Understanding Scleral Shape with the Eaglet Eye Surface Profiler

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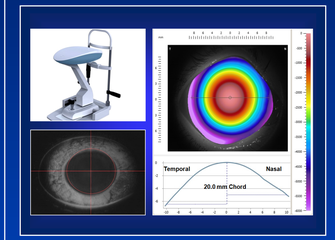
Introduction

Over the past 40 years, the shape of the human cornea has been well-established though Placido and Scheimpflug videography. However, scleral shape has always been difficult to image due to its opaque structure and lack reflective properties.

The Eye Surface Profiler (ESP), manufactured by Eaglet Eye, has overcome these obstacles through a system that projects moiré fringe patterns onto the anterior eye. The images are processed by the instrument to ultimately display the anterior shape and height of both the cornea and the sclera.

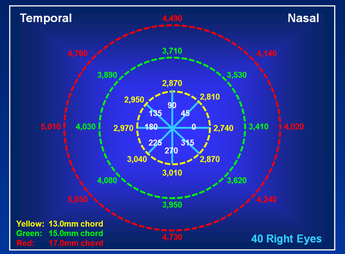


The Eaglet Eye Surface Profiler uses a double projection infrared, moiré profilometer to capture the surface profile of both the cornea and the sclera. The ESP can measure diameters of up to 20mm, 360 degrees around. With more than 250,000 data points, it directly measures corneal and scleral height to produce highly accurate elevation profiles and maps.

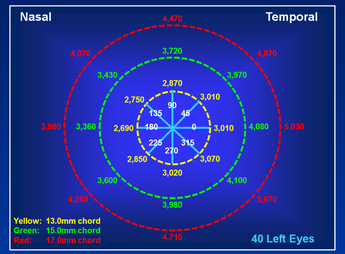
Traditional topographical imaging systems measure corneal curvature and elevation however, modern scleral lenses vault the cornea and limbus, landing on the bulbar conjunctiva (sclera) at chords of approx. 14 to 20mm. Therefore, the corneal topography underlying a scleral lens is essentially irrelevant, and the elevation, toricity and asymmetry of the sclera are of greater importance.

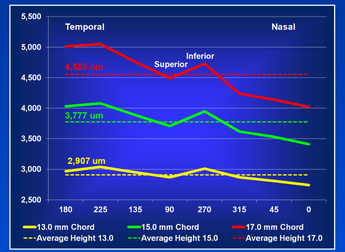
Methods

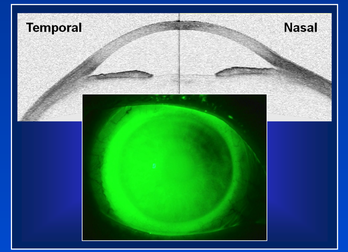
40 normal subjects (80 eyes) between the ages of 22 and 30 participated in this study. Exclusion criteria included the presence of any corneal, conjunctival, or scleral pathology, as well as any history of ocular surgery. The mapping of the cornea and sclera was performed by first applying sodium fluorescein to the ocular surface, followed by imaging with the Eaglet ESP system. The scleral height was measured in eight primary positions 90, 270, 0, 180, 45, 225, 135 and 315 at chords of 13.0, 15.0, and 17.0mm. The subjects data were averaged for each chord length.

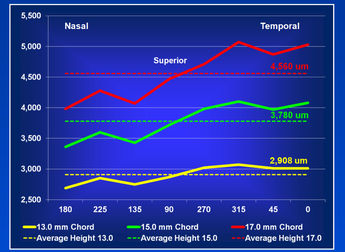


The areas of least scleral depth (nasal and superior) are where the scleral lens will "land" first. The lens will search for its resting point of equilibrium and move in the direction of greatest depth, the areas of least mechanical resistance.









Results

The results of this study show that:

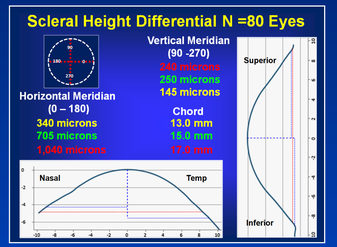
1, The sclera is highly asymmetric 360 degrees around.

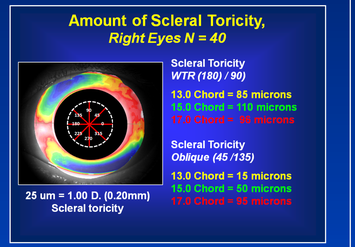
2, Along the ***horizontal*** meridian, the nasal aspect of the sclera shows the least amount of elevation.

3, Along the ***vertical*** meridian, the superior aspect of the sclera shows the least amount of elevation.

4, The differential between opposing axis' (0 nasal vs. 180 temporal) increases with the chord diameter.

5, The average scleral shape is with-the-rule and the average scleral troicity (13.0 to 17.0) is 97 um or 4.00 D. (0.80 mm).





Conclusions

These data help to explain a number of the fitting anomalies associated with scleral lenses (ie. nasal impingement, temporal and inferior lens decentration). As we better understand the toricity and asymmetries of the sclera, we will be better able to design future generations of scleral lenses.

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