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OBLATE DESIGN

Complex scleral lens fitting for a patient with advanced keratoconus – customized oblate and oval design adjustments significantly improved comfort and vision

PATIENT HISTORY

A 26-year-old female patient from South Asia with bilateral keratoconus presented with a history of acute corneal hydrops in the right eye (OD) in April 2024. They reported being diagnosed with keratoconus in India approximately ten years earlier and having undergone corneal cross-linking in the left eye (OS). The OD showed a large inferior

hydrops lesion, and corneal OCT confirmed a break in Descemet’s membrane. According to the corneal specialist, the OD was expected to be ready for refitting with a contact lens within six weeks.

At this point, only the OS was fitted (Figures 1 and 2).

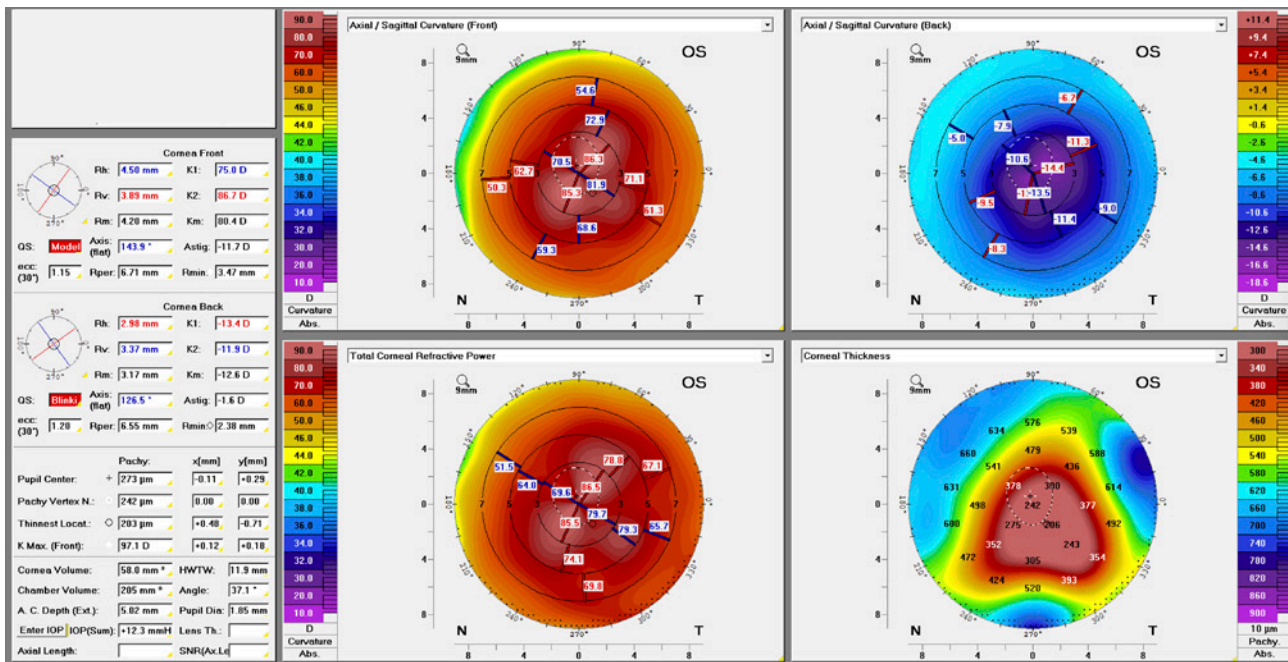


Fig. 1: Corneal tomography showed an advanced keratoconus with very steep keratometry (K) values. The steep K was 3.89 mm (86.70 D) and the flat K was 4.50 mm (75.00 D), with -11.70 D of astigmatism. The cornea was markedly thin, with the thinnest location of 208 μm.

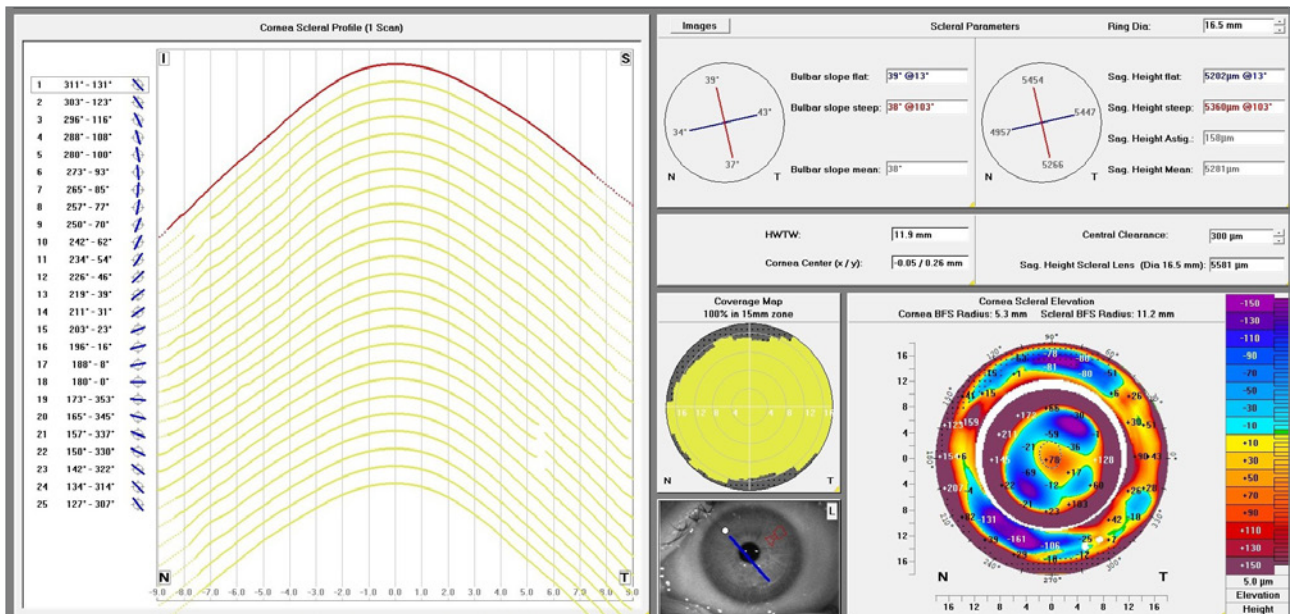


Fig. 2: Corneoscleral profilometry indicated a likely irregular scleral profile. The mean sagittal height at a 16.5-mm chord was 5281 µm. Considering a 300-µm central clearance, the software calculated a required lens sagittal height of 5581 µm. The horizontal white-to-white (HWTW) measurement was 11.9 mm.

INITIAL PRESENTATION AND SYMPTOMS

With the current OS lens (Figure 3), the patient reported significant discomfort, rating it 6/10 compared with other, more comfortable contact lenses they had previously worn. They also experienced poor vision and were able to tolerate the lens for only 6 hours per day. Therefore, **comfort** and **visual quality** were the primary issues to address. The initial contact lens design had an overall diameter (OAD) of 16.50 mm (pink circle in Figure 3)

with the highest sagittal height in the temporal area of 5877 µm orange arrow in (Figure 3), very similar to the corneoscleral profilometry (CSP) estimation (5581 µm) (Figure 2). Upon evaluation, the lens demonstrated limbal touch both horizontally and vertically. The lens power was -19.62 D (blue circle in Figure 3). An over-refraction of +1.75 D was recorded.

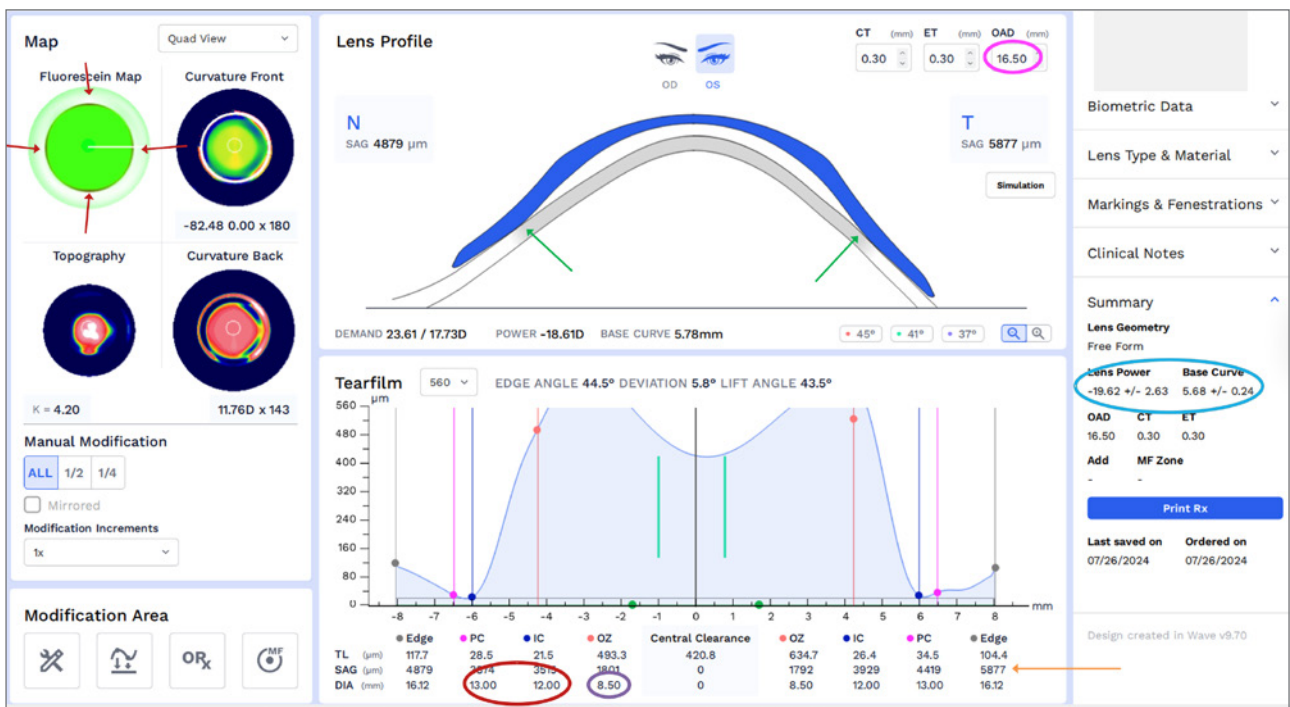


Fig. 3: Initial lens design. The green and red arrows indicate bearing on the limbal area. In the lens profile on the ocular surface, the lens touches the limbus, the light grey area in the graphic (green arrows). On the fluorescein map, black areas, both horizontally and vertically, indicate limbal touch (red arrows). Analyzing the lens design, the limbal diameter was only 1.00 mm (red circle), indicating that the lens was vaulting on the limbus by only 0.5 mm per part. The optic zone diameter was 8.50 mm (purple circle).

CONTACT LENS OPTIMIZATION AND FITTING STRATEGY

Comfort

To improve comfort and corneal physiology, the scleral lens needed to vault both the cornea and the limbus. The chamber vault was therefore increased; however, maintaining the same OAD would have reduced the landing zone width. Given the high lens sagittal height (5877 μm at a 16.50 mm chord), a narrower landing zone risked causing conjunctival compression and indentation.

To better distribute lens pressure and accommodate the exceptionally high sagittal height, the overall contact lens diameter was increased. CSP predicted a sagittal height of 5944 μm at 17.40 mm (the maximum chord available in this scan) (Figure 4). To ensure adequate pressure distribution and minimize discomfort, a larger contact lens was required. Therefore, an 18.00 mm scleral lens was designed (pink circle in Figure 5).

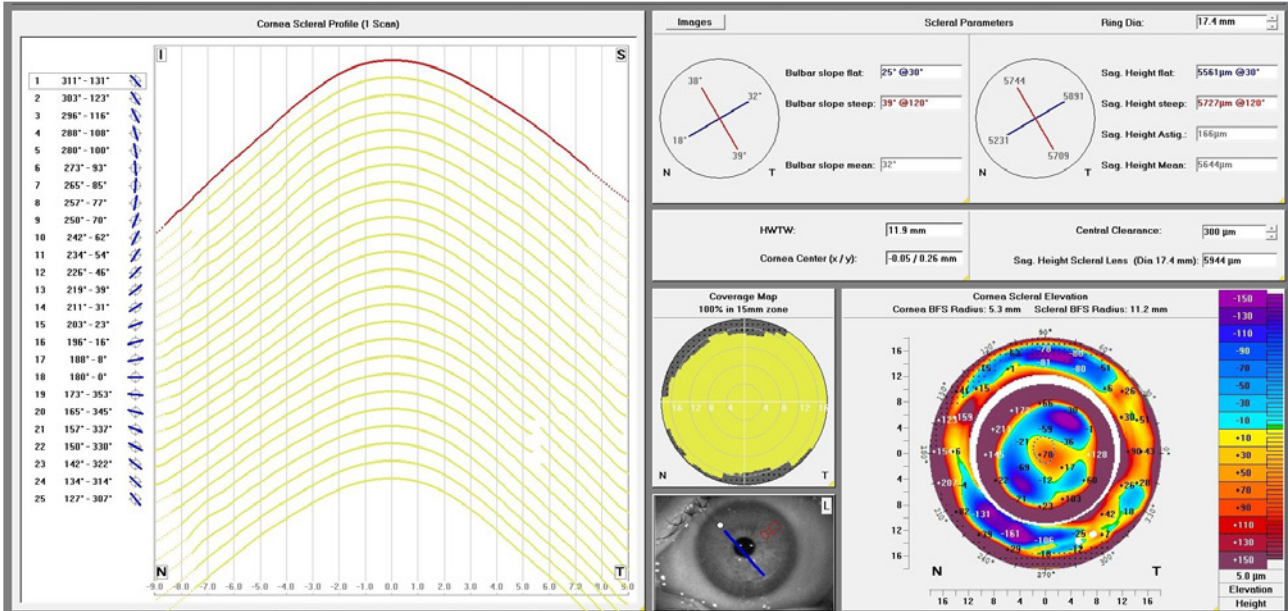


Fig. 4: The ring diameter was adjusted to the maximum value at which the software could provide data for this scan. At 17.40 mm, the software predicted a scleral lens sagittal height of 5944 μm .



Fig. 5: Second lens design. The sagittal height in the temporal area of 6589 μm (orange arrow). The green and red arrows indicate the scleral lens vaulting the limbus. In the lens profile on the ocular surface, the scleral lens is now vaulting the limbus (green arrows). On the fluorescein map, no black areas are seen anymore (red arrows). To clear the limbus, the chamber diameter was increased by moving the blue (IC) and pink (PC) dots (red circle) outward. Lens power was reduced to -0.36 D by flattening the base curve to 8.07 mm (blue circle). To reduce corneal peripheral clearance, the optic zone diameter was reduced to 5.40 mm (purple circle).

Re-evaluating the scans and lens design revealed that the horizontal white-to-white (HWTW) measurement was 11.90 mm. Upon verification, it became apparent that the vertical WTW (VWTW) was smaller, as the white ring extended well beyond the visible iris vertically (Figure 6). The vertical VWTW was therefore revised to 11.10 mm (Figure 7). Designing a scleral lenses solely based on the HWTW in the presence of such pronounced limbal ovality

would result in excessive inferior clearance, leading to contact lens decentration, discomfort, and potentially complications such as lens prolapse and midday fogging. Indeed, discomfort was reported in this case. To address the significant limbal ovality, oval scleral lenses were designed taking in consideration the HWTW and VWTW measurements (Figures 8).



Fig. 6: The white ring correctly delineates the horizontal white-to-white (HWTW), measuring 11.90 mm, but it extends well beyond the visible iris in the vertical meridian.



Fig. 7: The white ring was then adjusted to accurately delineate the vertical white-to-white, yielding a measurement of 11.10 mm.



Fig. 8: Lens design showing the oval chamber vault. The horizontal vault diameter is 13.10 mm, based on an IC of 12.20 mm.



Fig. 9: Lens design showing the oval chamber vault. The vertical vault diameter is 12.30 mm, based on a smaller IC of 11.40 mm.

Visual Quality

To address the visual issues, the high minus power of the scleral lens (-19.62 D) needed to be reduced. This was accomplished by flattening the base curve and designing an oblate scleral lens. The base curve was flattened from 5.68 mm to 8.07 mm, resulting in a final lens power of -0.36 D (Figure 5). This modification reduces spherical aberrations and contact lens mass, which in turn

enhances contact lens centration and decreases vertical and horizontal coma. However, flattening the base curve significantly increases mid-peripheral corneal clearance, potentially compromising the fit and corneal physiology. To mitigate this excessive clearance, the back optic zone diameter (BOZD) was reduced, considering the patient's scotopic pupil size measured with the Pentacam® (2.47 mm) (Figure 10).

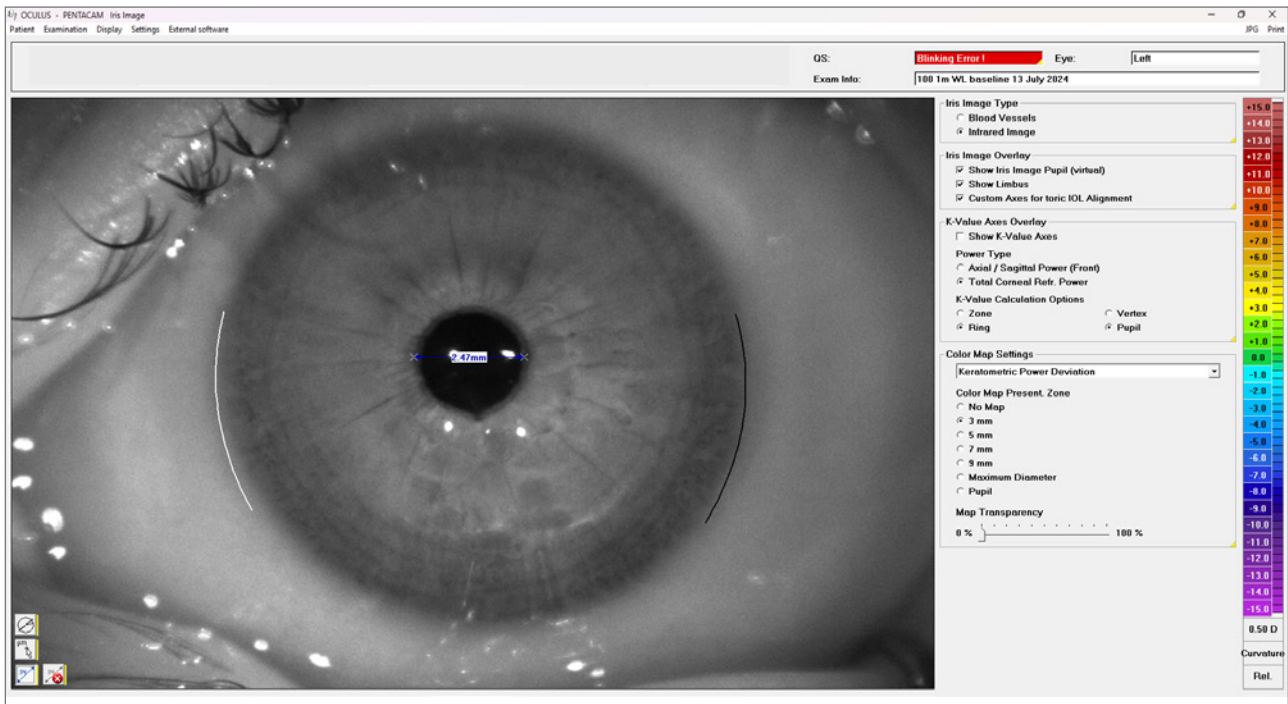


Fig. 10: Pupil size measurement with the Pentacam using the Iris Image display.

OUTCOME

Following these adjustments, the patient reported notable improvement in both comfort and visual quality. They were satisfied with the updated contact lens design and its performance.



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