of soft contact lenses. Most recently, in July of 2021, AVT acquired Lancaster Contact Lens, Inc.'s manufacturing division, including the Ni-Cone and the NRK GP designs for irregular and keratoconus corneas.

Consultation and customer service are among the main focuses for AVT. The consultation team consists of six highly trained consultants with real world experience, resulting in less chair time and refits for doctors.




**AVT manufactures contact lenses for humans and in research for mice, dogs, monkeys, and horses.**

The Naturalens MINI is the latest scleral AVT offers. This extremely customizable and versatile design makes it a powerhouse for your practice. The design is fantastic for any corneal types, including presbyopic patients and soft lens dropouts. Featuring a unique landing area they have tapped into the sclera angle just outside limbus, making for less lift adjustments, including less need for toric haptic zones, simplifying the fit. This lens can be fit without a fitting set with Rx, K's, Best Fit Sphere information and HVID. The lens is approximately the size of a custom soft lens, making it easier for insertion and removal and less intimidating for many patients.

AVT is a small company with a big vision thinking anything is possible. The company not only manufactures contact lenses for almost any cornea but also manufactures contact lenses used in research for mice, dogs, monkeys, and horses. Some of the augmented reality and smart lens designs have started with prototypes manufactured by AVT to prove or develop the possibility to manufacture.

Advanced Vision Technologies

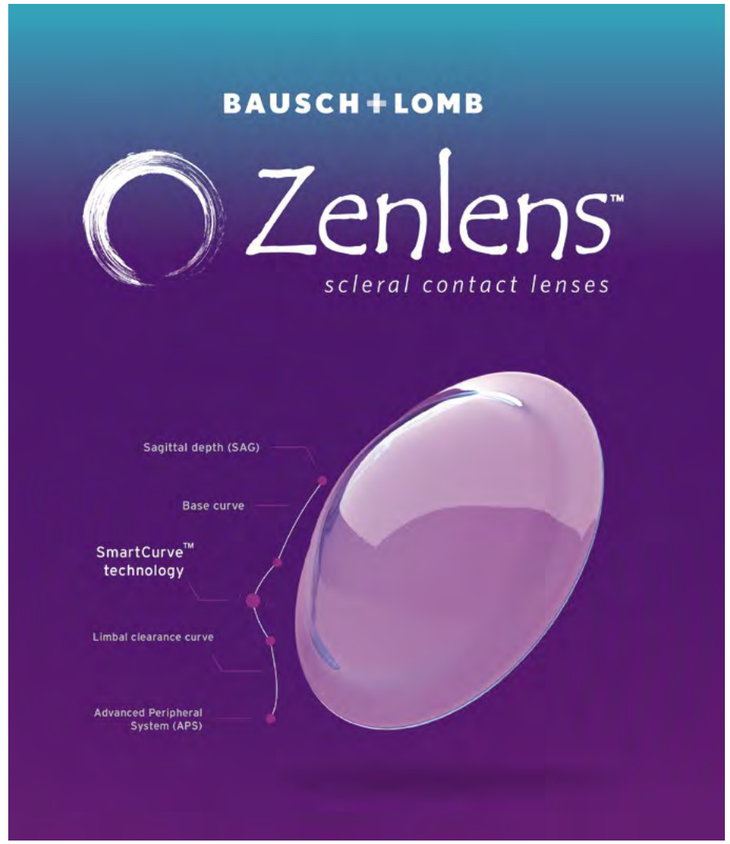
Advanced Vision Technologies (AVT) | 303-384-1111 | AVTLENS.com



## **Bausch + Lomb Specialty Vision Products** – A Family of Custom Contact Lenses

Bausch + Lomb is dedicated to delivering products, education, and training for eye care professionals in the custom contact lens space. Through our Zenlens™ family of scleral lenses, Boston® materials, and many other custom lens products, eye care professionals will have the support they need to meet the needs of their patients with challenging visual problems, including keratoconus, post-refractive surgery, irregular astigmatism, myopia, presbyopia, and ocular surface disease, including dry eye.

Interested in learning about Zenlens™? Bausch + Lomb Specialty Vision Products has created a highly informative video series. **You can watch it here: www.bauschsvp.com/zenlens-fitting-series**




BAUSCH+LOMB

Bausch + Lomb Specialty Vision Products | 800-253-3369 | bauschsvp.com

## **CooperVision Specialty EyeCare** – Versatile Design Options for All Eye Indications

CooperVision Specialty EyeCare represents the combined knowledge, experience, and bold heritage of some of the world's leading specialty vision companies, including Blanchard, GP Specialists, No. 7, Paragon, Procornea and Soflex.

Our team is recognized throughout the world of specialty eye care professionals for our best-in-class service and our unmatched portfolio of life-changing specialty lenses employed for scleral and advanced contact lens management, myopia management, and presbyopia management.

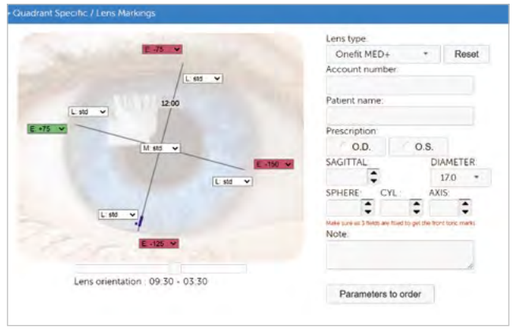
CooperVision Specialty EyeCare's Blanchard Onefit™ family of scleral lenses include an array of versatile design options to accommodate all eye indications.

**MED/MED+**

Onefit™ MED & Onefit™ MED+ advanced scleral lenses enhance your fitting experience with an abundance of innovative design options and unrivaled parameter selection supported by highly intuitive online fitting calculators and custom tools. You have total design control within four independent zones, as well as quadrant specific landing and limbal zone configurations, toric haptics, front-surface torics, notching, oblate geometries, and multifocal options that will soon include de-centered multifocal optics. The result is a fully customized, Made-to-Measure scleral lens that provides patients with crystal clear vision, exceptional comfort, and long-term corneal health.

Online fitting calculators help you to easily determine final lens parameters and provide an interactive graphical representation of the lens you designed, which allows you to visualize the changes made, and the resulting fluid reservoir depth over each zone. The fitting calculators allow for data to be imported from various eye profilers for efficiency.

Online custom tools include Controlled Peripheral




Recess (notching), Quadrant-Specific Lens Markings, Axis Compensation, a Dk/t Estimator, and more.

**Onefit**

The Onefit Scleral Lens Platform, with a standard diameter of just 14.9mm, and the Onefit A lens with a standard diameter of 14.7mm, simplify the fitting process for a wide range of applications, and minimize both lens thickness and tear layer required to support the lens, while maximizing oxygen transmission to the cornea and stems cells. Onefit lenses are designed to vault a given topography with an optimal sag height and are specified by the value of the base curve in millimeters of radius curvature, streamlining the fitting process and making it more user-friendly.

With a trial set composed of only 14 lenses, a simple six-step fitting approach, and an intuitive online fitting tool to remove any guesswork, Onefit is extremely easy to use.

**Personalized virtual training is available to learn how to fit Onefit scleral lens designs. Simply fill out this form. Be Bold. Stand Out. Change Lives.**

CooperVision® Specialty EyeCare

CooperVision Specialty EyeCare | 800-367-4009 | coopervisionspecialtylenses.com



## **X-Cel Specialty Contacts** – The Widest Selection of Specialty Contact Lenses

X-Cel Specialty Contacts is an industry-leading, specialty-lens-focused company, globally serving eye care professionals with an unmatched level of customer care that is backed by the widest selection of specialty contact lenses in the industry and supported by an ISO13485:2016 registered medical device quality management system.

Our expansive portfolio of specialty contact lenses includes scleral and corneal gas permeable designs, custom soft, myopia management, and proprietary designs manufactured for other companies. The easy-to-fit Atlantis™ Scleral, which includes, independent zone adjustability, quadrant-specific fitting options, a revolutionary 3D-Vault limbal vault adjustment, and multifocal and toric parameters, continues to be an industry leading solution. Some of the many corneal GP designs manufactured by X-Cel include solutions for patient indications such as presbyopia, keratoconus, astigmatism, post-surgical, and other irregular cornea conditions. These designs include, but are not limited to, the Pinnacle, Titan, ProPlus, Starlens, and Apex lines. X-Cel was one of the first labs to offer Tangible Hydra-PEG, a breakthrough custom contact lens coating for GP designs.

The Flexlens, Horizon, and Westcon Specialty Custom Soft designs include the Flexlens ARC for Atypical Refractive Correction. This custom soft lens is a great option for post trauma and irregular cornea patients who cannot wear scleral lenses or may prefer a cost-effective alternative to a scleral lens. X-Cel's XRP Toric is an extended-range toric with a quick turnaround, shipping in five business days or it's free!

New to X-Cel's myopia management category is the innovative REMLens®, a highly adjustable, yet easy-to-fit orthokeratology design for the management of myopia. REMLens features four independently adjustable fitting zones, multiple diameter and optic zone options, and the revolutionary Dynamic Edge Profile™, providing on-eye comfort in an open and closed eye setting. REMLens offers unique fitting simplicity and revolutionary adjustability, boasting an 89% first fit success rate*. Novice to expert orthokeratologists will appreciate the adjustability beyond what other orthokeratology designs offer. In partnership with our Walman sister divisions, we can offer advanced instrumentation, practice management assistance, and marketing expertise, whether you are just setting up a myopia management practice or are a seasoned pro.


X-Cel's legacy of excellence does not end once your patients' lenses leave our facility. To better serve the eye care professionals in the optical industry, X-Cel offers ongoing personalized training for you and your staff, practice management tools, online ordering capabilities, and hassle-free, no-return warranties with paperless credits.

X-CEL SPECIALTY CONTACTS

X-Cel Specialty Contacts | 800-241-9312 | xcelspecialtycontacts.com

## **Acuity Polymers, Inc.** – Innovating GP Lens Material Development

Headquartered in Rochester, N.Y., USA, Acuity Polymers is a privately held company focused on innovation of contact lens materials for specialty vision products around the globe. Dedicated to research, development and manufacturing of best-in-class materials, the company is the first to create an Ultra Dk* GP material, Acuity 200, the only latheable contact lens material with a Dk* of 200. This new material is ideal for scleral lens fitting as it provides more oxygen transmissibility than any other material, while having exceptional machining properties to permit the manufacture of the most sophisticated designs by specialty laboratories. The material is inherently wettable, which means it doesn't require any extra manufacturing treatments to render it wettable. Patients and fitters appreciate the material's unique combination of ultra-high gas permeability, precision manufacturability and stability, and on-eye, all-day comfort. Acuity Polymers is earning a reputation amongst eye care professionals for the quality of its innovative GP lens materials that provide optimal protection of ocular health and superior vision for their patients.


Besides Acuity 200, the company offers a full range of advanced GP materials, including low, medium, and high Dk, in many handling tints. For more information, please visit acuitypolymers.com or contact the company directly at info@acuitypolymers.com.

**Acuity Polymers Inc. | 888.765.9637 | acuitypolymers.com**

## **Contamac** – The World's Largest Manufacturer of Contact and Intraocular Lens Materials

Contamac is the world's largest manufacturer of contact and intraocular lens materials and a leading innovator of specialist polymers and biocompatible materials for medical applications. We are proud to have spent over 30 years working with lens manufacturers and eye care practitioners to truly make a difference in people's lives.

Founded in 1987, Contamac now manufactures in a 35,000-square-foot, purpose-built facility 20 miles south of Cambridge in England. We take great pride in ensuring that every material is manufactured to the same quality standards, whether they are implantable or sit on the eye. Our contact lens materials include traditional hydrogels and the first FDA-approved latheable silicone hydrogel material, Definitive®. Our flagship Optimum® line of GP materials features a wide range of oxygen permeabilities and excellent surface wettability. In 2019, Contamac expanded our product offerings in the United States by introducing HyClear®, a 0.01% hypochlorous acid solution for daily eyelid hygiene. The following year, Nutrifill®, a preservative-free scleral lens insertion solution designed to mimic the body's natural tears, was introduced.

We are proud to have been recognized for our commitment to quality at the highest standard, including two Queen's Awards for Enterprise. Most importantly, we are proud to have earned the trust and support of the industry, and for this we are truly thankful.

**Contamac | 866-872-6682 | Optimum-Infinite.com | Contamac.com**



## **Essilor Custom Contact Lens Specialists** – Essilor CCLS

Essilor Custom Contact Lens Specialists (Essilor CCLS) is composed of a passionate team sharing an expertise in specialty vision care. Offering a wide product portfolio, made-to-order custom specialty lenses manufactured by Essilor CCLS include: spherical, multifocal, scleral, ortho k, and surgical GP contact lenses made from premium GP materials with an unmatched, unlimited warranty.

Looking for a custom scleral lens design? The eJupiter™ is a signature scleral contact lens exclusively by Essilor CCLS and is available in a variety of custom scleral lens designs such as: toric pc, toric front, reverse curve, and multifocal; notching is available as an add-on too. Eye care professionals have enjoyed seeing the success from prescribing the eJupiter™ scleral lens with even their most challenging irregular cornea/scleral lens patients.

All this, combined with ongoing education and training from industry experts, along with friendly, knowledgeable consultation, it is no wonder why so many eye care professionals across the country choose Essilor CCLS.

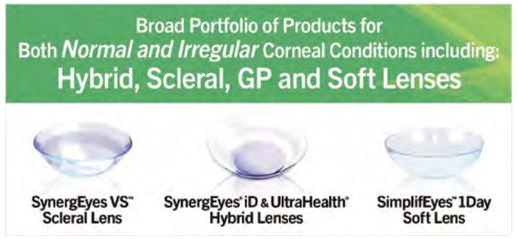
**Learn more at essilorcontacts.com or call 800.366.3933.**


**Essilor Custom Contact Lens Specialists | 800.366.3933 | essilorcontacts.com**

## **SynergEyes** – Transforming Vision for Normal & Irregular Corneal Conditions

SynergEyes, a leading expert in specialty contact lenses, offers a complete continuum of products for contact lens specialists. SynergEyes contact lenses transform vision for patients with astigmatism, presbyopia, and irregular corneas. The innovative SynergEyes iD hybrid lens is indicated for those with astigmatism and presbyopia, individually designed for each patient's unique ocular anatomy. SynergEyes lenses for the Continuum of Care for Keratoconus include UltraHealth hybrid lenses for mild-to-moderate keratoconus, and SynergEyes VS™ scleral for more advanced corneal conditions.

SynergEyes iD and UltraHealth hybrid lenses are empirically designed, allowing practitioners to order lenses without the need to put trial lenses on eye or disinfect and reuse diagnostic lenses. Empirical fitting streamlines the fitting process, saves valuable chair time, and reduces reliance on reusable fit sets, leading to increased practice efficiency and profitability.




The SynergEyes technically advanced clinical consultation and sales team is available to assist practitioners at every step of the fitting process to help improve patient outcomes.

SynergEyes supports practices with digital resources, patient application and removal training, and webinars from some of the industry's leading ODs.

**SynergEyes | 877.733.2012 Option 5 | SynergEyes.com/Professional**

## **BostonSight** – Innovations in Scleral Lens Design Since 1992

Founded in 1992, BostonSight has saved the sight of thousands of individuals suffering from ocular surface disease, corneal disease, injury, or damage. Our ongoing commitment to research and achieving optimal patient outcomes has driven numerous innovations in scleral lens design. Analysis from over 20,000 eyes has improved both practitioner fitting experience and patient long-term comfort and ocular health. BostonSight SCLERAL was launched in 2017 to improve access to our leading scleral lens designs around the world.

BostonSight SCLERAL lenses include built-in oval optic zones for improved lens centration, and SMART features, such as SmartChannels™ to vault anatomical obstacles and reduce suction and SmartSight™ FSE to address higher order aberrations.

Practitioners know their patients best so they should be able to design the lens that fits them best. BostonSight SCLERAL is available in two triple-play FitKit™ options – 16, 16.5, and 17mm, and 18, 18.5, and 19mm. Each FitKit contains a comprehensive 28-lens fitting set with right and left anatomical designs to address unique scleral shape profiles, and our step-by-step FitGuide™. Using SMART features for extra customization, practitioners can find an optimal fit, fast.


BostonSight SCLERAL is available in the U.S. and Canada and has distributor partnerships with Spectrum International in Latin America and L.V. Prasad Eye Institute in the Middle East and India.

**BostonSight | 781-726-7337 | bostonsight.org | bostonsightscleral.org**

## **TruForm Optics** – A Message from Jan Svochak, President

"TruForm Optics was founded in 1976 by my father, Frank Svochak, Sr. As the President of TruForm, I'm proud to be the second generation of contact lens manufacturers.


As a family-owned business, our focus has always been on specialty GP lenses. Of the lenses we produce, 90% or more are lens designs we developed ourselves. We don't distribute or license products, and we don't give lip service to innovation; we develop everything that we do. For example, we developed our own computerized lathes, we can develop our own hardware, our own software, or our whole manufacturing system using software that we write ourselves.

Many of the designs that are produced at TruForm cannot be manufactured with the software that's commercially available to specialty lens labs. We have access to all of that, but we're not limited by it. This gives us more opportunity for innovation. TruForm was the first lab to bring quadrant-specific technology to the industry, and we were the first lab to design lenses from optical coherence tomography instruments. TruForm holds eight patents that cover multifocals and sclerals, and we have the quadrant-specific patents.

We know our customers have a choice in who their GP provider will be, and we work tirelessly to give our customers the widest range of specialty lens options to meet the needs of every patient. It's not only our focus – it's what we do best."

**Specialty Lenses Are Our Focus™**

**TruForm Optics | 800-792-1095 | tfoptics.com**

# Professional Organizations

*Review of Optometric Business* would like to thank the following professional organizations for endorsing *Scleral Lenses 2021: The Scleral Lens Education Initiative*.

## Contact Lens & Cornea Section

The **Contact Lens & Cornea Section** (CLCS) is a nationally recognized segment of the American Optometric Association (AOA). Members of CLCS include eye care professionals and optometry students who are dedicated to furthering their understanding in the field of contact lenses, cornea, diagnosis, and treatment of anterior segment disease, refractive surgery, and related technologies. More information regarding the CLCS is available here. The AOA CLCS council can be contacted at clcs@aoa.org

## Gas Permeable Lens Institute

The **Gas Permeable Lens Institute** (GPLI) is dedicated to providing the eye care community with unbiased education, practice-building materials, and resources to realize the full benefits and advantages of GP and custom soft contact lenses. The GPLI provides a comprehensive schools program, including webinars and a three-day workshop program for cornea and contact lens residents. There are over 100 archived webinars from renowned speakers on topics such as myopia management, orthokeratology, scleral lenses, multifocal GPs, bitorics, keratoconus, spherical GPs, custom soft lenses, and lens care. Other resources include a "Find a GP Specialist" database, several empirical lens design calculators, a comprehensive staff training module, a specialty contact lens coding and billing module, a case grand rounds troubleshooting book, and a laboratory consultant FAQs module. Several resources are available for order online, including laminated cards on lens fitting and care as well as numerous consumer brochures on GP lenses.

## International Keratoconus Academy of Eye Care Professionals

The International Keratoconus Academy of Eye Care Professionals (IKA) was established to promote ongoing professional education and scientific development in the area of keratoconus and other forms of corneal ectasia. Its mission is to promote and develop the knowledge base and awareness of the state of the art pertaining to the diagnosis and management of keratoconus and other forms of corneal ectasia. The IKA also promotes the awareness and understanding of the most appropriate and effective treatment strategies for the management of these diseases. IKA accomplishes its mission by providing an array of educational initiatives, which include live events, web-based education, social media activities, and publications in the professional literature. It also is dedicated to supporting ongoing clinical research. IKA functions as a complementary entity to other organizations that support patients with these diseases such as the National Keratoconus Foundation (NKCF). These organizations work cooperatively to establish a comprehensive effort to advance knowledge, awareness, and quality of care.


## The Intrepid Eye Society

The Intrepid Eye Society is a diverse group of emerging thought leaders in optometry with a goal of promoting excellence and growth in our field. Our initiatives include advancement of optometry through innovative thought sharing on topics related to future medical therapeutics, diagnostics, practice development, research and development, and collaborative care with ophthalmology. The Intrepid Eye Society was started in 2015 to promote excellence and growth of optometry through teamwork of future leaders in our field. The founding members' vision for the group included the advancement of optometry through innovative thought sharing on topics related to future medical therapeutics, diagnostics, practice development, and research and development. The other key goals of the group were to follow in the footsteps of leaders in optometry to educate and advise current colleagues and industry partners on all facets of optometry.


## Scleral Lens Education Society

The Scleral Lens Education Society (SLS) is a registered non-profit charitable organization with a mission to provide scleral lens education and resources to eye care practitioners, students, and patients. We strive to teach the science and art of prescribing scleral lenses, support public health initiatives, and provide education that highlights the benefits of scleral lenses and improves their access and success in the eye care community. We offer live and online education, including lectures, webinars, as well as hands-on workshops at most major U.S.-based meetings and some international meetings. Our website has a vast collection of information about scleral lenses for doctors and patients, including training videos to help patients learn about applying and removing scleral lenses. The SLS is committed to the highest level of diversity, equity, and inclusion for all members, fellows, and leaders of the organization, with members and fellows from around the globe. Become a member (free) and get access to all our resources by visiting our website at sclerallens.org.