Do it Better, Do it Faster: The Developing Roles of Scleral Lenses in Today's Society

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Now that the Internet, email and GPS are instantly available in the palm of our hands, the speed at which society moves is faster than ever. As practitioners we want more technology, more information, and we want it now. Our patients are expecting the same mindset from their health care providers. They appreciate high-tech scans of their eyes and explanations about new spectacle and contact lens designs, especially those that hope to improve the performance over their current modality or those that simply want the best options available. Why do we keep trying to 'make it work' with soft toric contact lenses on these patients when they have moderate to high amounts of corneal cylinder? Why do we jump from one soft lens to another on our patients that suffer from dry eye, while we watch them lose hope with each diagnostic lens that we hand out? Now is the time for us to keep up with the rest of society and start doing our job better, doing it faster and with the addition of scleral contact lenses in our arsenal, we finally have the tools to do so.

Original scleral lens indications and fitting philosophies

Scleral gas permeable contact lenses hit the scene over 100 years ago to correct vision and promote ocular surface healing on irregular corneas, but several hurdles made the scleral contact lenses short-lived. The material that scleral lenses were made with had poor transmissibility of oxygen through the lens, which forced the discontinuation of lens wear due to corneal hypoxia. The lenses were handmade and difficult to replicate in the instance of breakage or loss and improper fitting techniques sacrificed corneal health. Now that we have the availability of materials described as hyper-permeable to oxygen, computer driven lathes and better fitting techniques, scleral lenses are again back on the scene changing lives for those patients who previously thought they were no longer candidates for contact lens wear. We have nearly three decades of documentation and hundreds of scientific studies proving the success and benefits of wearing scleral contact lenses. Our patients with keratoconus, corneal transplants, ocular surface disease and other types of irregular corneas are now enjoying healthy lens wear and great vision with similar initial comfort to that of a soft contact lens.

Modern scleral lenses are described as lenses that are 16.5 millimeters or larger in overall diameter and rest all weight on the sclera with complete corneal and limbal clearance. Initially, an ideal fit was 200-300 microns of clearance over the apex of the cornea. Some practitioners utilized fenestrations in the optic zone of the lens to assist in tear exchange and oxygen transmission. The most common groups of scleral lens wearers were those with corneal ectasias, like keratoconus and pellucid marginal degeneration. There was also a small percentage of patients wearing the lenses to promote healing of their ocular surface conditions.

A shift in mindset

Over the past three decades, the use of scleral lenses has become wide spread across many ocular conditions, and the applications for them continue to grow. The largest group of lens wearers continues to be those with corneal ectasias, but the uses in the ocular surface disease realm is expanding at a rapid pace. Scleral lenses are restoring vision in patients with neurotrophic and exposure keratopathies, replacing the need for tarsorrhaphies and corneal transplants in many cases.[1-4] Laboratories are continuing to improve their designs and are finding ways to increase potential patient candidates for their lenses. In the last decade, developments in scleral lens technology include front surface toric lenses for residual astigmatism and toric peripheral curves for eyes with greater than average scleral toricity.[5] Reverse geometry design and multifocal scleral lenses are available from many laboratories. These options allow us to reach an entirely different group of patients, as well as the opportunity to provide an amazing level of customized care for our entire patient base. These changes to scleral lens designs have improved vision, comfort and overall quality of life for habitual and new lens wearers alike.

As the technology and designs of scleral lenses continue to evolve, so have the fitting techniques and the types of patients that are now considered candidates for scleral contact lenses.[6] Patients with normal corneas are now considered great candidates, especially when their visual needs exceed typical soft lens parameters.[7] Certain lens laboratories are designing scleral lenses made specifically to vault a normal cornea, and patients that have more than a few diopters of corneal astigmatism are ecstatic about their results. Those with high astigmatism and desiring a multifocal option are no longer restricted to corneal gas permeable lenses (even though they remain a great option for lens wear in certain cases).[8,9] The addition of normal eyes to the scleral lens wearing population has been a change in philosophy from years past and is gaining popularity. Another significant change in viewpoint focuses around the overall diameter of scleral lenses. The theory behind lens diameter selection remains the same, in that the more sagittal depth needed to vault the corneal apex, the larger the lens diameter should be. But now, diameters come as small as 14.3 millimeters and maintain a full corneal and limbal vault rather than utilizing a corneoscleral fitting technique. While this design is not applicable for all irregular corneas, there has been great success with normal corneas and a vault of as little as 100 microns is considered acceptable in many cases. The smaller diameter lenses are less intimidating, easier for patients to handle, less expensive and are typically a more predictable fit. Small diameter lenses are successful because less modification needs to be made to the peripheral curvatures of the lens. The scleral curvature is most regular and relatively consistent patient to patient near the cornea, and becomes more toric and variable beyond the cornea onto the sclera. The most important fitting factor to monitor while using smaller diameter lenses is to make certain that limbal clearance in maintained during lens wear, ensuring the health of limbal stem cells. A final change in fitting technique worth discussing is the use of fenestrations. Fenestrations are used very selectively now, on a case-by-case basis. A common use of fenestrations is to release bubbles that are trapped under the scleral lens from improper application technique, rather than their original uses of promoting the flow of oxygen and facilitating tear exchange.

Scleral lens fittings sets now offer more options for parameter changes to expedite the fitting process. In addition to numerous base curves, many fitting sets include lenses with different overall diameters, changes to the peripheral curve lifts, different curvatures to contour the limbus and even different specifications in sagittal depth.

Utilizing these lenses in the initial fitting process gives instant information to both the practitioner and the patient so we can keep up with our 'do it fast, do it better' society.

New concepts for a new patient base

With all of the additions in scleral lens parameters and technology, nearly every patient in your office becomes a scleral lens candidate once their vision needs or contact lens frustrations surpass the visual potential that can be provided by soft contact lenses. Sometimes, it's up to the practitioner to ensure lens satisfaction and it is acceptable to ask your patient if they are satisfied with their quality of vision. Some patients may think that their lenses are the best that can be done, so they do not bother about asking about what is new in the contact lens world. Common groups of patients that may fit into this category are those with high astigmatism, residual refractive error post-LASIK surgery and presbyopia.

Patients with high astigmatism will especially love scleral lenses, because the lens can twist and rotate with no effect on their vision. As you explain the new lens to them, you may encounter some resistance because all of these patients have heard they should be wearing "hard lenses," or perhaps they have already tried them and tremble at the thought of attempting to adapt to the lenses again (because frankly, who has time to adapt anymore?) Thankfully, we are able to utilize fitting sets in the office the day of the fitting to meet the 'do it now, do it better mentality.' Once the final diagnostic lens is on, you are only a few minutes away from showing the patient the best vision they have had in years through a quick over-refraction. With your astigmatic patients, keep in mind that if their topography shows limbus-to-limbus toricity, it may extend onto the sclera and produce some lens flexure. As a practitioner, you'll see with-the-rule astigmatism on retinoscopy and the patient may comment on vision fluctuation or reduced acuity with a spherical over-refraction. I then recommend a spherical-cylindrical over-refraction and keratometry or topography over the lens to gain insight on how much flexure is occurring. Typically, increasing the center thickness of the lens by anywhere from 0.05 to 0.20 millimeters is my first adjustment, but decreasing the overall diameter is another option that may reduce flexure. A final option to try and decrease flexure is to add toric peripheral curves to the lenses to attempt a better contour to the patient's sclera.

Patients that struggle with refractive changes or mild ectasia after LASIK surgery are another group that struggle to wear contact lenses successfully, especially if any amount of astigmatism is involved. The oblate shaped cornea no longer fits well to toric soft lenses on the market and patients become frustrated with lens movement. Scleral lenses are an excellent option for these patients because of vision stability and the fluid layer for any residual dry eye. While they are not always necessary, a reverse geometry designed scleral lenses fits a post-LASIK cornea very well, as they keep the vault in the center of the cornea from becoming too deep and instead maintain an even tear film from limbus-to-limbus. Many post-LASIK patients return to the office looking for contact lens options when presbyopia becomes a problem in their daily routine. But thanks to some hard work by our gas permeable lens laboratories, many well-designed multifocal scleral lenses are on the market today, and we are able to keep these patients satisfied with one of the new lens options out there.

Numerous companies are in the process of, or have recently released multifocal scleral lenses.[10] This section of the article will review these lenses by company.

Multifocal Scleral Lenses

Company	Lens
Acculens	Maxim Plus
Acculens	Comfort SL Plus
Art Optical	So_2Clear Progressive
Advanced Vision Technologies	AVT
Blanchard	MSD
Blanchard	One Fit
Dakota Sciences	So_2Clear Progressive
Essilor	Jupiter Plus
Metro Optics	So_2Clear Progressive
Lens Dynamics	Dyna Semi-Scleral
Truform	Digiform Multifocal
Valley Contax	Stable Near

Acculens

Acculens has multifocal options in both the Maxim and Comfort SL designs. The Maxim Plus lens is for distorted corneas with a presbyopia design. Maxim scleral lenses are designed to fit a diverse range of corneal distortion including advanced keratoconus, pellucid marginal degeneration, post-corneal surgery and corneal trauma. A trial lens fitting set is not needed to fit these lenses. The multifocal is a center-near add design. The optic zone is based off of the pupil size in normal illumination.

Comfort SL Plus are multifocal lenses for non-distorted corneas. Theses lenses utilize the multi-curve / aspheric posterior surface to create proper corneal alignment. Comfort SL lenses are fabricated with the patient's keratometry readings, spectacle prescription and corneal diameter. The Comfort SL Plus Multifocal lens requires pupil diameter as well. A trial lens fitting set is not needed to fit these lenses. The multifocal is a center near add design. The optic zone is based off of the pupil size in normal illumination.

The company recommends a smaller optical zone in the dominant eye as compared to the non-dominant eye. Add powers can be ordered in any power. In addition, adding +0.50 to the spectacle add power is beneficial.

Maxim Plus scleral lenses range in diameter from 15.7mm to 20.5mm. Comfort SL Plus scleral lenses range in diameter from 15.7mm to 16.7mm. Available powers for both Maxim and Comfort SL lenses range from +/- 20.0D and near add powers from +1.00 to +3.50D. Toric options are available up to 6.00D. The lenses are manufactured in Boston XO2 material with a 140DK.

Custom fabrication of lenses is possible including custom edge lift and optic zones. Optic zone changes are utilized to change the sagittal depth. A lens with a larger optical zone will have a deeper sagittal depth and will have better corneal coverage. Both Maxim and Comfort SL can have up to eight posterior curves. There are four scleral curves, one limbal curve and potentially three corneal curves depending on the steepness of the base curve. According to Bill Masler, President of Acculens, the design reason is not to have the posterior curves step down too dramatically from one to the next.

Art Optical / Dakota Sciences / Metro Optics

The So2Clear Progressive corneal-scleral design (Art Optical / Dakota Sciences / Metro Optics) is available in the standard design. The lens diameter is from 13.00mm to 15.00mm. The SoClear Standard is ideal for astigmatism correction, difficult to fit single vision patients, oval keratoconus, irregular corneas, pellucid marginal degeneration and corneal ectasia. The standard So2Clear fitting set can be used to fit the lens and then the presbyopic version can be ordered based on the best-fit lens. It is a center-near multifocal design with a standard 2.0mm center-near zone that ranges from 0.05mm to 6.0mm in 0.05mm increments. Add powers are from +1.00D to +3.50D in 0.25D steps. Base curves are available from 6.60mm to 9.50mm. Powers range from -20.00D to +20.00D in 0.25D steps. The lenses are manufactured in Boston XO2 material. Fitting sets are available for both the SoClear Progressive as well as the Standard design. The fitting set base curve range is from 7.34 mm to 8.33 mm and the diameter range is from 13.3 mm to 15.5 mm.

Advanced Vision Technologies

The AVT scleral multifocal is a center distance, back aspheric lens with variable eccentricity zones for all ranges of distance, intermediate and near visual demands. The AVT multifocal can be fit utilizing the Standard AVT Scleral Diagnostic Fitting system; a special fitting set is not required. The best fitting standard AVT scleral diagnostic lens can be converted to the AVT multifocal scleral design. This lens is a presbyopic option for all types of patients with normal or highly irregular corneas. Add powers are available from +1.00 to +3.00.

The Diagnostic Fitting System consists of three central base curves (40.00D, 45.00D, 50.00D), three diameters (16.1mm, 16.6mm and 17.1mm) and three tangent carrier angles. This combination of parameters create a versatile range a sagittal depth values.

The tangent angle carrier is an adjustable peripheral landing zone of the lens. When fit properly, the tangent angle carrier offers enhanced tear exchange throughout the day. These angles are described as low (2 steep angle), medium (1 steep angle), high (standard / average which is the most common), extra high (1 flat angle) and extra extra high (2 flat angle).

The center thickness of all diagnostic lenses is 0.35mm (350 microns) to aid in determining the tear layer beneath the lens. Center thickness may be increased if lens flexure is present.

Front and back toric lenses are available to accommodate irregular scleral conditions and residual astigmatism. Customizable parameters are available at no additional charge.

Blanchard

Blanchard Contact Lenses Inc. plans on launching the Onefit lens with multifocal optics by June, 2013. It will be an anterior surface simultaneous vision design featuring a near centered high add (+2.25D) and low add (+1.75D). This lens will be an add on to Onefit Cone as well as Onefit P+A lenses to fit both normal and irregular corneas.

The fitting process is the same as Onefit lenses. The only difference is anterior surface multifocal optics. Simultaneous optic correction is utilized since the lenses do not translate. If the patient has a manifest add less than +2.00D, the low add is used. If the patient has a manifest add equal to or greater than +2.00D, the high add is used. The dominant and non-dominant eye will be identified to favor the low add optics for the dominant eye and high add optics for the non-dominant eye.

Onefit Cone lenses have a base curve range from 5.50mm to 7.50mm. Available diameters are 13.7mm, 14.0mm, 14.3mm and 14.6mm. Onefit P+A lenses base curves range from 6.70mm to 8.50mm. Available diameters are 13.8mm,

14.3mm, 14.6mm and 14.9mm. Both lenses have edge lift values of standard, steep 1, steep 2 and flat 1. Onefit lenses are manufactured in materials with a minimum oxygen permeability of 100DK.

Essilor

Essilor plans to release a lens called the Jupiter Plus. It is a pure center distance lens with a unique proprietary design. The design will give an add of +1.50D to +1.75D, making lens optimal for computer and office work. The lens can be made of Tyro, Boston XO, Boston XO2 and Optimum Extra. The lens diameter is currently up to 16.6mm, but most likely will be able to go to 17.6mm in the Optimum Extra material in the future. It is not yet available in 18.2mm, 18.8mm and 20.2mm diameters. The Jupiter Plus lens will be able to fit both normal and irregular corneas.

Lens Dynamics

The Dyna Semi Scleral lens by Lens Dynamics has a front aspheric optic proprietary multifocal design. The design has a small central front optical zone that is spherical; the remainder of the front surface is aspheric. According to Al Vaske, President of Lens Dynamics, Inc. this gives a better distance optical effect. Any Dyna Semi Scleral lens can be utilized as a multifocal design. Preferred diameters are between 15.0mm and 16.0mm for the multifocal design.

Lens diameters span from 13.5mm to 16.0mm. Available powers range from +/- 30.0D and near add powers from +1.00 to +2.50D. The optical zone is generally from 9.0mm to 10.0mm, but can be modified if needed. Dyna Semi Scleral lenses are available in Boston XO, Optimum Extra, Tyro 97 and Menicon Z materials. The edge can be modified from standard as needed with Quad Sym treatment (different edge lift in all four quadrants). Front toric options are also available.

TruForm Optics

TruForm Optics has two multifocal designs. The DigiForm 15.0mm lens ranges from 13.5mm to 16mm with an average 15mm diameter. Five different condition specific designs are available. The DigiForm 18 lens is a 18mm design with diagnostic etchings on the front surface of the lenses to aid in lens fitting. These lenses are indicated for post refractive surgery, pellucid marginal degeneration, keratoglobus, Steven-Johnson's syndrome, post-trauma, ocular surface disease or when corneal lenses don't center.

Both DigiForm 15mm and 18mm diameter lenses are available with front surface center near multifocal options. The add power and zone size may be specified. The add power may be specified in any 0.25 diopter increment. The standard zone size is 2mm center near. This may be adjusted depending on the patient’s pupil size. This option is available with quadrant specific, front toric and back toric designs as well. Available lens materials are Optimum Extra, Menicon Z, Tyro 97, HDS100, Boston XO and Boston XO2.

TruForm has fitting sets available with the add incorporated on the diagnostic lenses. George Mera, Fitting Consultant, TruForm Optics recommends using the fitting set to establish the correct lens for the patient.

Valley Contax

The StableNear lens by Valley Contax has a front surface application that contains a near zone that is derived from eye dominance and pupil size. The application is used over the front surface of both the Stable 15 and Stable 16 lenses. This lens is designed for any patient who has struggled with the acuity of soft lens multifocals and the comfort of corneal gas permeable lenses. These lenses are designed to fit both normal and irregular corneas. The back surface of Stable Near lenses is designed like the single vision versions, however the near center zone is designed to be one half of pupil size on

the dominant eye, and two thirds of the pupil size on the non-dominant eye. The near add is specified identical to any conventional corneal gas permeable lens.

Stable Near lens diameters are 15.0mm and 16.0mm. Stable Near lenses are manufactured in Boston XO and XO2 materials. The lenses utilize the production techniques including Digital Radial Edge Profiling (DREP) which is a unique edging system to create a comfortable lens edge, plasma treatment and NIMO analysis which is advanced mapping and analysis to ensures premium quality and an exact fit. Laser monogramming of the lenses is an optional treatment. Toric options are also available.

New patient base, new fitting tips

After this review, perhaps the most common 'new' patients that you might want to consider fitting in scleral lenses are your patients with normal corneas that wear soft lenses for astigmatism or presbyopia and have complaints of fluctuating vision, or problems seeing at night. These groups will be motivated to switch out of their current lenses and try something new. In order to be successful at converting our soft lens-wearing patients, we have to prove to them that we can do it faster and with better results while maintaining good lens comfort. Begin by assessing their current frustration level and their desire to change modalities and undergo a new fitting. Once the patient has agreed to try new lenses, I like to use information from their topographies, corneal diameter and palpebral fissure widths to help in the selection of lens design. We all know that scleral lenses are comfortable when compared to smaller diameter corneal gas permeable lenses, but with our soft lens wearers, we need to select an appropriate design to ensure a good first experience so the patient can remain excited about the vision potential with a new lens design. Since I have begun to fit normal corneas in scleral lenses, I have learned a few tips and tricks that help with the education and fitting process. Some of the most effective tips I've learned are as follows:

- *Lens diameter selection*: The overall diameter of the scleral lens is my first decision, because that is the primary reason scleral lenses are more comfortable that corneal gas permeable lenses. Many patients think their soft lenses are more comfortable than gas permeable contacts because the lenses are soft, but we know that it's because they have a larger overall diameter. That is an important point to communicate to your patient. The larger lenses sit behind both lids, which minimizes the eyelid-lens interaction and promotes excellent comfort and lens stability. Once patients understand this concept, the 'hard' lenses are not nearly as intimidating. But, just because larger lenses are more comfortable, that doesn't mean I jump for an 18-millimeter lens for all of my patients. For normal corneas, 14 to about 16-millimeter lenses work great because the lens size is similar to a habitual soft lens and they fit most normal corneas.
- *Observe corneal diameter and palpebral fissure widths:* On the market today, there are probably ten or more scleral lens fitting sets with overall diameters between 14 and 16 millimeters. How do we further choose the appropriate diameters for our patients? Corneal diameter and palpebral fissure width are my next secret weapons in promoting great lens comfort (notice we haven't even thought about keratometry readings yet). When observing corneal diameter, which is often described as white to white, be on the look out for larger than average corneas. If the cornea is 12 millimeters or more in overall diameter, you may want to begin with a lens that is at least 14.5 to 15 millimeters so the lens can appropriately vault both the central cornea and limbus comfortably. The same concept applies for when your patient has larger than average palpebral fissure widths, which is the vertical distance between the upper and lower lids in primary gaze. An average palpebral fissure width is about ten millimeters. If a patient has an average sized cornea with a small to average palpebral fissure width, lenses that are 14 to 15 millimeters in overall diameter will perform well, and the patient will appreciate how easy the lens is to apply and remove from their eye. Larger palpebral fissure widths call for a larger lens diameter to ensure the edges of the lens are tucked behind both lids for good comfort. These tips may seem self-explanatory, but remember we are now fitting patients that habitually wear very comfortable soft lenses, and we need to match comfort that with the appropriate scleral lens or the patient will ultimately end up back in their soft contact lenses. Patients that have habitually wearing corneal

diameter gas permeable lenses are typically easier to please because even a scleral lens that doesn't fit quite perfectly can match the comfort of a corneal sized lens, due to the adaptation of their eyelids to gas permeable lens edges. If your patient notes the lens is "a little uncomfortable" you may want to try on or order a lens 0.3 to 0.5 millimeters larger to further push the lens edges behind the lids.

- *Corneal topography and keratometry readings:* While a Mayo Clinic study demonstrated there is minimal to no relationship between corneal topography readings and scleral lens base curves, there is still much information that can be taken from these scans to improve your fitting technique. Note the study was done on irregular corneas, but the take home point about scleral lenses is that appropriate fitting is more about the amount of lens sagittal depth needed to vault the cornea and limbus, and less about matching lens base curves to the corneal curvatures. Topographies are a great tool to assist in fitting scleral lenses. Having knowledge about the shape of the overall cornea can be the deciding factor in your lens design selection. For example, if the topography shows a moderate to large amount of limbus-to-limbus toricity, one might expect the sclera to have a more than average amount of toricity as well. A proper choice on lens design may be one that comes from a lab that can produce toric peripheral curves to match the patient's toric sclera. Whereas if the corneal toricity is only in the central cornea, then one can be confident a lens with toric peripheral curves is not needed. Topographic readings are also very useful in evaluation of post surgical corneas.

It's the same, but only different

With all of the changes in scleral lenses in the past decade, it can be confusing to keep all the information straight. Remember that your lens consultants are a wealth of knowledge, as well as groups like the Scleral Lens Education Society. With the new designs, there is new technique to learn, but the patient communication remains the same. These lenses are healthy, comfortable and can provide excellent vision correction. The fitting process does require some patience, as lenses are complicated in design need to be ordered custom to your patient's eyes. With clear communication and guidance from your laboratories, the addition of scleral lenses for normal corneas should be a booster in developing relationships and loyalty with your patients for years to come.

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