INTRODUCTION

Toric haptic scleral lens designs are prescribed more often than in previous years. Recent interest in mapping the sclera and conjunctiva indicates that scleral shape demonstrates interocular and individual variability, which may explain the difficulty in fitting some patients with scleral lenses. A corneo-scleral topographical system (sMap3D, Precision Ocular Metrology) was utilized to evaluate two atypical cases, in which both patients had irregular ocular shape that adversely impacted the successful fitting of scleral lenses. In both cases, a custom multi-meridian back surface toric haptic scleral lens was designed to address the atypical scleral shape, which significantly deviated from a Sin² toric curve with a periodicity of 180°.

CIRCUMFERENTIAL SCLERAL PLOTS: THE KEY TO UNDERSTANDING SCLERAL SHAPE

Figure 2 compares the scleral elevation map which is a visual qualitative assessment of scleral shape to the circumferential scleral shape plot which is a quantitative assessment. This graph plots the axis in degrees on the X-axis and the SAG value of the eye on the Y-axis (larger values as one goes down the scale) circumferentially at a radius of 8mm (diameter of 16mm) from the corneal center. In this particular case, the steep axes superiorly and inferiorly are represented by the low areas on the toricity plot and the flat axes are represented by the high areas. The pattern is one of a toric (Sin²) curve with a periodicity (repeating pattern) every 180 degrees. Note that each scale point on the Y-Axis is 200µ and from the highest to lowest point on the graph, the change in SAG is >1000µ.

Figure 3 demonstrates a case which has a largely spherical scleral surface. Note that each scale point on the Y-Axis is only 20µ and from the highest to lowest point on the graph, the change in SAG is <125µ.

CASE REPORT 1

This 46 year old female patient had advanced keratoconus with corneal ring implants and habitually poor fitting scleral lenses resulting in a recurrent corneal ulcer overlying the bulging edge of one of the ring implants, and chronic lens intolerance. Patient had inferior lens lift and bubbles leaking under the lens (Figure 1).

Qualitative 3D imaging with the sMap3D corneo-scleral topographer (Figure 2) demonstrated a much steeper scleral surface inferiorly than superiorly. A recent innovation with this instrument is the circumferential scleral shape plot which demonstrates the ocular SAG value (Y-axis) by axis meridian (X-axis) 360° around (Figure 3).

In this particular case, there was high scleral/conjunctival toricity, but with the steep axis inferiorly (266°) having a SAG >500µ greater than the steep axis superiorly (73°) [5035µ vs. 4434µ].

A custom lens was designed based on empirical corneo-scleral topography data to conform to this irregular scleral shape (Figure 4) which had an optimal fit per OCT and slit lamp evaluation, was comfortable, provided excellent acuity and had no edge lift or bubble leakage (Figure 5).

DISCUSSION / CONCLUSION

The novel topography device and innovative software technology accurately mapped both the corneal and scleral irregularities, empirically designed the scleral lenses, and accurately predicted the fit and fluorescein patterns. These virtually fit scleral lenses provided both patients with good comfort and vision they did not experience with previous lens designs. These cases also provide evidence for the usefulness of integrating education about corneo-scleral topography into clinical training programs provided in Optometry schools, and industry partners.

DISCLOSURE

Drs. DeNaeyer and Sanders are shareholders in Precision Ocular Metrology, the manufacturer of the sMap3D® instrument. Dr. Sanders is a shareholder of and Dr. DeNaeyer is a consultant to Visionary Optics.