# SCLERAL LENSES FOR PRESBYOPIA

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Third in a series of four scleral lens CE activities for 2021

This course is COPE approved for 2 hours of CE credit.

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This continuing education (CE) activity captures key statistics and insights from contributing faculty.

## ACTIVITY DESCRIPTION

The goal of this article is to better eyecare professionals' understanding of scleral lenses by listing the most common fitting challenges practitioners face and a solution for each one. A review of the literature will provide the reader with an improved understanding of various instrumentation, scleral lens prescriptions, and fitting techniques.

## TARGET AUDIENCE

This educational activity is intended for optometrists, contact lens specialists, and other eyecare professionals.

## ACCREDITATION DESIGNATION STATEMENT

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Rob Ensley, OD, has received honorarium from CooperVision Specialty Products.

Chad Rosen, OD, MBA, editor of the continuing education series, reports no conflicts of interest.

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The rapid advancement in technological innovation has expanded the utility of scleral lenses and contributed to their growing popularity. Once reserved for the most complex of cases, scleral lenses are now viable for ocular conditions ranging from severe corneal irregularity and advanced ocular surface disease to normal, healthy corneas. No matter what indication for which a scleral lens is prescribed, one concern that practitioners must address during the fitting process is near vision for presbyopic patients. This article will review the options available and discuss a few considerations that factor into the decision-making process.

## WHY SCLERAL LENSES

Traditionally, scleral lenses have been used primarily for vision restoration and ocular surface protection.[1] According to the findings from the Scleral Lenses in Current Ophthalmic Practice Evaluation (SCOPE) study group, corneal irregularity is the most common indication for scleral lens wear.[2] Their large diameter allows the scleral lens to vault over a wide range of abnormalities, including both ectatic and oblate post-surgical corneas, while the fluid reservoir optically neutralizes any astigmatism originating from the anterior cornea. Keratoconus is the leading indication for scleral lenses, but pellucid marginal degeneration (PMD), post-refractive surgery, and post-penetrating keratoplasty all fall under this category.[1,2]

The fluid reservoir also serves a role in the therapeutic benefit of scleral lenses for severe ocular surface disease (OSD). By bathing the ocular surface and preventing dehydration, the lenses can provide mechanical protection, reduce neuropathic pain, and promote healing of the ocular surface.[3-5] Potential indications include chronic Sjögren's, graft-versus-host disease (GVHD), Stevens-Johnson syndrome, ocular cicatricial pemphigoid, neurotrophic keratopathy, exposure keratopathy, limbal stem cell deficiency (LSCD), and persistent epithelial defects.[1,3]

Although dry eye disease (DED) could fall under the umbrella of OSD, there is a wide spectrum of severity, and the prevalence ranges from 5% to 50%.[6] The Tear Film and Ocular Surface Society (TFOS) DEWS II report classified DED as a multifactorial disease and recommended a treatment algorithm that includes prescribing scleral lenses when traditional therapies have failed to provide adequate relief.[7] The SCOPE survey results reflected this general protocol, although the paradigm may be shifting as smaller-diameter scleral lenses become more widely available.[2] Many patients who suffer from DED are also current or former contact lens wearers. DED can be exacerbated by contact lens wear, leading to contact lens discomfort (CLD), which is the driving force behind contact lens dropout.[8,9] Thus, the use of scleral lenses to manage DED begins to overlap with normal cornea applications and blurs the margin with regard to classifying the primary reason for prescribing.

The same benefits that scleral lenses provide for irregular and diseased corneas can also apply to normal corneas. For patients who have mild-to-moderate

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DED, GP intolerance, or CLD with soft lenses, scleral lenses may be a viable option. In addition to the fluid reservoir, a properly aligned scleral lens has minimal lid-to-lens interaction, which aids in delivering good comfort and stability on the eye. Scleral lens optics are also inherently more stable compared with soft lenses. Fluctuating vision caused by environmental elements is less of a concern with scleral lenses, and the neutralization of corneal astigmatism by the post-lens tear layer renders rotational instability less of an issue. An early study comparing vision and comfort of soft toric lenses to scleral lenses reported that scleral lenses outperformed the soft toric lenses.[10] In addition to acuity standards, scleral lenses also have a larger optic zone, which can reduce halos and glare. In some situations of high ametropia, the base curve of the scleral lens can be manipulated without affecting sagittal depth to alter the final contact lens power using the SAM-FAP (steeper add minus/flatter add plus) principle. Changing the power profile to reduce minus power or to increase plus power can be useful for presbyopic patients.

## OPTIONS FOR NEAR VISION

For many scleral lens patients, correcting near vision is low on the decision-making totem pole. The primary objective is restoring vision or rehabilitating the ocular surface in an efficient manner. Adding another variable may only complicate the fitting process. However, the loss of accommodation is inevitable, so the options must be discussed with patients approaching or already experiencing the effects of presbyopia.

***Spectacles*** Perhaps the easiest and most appropriate option for many patients is providing the best correction possible at distance and using spectacles over top for near vision. Either over-the-counter readers or prescription bifocal glasses can be worn as needed over the top of scleral lenses to provide near correction. Although spectacles in combination with contact lenses may be a minor inconvenience, there are several instances for which this may be the preferred route.

Despite the improvement in visual performance that scleral lenses provide, many patients are still unable to achieve 20/20 acuity. When acuity or quality of vision is already potentially limited, having optimal distance correction may be preferred over the compromise that monovision or multifocals may provide. Residual astigmatism can also reduce the quality of vision and complicate the scleral lens optics. Although toric and multifocal optics can be combined on the front surface of scleral lenses, rotational stability is essential. Any instability or decentration will mitigate the benefit of multifocal optics. Placing the residual astigmatic correction in prescription spectacles and combining with a bifocal is an option with fewer variables to derail success.

***Monovision*** If the patient is willing to go to greater lengths to avoid spectacles, monovision is another option for increasing the range of vision. When the visual potential is equal between both eyes, less minus or more plus power is typically given to the nondominant eye. In cases of unequal vision potential, monovision can be successful by correcting the lesser-seeing eye for near vision. However, as is the case for monovision with other modalities, there are drawbacks to this setup. As the power difference between eyes increases, it can become more difficult to suppress blur, affecting binocularity and depth perception. Monovision has also been shown to reduce both contrast sensitivity and acuity.[11] When comparing monovision to multifocal contact lenses, studies consistently show that patients prefer multifocals.[12]

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***Multifocal Scleral Lenses*** The ability to place an add power on the front surface of a scleral lens is now a viable option, with nearly every laboratory offering a multifocal design in their portfolio. Because there is no translation, scleral lens multifocals employ either concentric or aspheric simultaneous vision designs. These lenses feature power changes from the center of the lens toward the periphery. In center-near designs, the minus power increases toward the periphery, whereas plus power increases towards the periphery in center-distance designs. Concentric designs have sharp, alternating changes in power, while aspheric designs have a more gradual gradient power change. As with any simultaneous vision design, light rays from both far and near targets enter the pupil, forming both focused and defocused images on the retina. In addition to proper placement of the optics, success with these designs is contingent on the patient's neuroadaptive ability to suppress the defocused image and to accept the image that is in focus.[13]

If a satisfactory vision range cannot be obtained with multifocal optics, modified monovision is another option. A monofocal scleral lens, typically corrected for distance, is fit on the dominant eye, whereas a multifocal scleral lens is fit on the nondominant eye.

## CUSTOMIZE THE FIT

***Centration*** Alignment of the lens haptics to the sclera is a key component of scleral lens success. A poorly aligned lens can lead to discomfort and poor vision from either decentered optics or the influx of post-lens tear layer debris. Fortunately, research-guided scleral lens innovation allows total control of the peripheral fit.

Most scleral diagnostic sets now include lenses with toric haptics after early studies suggested that toric haptics improve comfort and stabilize quickly.[14] Recent research evaluating scleral shape using profilometry has indicated that the sclera is rotationally asymmetric, with only 30% of patients who have normal corneas presenting a toric sclera and 65% being described as asymmetric.[15] Further analysis reveals that the nasal sclera is characterized by a flatter curvature and higher sagittal height, while the temporal sclera is steeper and lowest in height.[16] This helps explain the inferior-temporal decentration that can often occur with scleral lenses. Moving farther away from the cornea also increases asymmetry, so larger lenses may decenter more compared with smaller-diameter lenses.[16]

More recently, the Scleral Shape Study Group found that patients who have peripheral ectasias had a higher degree of scleral asymmetry.[17] Other studies have also demonstrated that corneal toricity correlates to scleral toricity, particularly when the astigmatism is irregular in nature.[18,19] When fitting highly astigmatic patients, beginning with a back-toric diagnostic lens can help ensure better peripheral alignment and centration.

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When available, scleral profilometry is a great tool to order an accurate initial lens by either designing a freeform lens or measuring the exact scleral toricity. If profilometry is not available, diagnostic fitting can be performed using toric or quadrant-specific diagnostic lenses. If conjunctival abnormalities, such as pingueculae or conjunctival hypertrophy, are present, most designs are also capable of vaulting or notching around these elevations. Toric peripheral curves are used to stabilize these customizations. In the most advanced cases, impression-based scleral lenses are extremely useful.

***Pupil Size and Optic Zone*** The relationship between pupil size and the optic zone is critical to the success of simultaneous vision multifocals. Both the near and far optics of the lens must be accessible to the pupil, which acts as an aperture limiting the light rays entering the eye. For younger patients, or for those who have larger pupils, beginning with a concentric or center-distance design may yield better distance vision but more difficulty reaching full near power. Larger pupils allow a wider power spread but may create more light distortion and complaints of ghosting and glare.[20,21] As patients age, senile miosis takes hold, and pupils get smaller and dilate less in scotopic conditions.[22] Small pupils may limit the accessibility of different powers within the optic zone. For example, a small pupil with center-near aspheric optics may have difficulty reaching the distance optics in the lens during photopic conditions. However, this can be potentially offset some by the pinhole effect of miotic pupils, which increases depth of focus.[23]

When choosing a multifocal design, some laboratories offer both center-distance and center-near designs, while others recommend a distance-biased lens on the dominant eye and a near-biased lens on the non-dominant eye. In the latter scenario, both lenses are center-near multifocals, but they differ in their zone sizes. There are a few designs available that have fixed zones, but most multifocals have variable zone sizes that can be customized based on pupil size or during troubleshooting steps.

***Decentered Optics*** Another contributor to multifocal success is proper alignment of the optics. Misalignment of multifocal optics can cause ghosting, shadowing, and increased aberrations. When the optics are placed in the geometric center of the scleral lens, they will not align with the line of sight. The fovea is anatomically positioned inferior-temporal in the retina, which corresponds to a superior-nasal line of sight compared with the pupillary axis. This angular distance is known as angle lambda, although it is often referenced as angle kappa and is essentially clinically equivalent. Additionally, large-diameter scleral lenses will tend to decenter inferior-temporally due to scleral shape, pushing the center of the optic zone even further from the line of sight.

Assuming that the lens is well-centered, another method to resolve this mismatch is to decenter the optics. A study of center-near soft lens multifocals showed that a 1.0mm nasal offset provided both better near acuity and a subjective improvement in quality of vision.[24] A similar offset in scleral multifocals can have the same benefits as that of their soft lens counterparts. Several laboratories offer decentered optics with a standard, predetermined offset. To determine whether decentered optics would be beneficial, corneal topog-

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raphy can be taken over a scleral lens and compared with the topography of the cornea without the lens on eye. Subtractive tangential maps can show where the multifocal optics are centered in relation to the pupil.

## THE MULTIFOCAL FITTING PROCESS

There is no algorithm for guaranteed success with scleral multifocals, but following these steps may start you down the right path.

***Thorough Evaluation*** All potential scleral fittings begin with a comprehensive evaluation of ocular health and anatomy. If a multifocal scleral lens is being considered, look for potential roadblocks to success. Corneal opacification, neovascularization, or irregularity that can obstruct the visual axis or compromise corneal clarity should be documented and photographed when possible. Cataract formation and posterior-segment pathologies can also reduce best-potential vision and may easily be overlooked, especially in the presence of a highly irregular or diseased cornea. Although they won't affect vision potential, pay attention to the conjunctiva and eyelids for any anatomical features that would require customization or that would limit the scleral design choices.

Ancillary testing—including corneal topography, tomography, and profilometry—assists practitioners with assessing corneal and scleral shape, which aids in selecting a scleral lens design and initial diagnostic lens. Dry eye testing, particularly meibography, may be useful when evaluating patients who have mild-to-moderate dry eye. Scleral lenses improve symptomology, but a poor tear film can create anterior lens wetting issues that would impact quality of vision.

Refractive data is not critical to order scleral lenses, as scleral lens power depends in part on the base curve and sagitta of the lens. However, add power must be determined to order a multifocal lens. In many cases, the optimal diagnostic lenses cannot be placed simultaneously on both eyes, so monocular build up is an appropriate technique. Eye dominance and pupil size data are necessary for ordering a multifocal lens. Eye dominance can be assessed by sighting or sensory methods. Pupil size can be variable, so measuring in both photopic and scotopic conditions is recommended.

***Choosing Candidates*** Good candidates for multifocals should check two boxes: good potential vision and proper motivation and expectations. There is no minimum acuity threshold that must be met for multifocals, but acuity that is equal between the eyes and closer to 20/20 has higher odds for success. In addition to acuity, good subjective quality of vision is desired. For example, a keratoconus patient can have better acuity with scleral lenses, but visual quality can be derailed by central posterior bowing or even faint apical haze. The potential for poor lens surface wetting is another scenario for which to avoid multifocals.

Taking a good case history can help weed out multifocal candidates who have unrealistic expectations. Knowing a patient's occupation, hobbies, and motivation for contact lens wear can provide an idea of his or her visual demands and potential wear schedule. Full-time wear and an adequate adaptation period is essential for neuroadaptation, as is a willingness to potentially compromise top-end distance or near vision for a full range of vision. If the patient has a long history of contact lens failures, multifocal sclerals are not likely to be the magical solution.

Although irregular cornea patients face more barriers to potential vision, they may be amenable to the multifocal compromise if they are able to achieve satisfactory distance vision. Meanwhile, post-refractive surgery or normal cornea patients who have high ametropia make great multifocal candidates on paper but may be more difficult to please. Post-refractive surgery patients are usually willing to pay to be free of spectacle wear, but their investment can come with high demands. Patients who have a normal cornea can be corrected to 20/20, so any reduction in quality of vision may also be more noticeable. If demands and expectations are high, proceed with cautious optimism.

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***Set Expectations*** Poor vision is another common reason for contact lens dropout, especially with multifocal contact lenses, so it may be helpful to define what successful vision means.[25] The goal for multifocals is functional distance vision, with the ability to perform most near tasks without additional assistance. However, good lighting and the occasional use of additional plus power does not equal failure.

Prior to ordering multifocal scleral lenses, patients should be aware of the fitting process. Time is needed for neuroadaptation, and extra follow-up visits may be required. Multifocal lenses also have an added cost compared with single-vision lenses. Patients who have a busy schedule or a condensed time frame to complete the process will pose a larger challenge. Some patients may be concerned about adaptation to scleral lens wear in general, but scleral lens neophytes can typically learn application and removal within one week and can tolerate scleral lens wear well.[26] Spending time to educate them on the proper techniques and care regimen is paramount.

***Fit First*** When performing a diagnostic fit, the proper in-office settling time is debatable. Twenty minutes is the minimal time to predict final lens settling, but full settling may take up to eight hours.[27,28] If a patient cannot wait in the office for 4 to 8 hours to evaluate full lens settling, the practitioner must extrapolate some data. Adding multifocal optics, especially when offset, to an unstable lens will only lead to headaches. If there is not 100% confidence in the amount of settling, centration, and rotational stability of the initially ordered lens, it is advisable to leave the multifocal optics out until the fit can be confirmed with substantial wear time. Unexpected lens settling can lead to subtle spherical power changes or to a sphero-cylindrical over-refraction if haptic misalignment is creating a torsional effect on the lens. If toric haptics are being utilized, the markings should be visible on both the diagnostic lenses and the ordered lenses. When decentering the multifocal optic zone, it's important to also note the axis position of all lens markings.

***Fine Tuning*** The initial goal should be to get the patient into the real world to test the lens performance. Follow-up visits should confirm corneal health, proper lens fit, comfort, visual acuity, and subjective happiness. If vision is poor, first confirm that the corneal clearance is acceptable and that any toric markings are consistent with previous visits. Over-refractions should be performed with loose lenses both monocularly and binocularly at distance and near. If near vision is poor in an aspheric design, try pushing plus at distance first before increasing add power or adjusting zone size. With distance vision complaints, lowering the add power or adjusting the zone size may be helpful. If there are any doubts about the next step, utilize the laboratory consultation team, because each lens design has its own intricacies.

## CONCLUSION

Addressing near vision may not be the primary focus of a scleral fit, but it cannot be overlooked for presbyopic patients. Careful examination and patient screening is essential to determine candidacy for multifocal scleral lenses. The majority of laboratories have multifocal designs with the ability to customize the fit to improve the odds for success. Before adding the multifocal optics, be sure that the fit is centered and that the vision is optimized. In the worst-case scenario with multifocal optics, the patient can always easily return to distance optics and reading glasses for near vision.

*For references, please visit www.clspectrum.com/references and click on document #309.*

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