The IT Factor of Scleral Lens Fitting: A Scleral Shape Study

Amrit Singh and Nicholas Gidosh OD, FAAO

Introduction

One of the main challenges that arises when fitting a scleral lens is addressing issues involving the landing zone. When fitting scleral lenses, patients can show compression, edge lift, and decentration of the lens. The edge lift and compression can be attributed to a misalignment of the landing zone to the patient's sclera. The decentration is more often inferior-temporal. The inferior decentration is often theorized to result from gravity and blink pressure but these theories don't address the nasal decentration. Many studies have shown the significant irregularity of the sclera, usually increasing farther from the limbus. This study was meant to investigate the shape of each quadrant of the sclera and compare them at various chord lengths. Research has shown there to be steeper scleral slope in the inferior temporal (IT) quadrant which may explain why scleral lenses often decenter in that direction. This decentration presents challenges during the fitting process such as differences in limbal clearances and the decentered optics can also induce undesirable prismatic effects.

Methods

The Pentacam® was used to obtain a CSP report on 25 subjects, 50 eyes total. Five scans were taken of each eye to ensuring at least 17mm of data was captured and compiled into a CSP report. The sagittal depth and bulbar slope were measured at 15.5, 16.0, 16.5, and 17.0mm chords and data was analyzed in each quadrant. Quadrants were assigned as Q1 corresponding to 1° to 90°, Q2 corresponding to 91° to 180°, Q3 corresponding to 181° to 270°, and Q4 corresponding to 271° to 0/360°. The data collected was then analyzed by quadrant and by rank of depth.

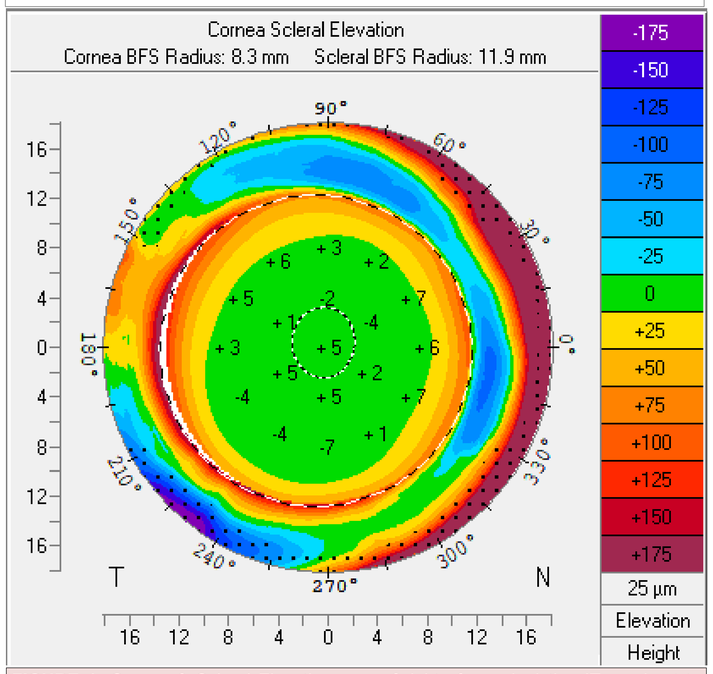

FIGURE 1: Cornea & Scleral Elevation map of right of eye depicting IT quadrant to have deeper saggital height compared to other quadrants

Results

At all chord lengths, the averages of each quadrant in both eyes showed the IT region (Q3 OD and Q4 OS) to be significantly steeper in bulbar slope and deeper in sagittal depth than all the other quadrants. At a chord length of 16.0mm, the average steepest bulbar slope was 44.08° OD and 43.16° OS. The next steepest slopes were 39.12° and 39.04° respectively.

This significant difference in slope also translated to a significant difference in elevation with the IT quadrant. At a chord length of 16.0mm, the average sagittal difference between the IT quadrant and the next deepest was 244 microns OD and 210 microns OS at 16.0mm chord length. The difference between the steepest and shallowest quadrant was 335 microns OD and 312 microns OS. Increasing the chord length by 0.5mm resulted in the difference between steepest and shallowest to increase by 69 microns OD and 48 microns OS.

	Chord	Steepest Quad	Bulbar Slope (degrees)				Sagittal Depth (microns)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
OD	15.5mm	Q3	37.72	39.24	43.24	36.44	3847	3949	3990	3902
	16.0mm	Q3	38.32	39.12	44.08	36.72	4047	4147	4391	4096
	16.5mm	Q3	38.64	38.92	45.20	36.52	4256	4341	4661	4257
	17.0mm	Q3	39.40	38.84	45.52	34.96	4490	4554	4888	4226

	Chord	Steepest Quad	Bulbar Slope (degrees)				Sagittal Depth (microns)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
OS	15.5mm	Q4	38.72	37.20	37.08	42.76	3937	3866	3967	4142
	16.0mm	Q4	39.04	37.56	37.20	43.16	4137	4056	4158	4368
	16.5mm	Q4	38.28	38.92	36.92	44.84	4324	4263	4349	4624
	17.0mm	Q4	38.12	40.00	36.08	45.60	4560	4490	4472	4893

FIGURE 2: Data result from CSP scans on 50 eyes, sagittal depth and bulbar slope were recorded across four chord lengths

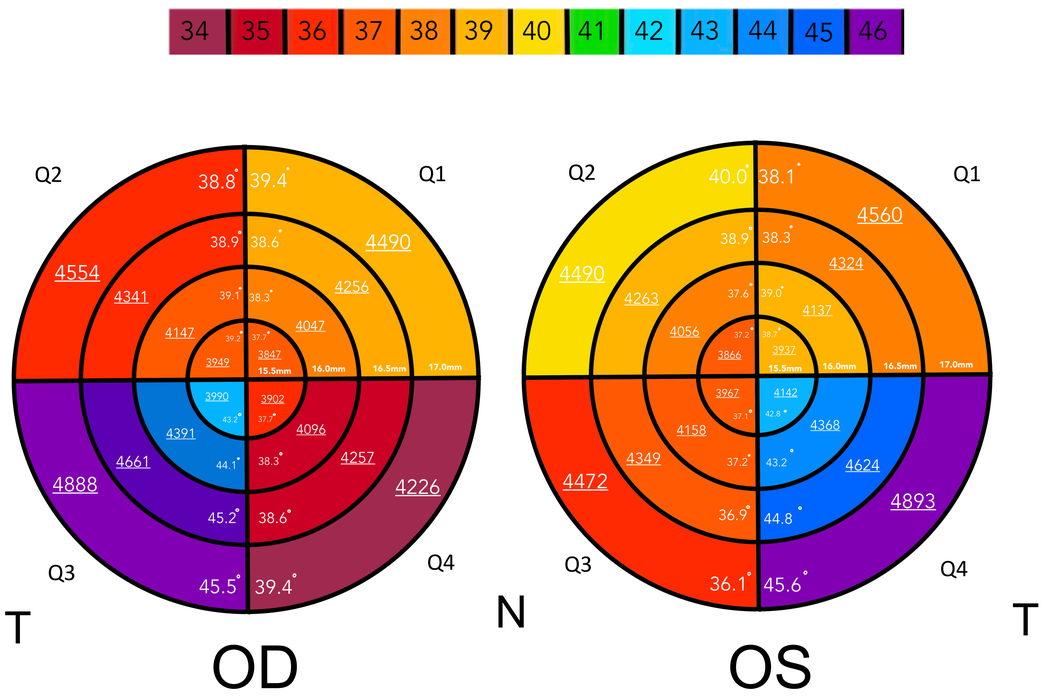

FIGURE 3: Data result from CSP scans on 50 eyes. Concentric rings depict different chord lengths observed in study, average bulbar slope and sagittal depth is plotted according to their respective quadrant. Color graded based on bulbar slope.

Conclusion

The data from this study suggests the IT quadrant to be significantly steeper and deeper than other quadrants of sclera. Other studies have demonstrated asymmetry in scleral shape, and this data adds to what has already been shown. Given the asymmetric nature of the sclera, many of the scleral lens trials today have now included toric landing zones in their starting lenses. While this shift to torics is an improvement from the past where spherical landing zones were the norm, the toric design may not be the best starting point.

Considering the results of this study, a quadrant specific landing zone could be considered a better starting point when fitting scleral lenses. Previously, these designs have been used more as customization and troubleshooting rather than a starting point. Regarding the shape of the sclera, the most ideal trials would be quadrant specific accounting for the 200+ micron difference in the IT quadrant as well as the increased sagittal depth when increasing the diameter of the lens. Our study suggests that such a trial lens may result in better edge alignment and centration upon initial lens application.

Discussion

The issue of an inferior-temporally decentered lens can best be addressed with a quadrant specific landing zone with increased sagittal depth in the IT quadrant. Such a lens should also have an increase in sagittal depth when increasing the overall diameter.

- **Benefits for ECPs to incorporating such a design include:**
  - Less office visits for patients
  - Less chair time
  - Less lens remakes and changes (first fit success)
- **A well aligned landing zone resulting from a quad specific design incorporating the findings of this study include**:
  - Improve pt comfort (decrease edge awareness)
  - Decrease blanching/compression
  - Decrease mid-day fog resulting from tear exchange
  - Improve vision when incorporating multifocal optics
  - Less induced prismatic effects
  - Decrease in risk for conjunctival prolapse

FIGURE 4: A quadrant specific lens as shown in the image to the left would include different sagittal depths in four different quadrants.

References

Available upon request