The Use of Free-Form Scleral Lenses on an Atypical Asymmetrical Scleral Surface

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Introduction

With the increasing popularity of scleral lenses, clinicians and researchers want to better understand the anterior ocular surface to design lenses that better align with the scleral. This will provide better comfort and vision for their patients. However, questions remain about scleral shape; is it spherical, toric, or asymmetric? The current consensus in the literature is that the nasal scleral is flatter than the temporal scleral. Therefore, the assumption is that spherical scleral lenses will initially land on the segment of the eye with the greatest elevation (nasal) and move towards an area of the lowest elevation (temporal). Then with gravity and upper eyelid forces, it may decenter inferiorly. Consequently, we expect an inferior-temporal decentration with most spherical scleral lenses.

Case History

A 29-year-old African American male presents to the specialty contact lens service interested in trying scleral lenses to improve his vision. He is a degenerative myope with a best-corrected visual acuity of 20/30 OD and OS using custom soft contact lenses. He has an unremarkable medical and ocular history. The ocular examination is also unremarkable; clear cornea, clear lens, and flat macula appearance.
Spectacle Rx: -17.25 -0.50 x015 OD and OS

CL Exam

Acculens Easy Fit 15.9mm scleral lenses were trialed in the office. On-Point Technology is readily available on their diagnostic lenses.
OD: 4 hash marks 135º, lenses, and 3 hash marks 90º decentered inferior-nasal
OS: 4 hash marks at the 135º, lenses decentered inferior-temporal

With an atypical scleral lens decentration (inferior-nasal) in the patient's right eye, it was decided to map his scleral shape using the cornea-scleral profile (CSP) offered by the Pentacam. The results of this scan do validate the slit-lamp findings, deeper sagittal depth in the inferior-nasal quadrant (4729 OD). CSP scans and diagnostic lens data were then sent to Acculens to produce free-form scleral lenses for our patient.

Dispensing visit: Lenses display excellent haptic alignment, absence of edge lift, impingement, compression, and appropriate central and limbal clearance. Visual acuities were 20/20- OD and OS. The patient was ecstatic to try these lenses. His follow-up was scheduled two weeks later, ensuring three hours of wear before the presentation.

Follow-up: The patient reported that he was delighted with the lenses and had excellent comfort and vision. After fully settling, the lenses had a great haptic alignment, no central or limbal corneal touch. The patient was educated to return in one year.

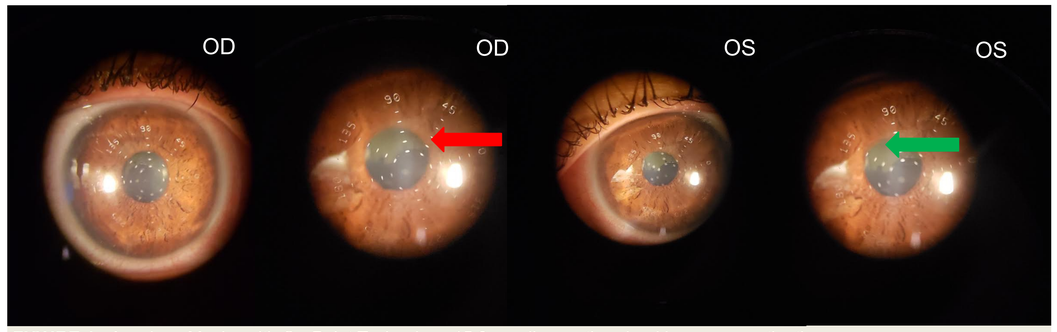


FIGURE 1: Acculens Maxim with On-Point Technology 15.9mm diagnostic scleral lenses on patient's eye

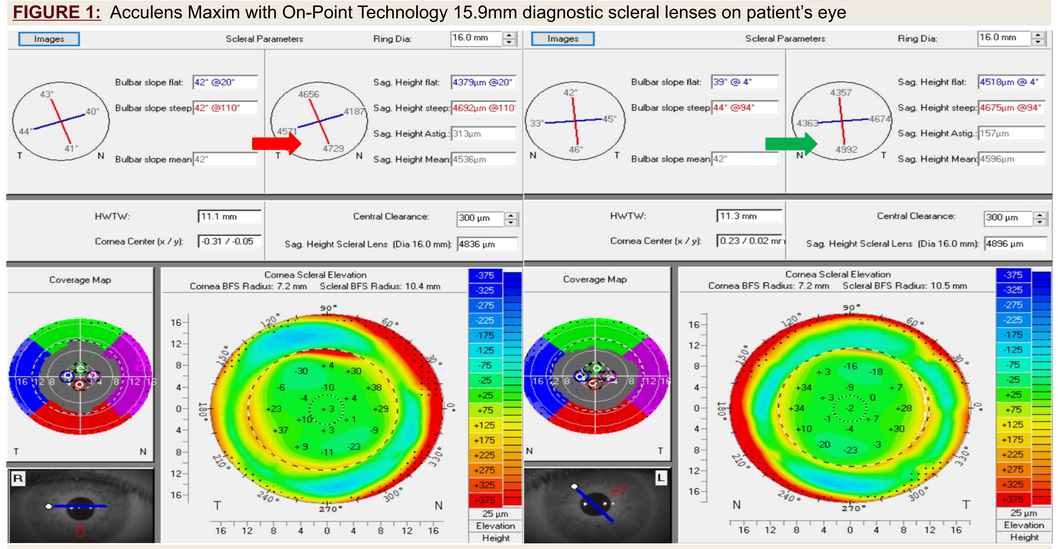


FIGURE 2: Pentacam CSP scans at the 16mm cord. OD: 4729 sag inferior-nasal (red arrow), OS: 4992 sag inferior-temporal (green arrow)

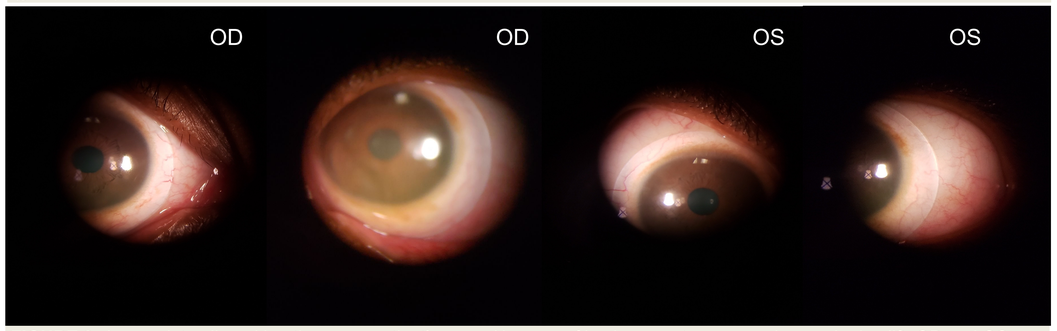
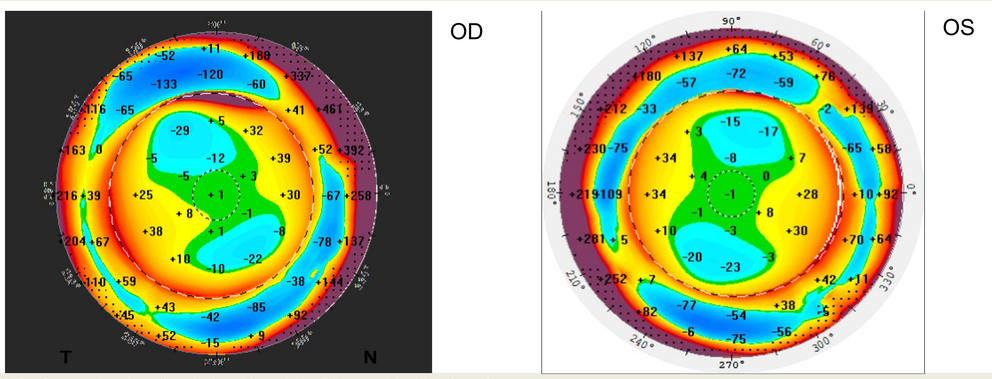


FIGURE 3: Appropriate aligned haptic on our patient's eyes. Absence of impingement, compression, and edge lift. OD and OS



BONUS: Our patient's scleral elevation data OU provided by Acculens

Discussion

During the scleral fitting process with our patient, we encountered atypical decentration of the scleral lens in the right eye. We visualized this by using an Acculens EasyFit diagnostic lens with On-Point Technology. This feature is beneficial, especially in multifocal fitting, as it shifts the near zone optics from the geometric center of the lens to the patient's visual axis to improve vision, reduce glare and halos. In our case, this technology was advantageous to understand our patient's scleral surface grossly. The eye care practitioner (ECP) reports the meridian with the most hash marks inside the pupil to the consultants. Wanting to understand our patient's scleral shape further, we used Pentacam's CSP. The CSP module can map the cornea and sclera up to an 18mm diameter by taking 250 images. The Pentacam also supports many external lens manufacturers, such as Acculens. We sent the CSP data to their consultants to help us generate free-form scleral lenses (Maxim 3D) for our patient. We discussed our case more with our lens consultant to understand how free-form lenses are made. Scleral lenses land on an area of tissue 1.0-1.5mm wide on average. Additionally, the elevation map provided by the CSP gives an elevation difference every 18 degrees, which is beneficial in designing a lens haptic at any angle. Another benefit of the CSP is that it can help create an appropriate lens sag pre-settling. This information helps the manufacturer create a scleral lens with high first fit success.

With the advances in profilometers, we now understand the scleral surface better than ever before. Ritzmann et al. examined the shape of the anterior scleral at three-chord lengths (10, 12.8, 15mm) using the Zeiss Visante OCT. Using sagittal height, they concluded that at 10mm chord (cornea), displayed with-the-rule astigmatism, 12.8mm, the scleral was rotationally symmetric, and at 15mm, the scleral was asymmetric[1]. Many potential factors influence the scleral shape such as the insertion of the extraocular muscles onto the scleral (Spiral of Tillaux). The medial rectus is inserted more anteriorly, closer to the limbus, resulting in a flatter sclera contour[1]. The proximity of adjacent muscles can also influence shape; the closer the muscle's insertion the more likely to create a flatter contour (medial and inferior), while a further insertion (temporal and inferior) contributes to a steeper scleral shape[1]. Gravity and eyelid forces also contribute to an inferior-temporal decentration with most scleral lenses. Literature has also stated that the magnitude of scleral asymmetry increases with distance from the corneal apex[1]. This is noteworthy when fitting large diameter scleral on severe ectasia and other conditions. With our ever-growing knowledge of scleral shape, there will be more of a need for toric, quadrant, and especially freeform haptics.

Conclusion

Many questions remain about the scleral shape, but we now understand it better than ever before with the advances in technology. Using profilometry data, scleral lens manufacturers such as Acculens can create highly customizable free-form scleral lenses. This fitting modality allowed for decreased chair-time and follow-ups for our patient. It also improved the scleral lens-to-ocular surface relationship, allowing our patient to have all-day comfort and good vision.

References

1. Ritzmann, M., Caroline, P. J., Börret, R., & Korszen, E. (2018). An analysis of anterior scleral shape and its role in the design and fitting of scleral contact lenses. Contact Lens and Anterior Eye, 41(2), 205–213.