

Novel Design of Freeform Rigid Gas Permeable Contact Lenses: A Case Report

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INTRODUCTION

Keratoconus is a progressive corneal ectasia typically characterized by central or inferior thinning of the stroma. Inferior keratoconus can be mistaken for other ectatic corneal conditions, most commonly pellucid marginal degeneration. Management is often non-surgical via rigid gas permeable (RGP) or scleral lenses, though surgical management may be indicated in advanced cases. This case report describes using a novel free-form design of RGP contact lenses to manage a highly ectatic post-penetrating keratoplasty keratoconic patient.

BACKGROUND

A 65 year-old white male with keratoconus s/p penetrating keratoplasty (PK) in both eyes was referred from the cornea service for specialty contact lens evaluation. His chief complaint was that he “doesn’t want surgery”. His medical history and systemic medications were non-contributory (list available upon request). He was on no ocular medications, and his ocular history was positive for the following: (+) s/p PK “in the 1970’s” OU, (+) grade 3 nuclear sclerotic cataracts OU, (+) keratoconus OU.

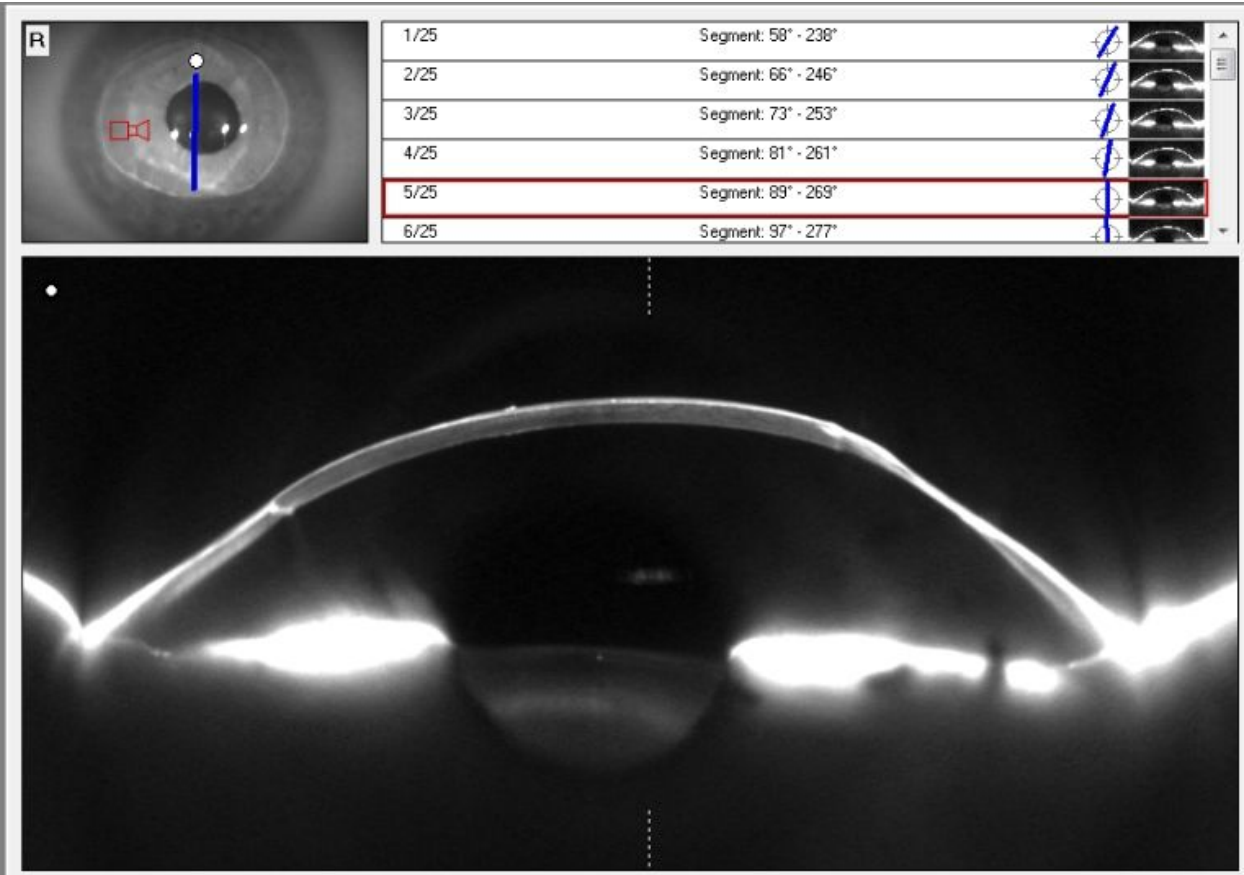


Figure 1: Optical coherence tomography (OCT) imaging of the right (above) and left (below) qualitatively highlighting the corneal shape and thickness

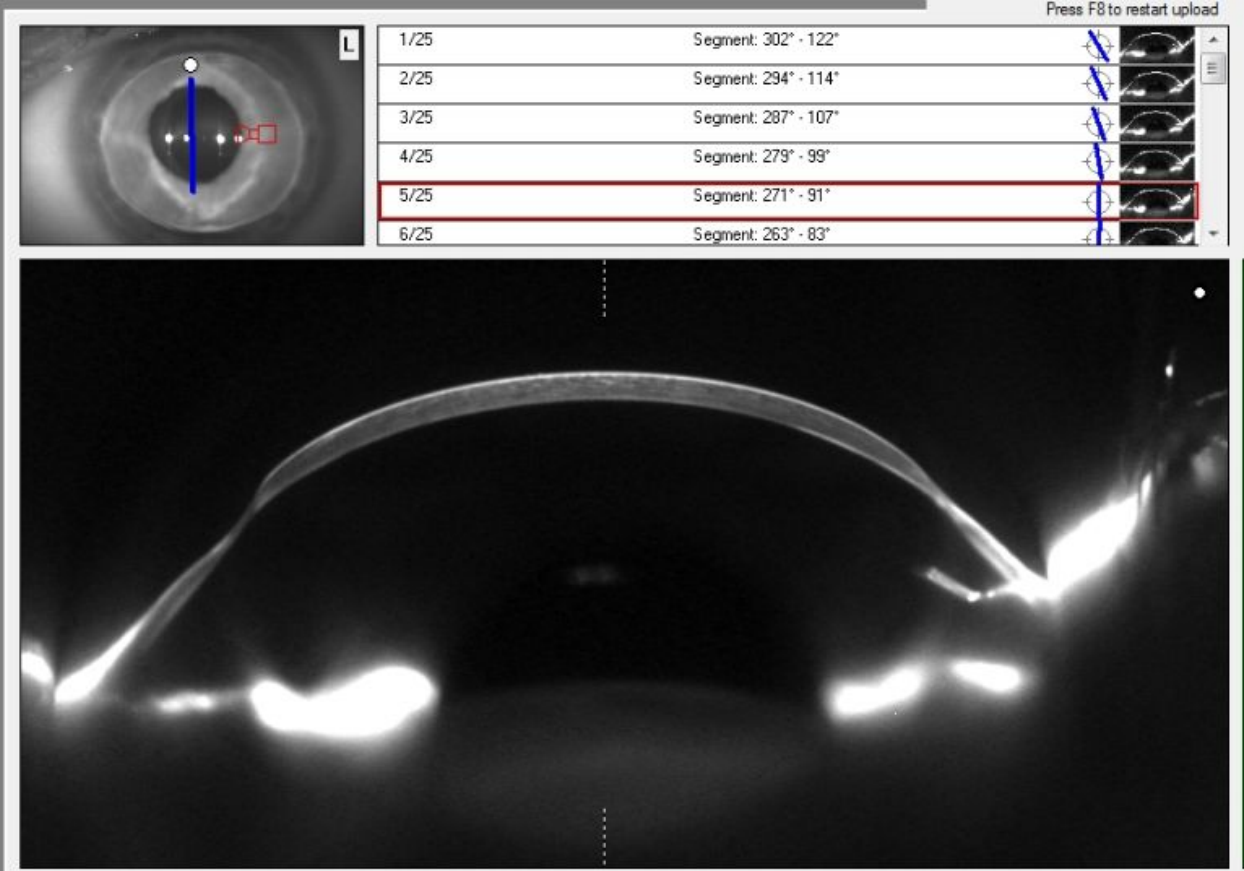


Figure 2: Slit lamp photographs of the RGP lenses on-eye with sodium fluorescein (NaFl) instilled.



METHODS AND RESULTS

This patient presented with keratoconus s/p PK OU. His surgery was done “sometime in the 1970s” and he was lost to follow-up. He presented with a best-corrected visual acuity (BCVA) of 20/60ish OD, 20/300 OS in his spectacles. He was previously diagnosed with grade 3 nuclear sclerotic cataracts bilaterally. He deferred surgery for both cataract extraction, and repeat corneal transplant. Pachymetry readings showed 660um OD, 735um OS. Unfortunately his corneal endothelial cell count readings were unreliable– 140/mm2 OD, 844/mm2 OS, likely due to the irregularity of his corneas. His OCT imaging and pentacam imaging can be found below in Figures 1 & 3, respectively. Contributory slit lamp exam findings include the following (all other findings WNL):

Eyelids/Adnexa: Floppy eyelid, meibomian gland dysfunction, incomplete blink OU

Cornea: PK graft with ectasia, inferior cornea (host and ~1.5 mm of donor button) are thin and ectatic. Mild stromal haze and peripheral suture scars; tr punctate epithelial erosions, irregular surface OD; Same with (+) keratoglobus OS

Lens: Grade 3+ nuclear sclerotic cataracts OU

He was fit with an EyePrint Gas Permeable (EPGP) free-form lens in each eye (Figure 2) and required no further lens modifications or revisions! His vision improved to **20/25 OD, 20/20 OS** (see “Conclusions” for exact parameters) and was able to comfortably wear his lenses for all-day wear!

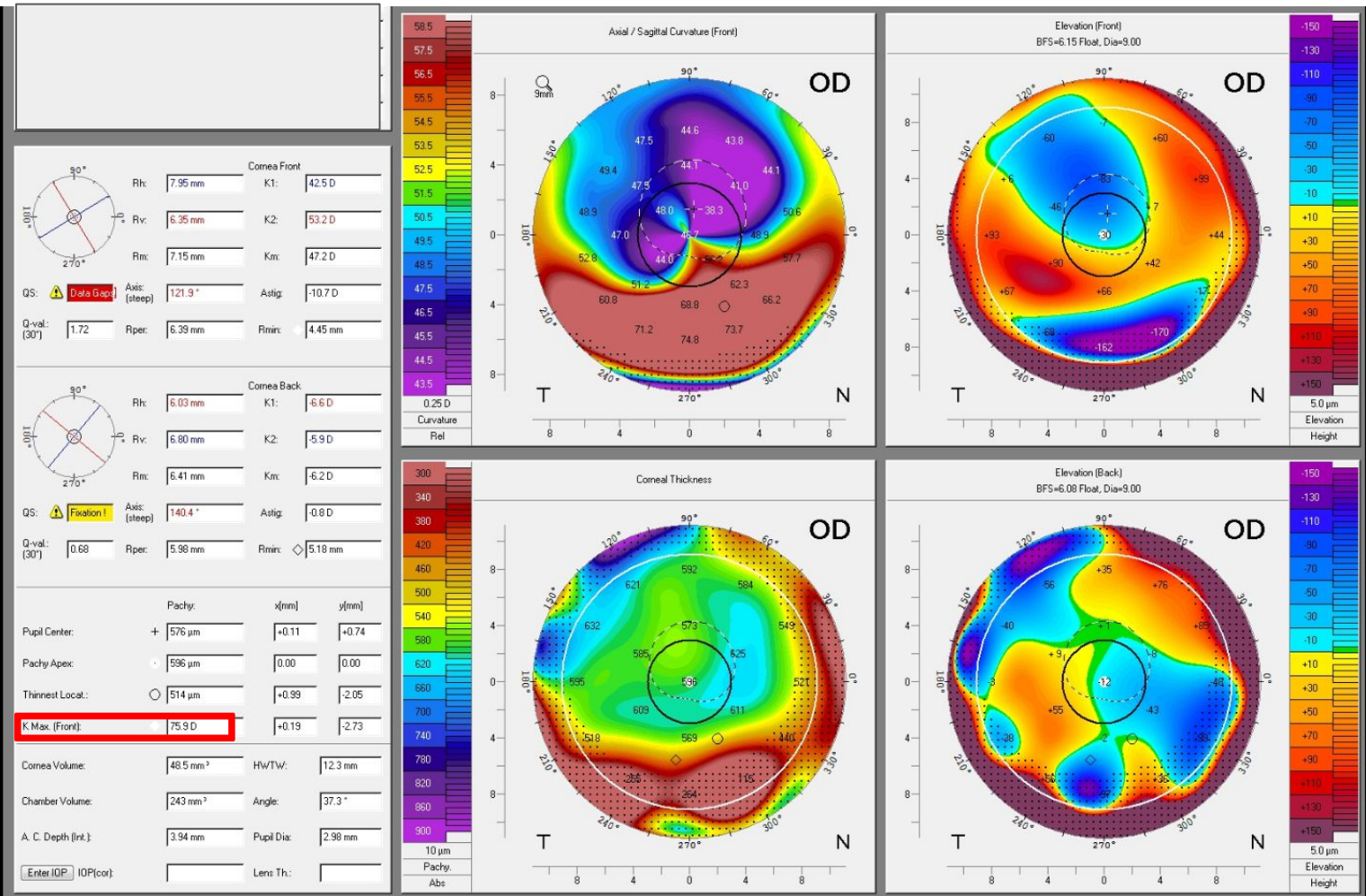
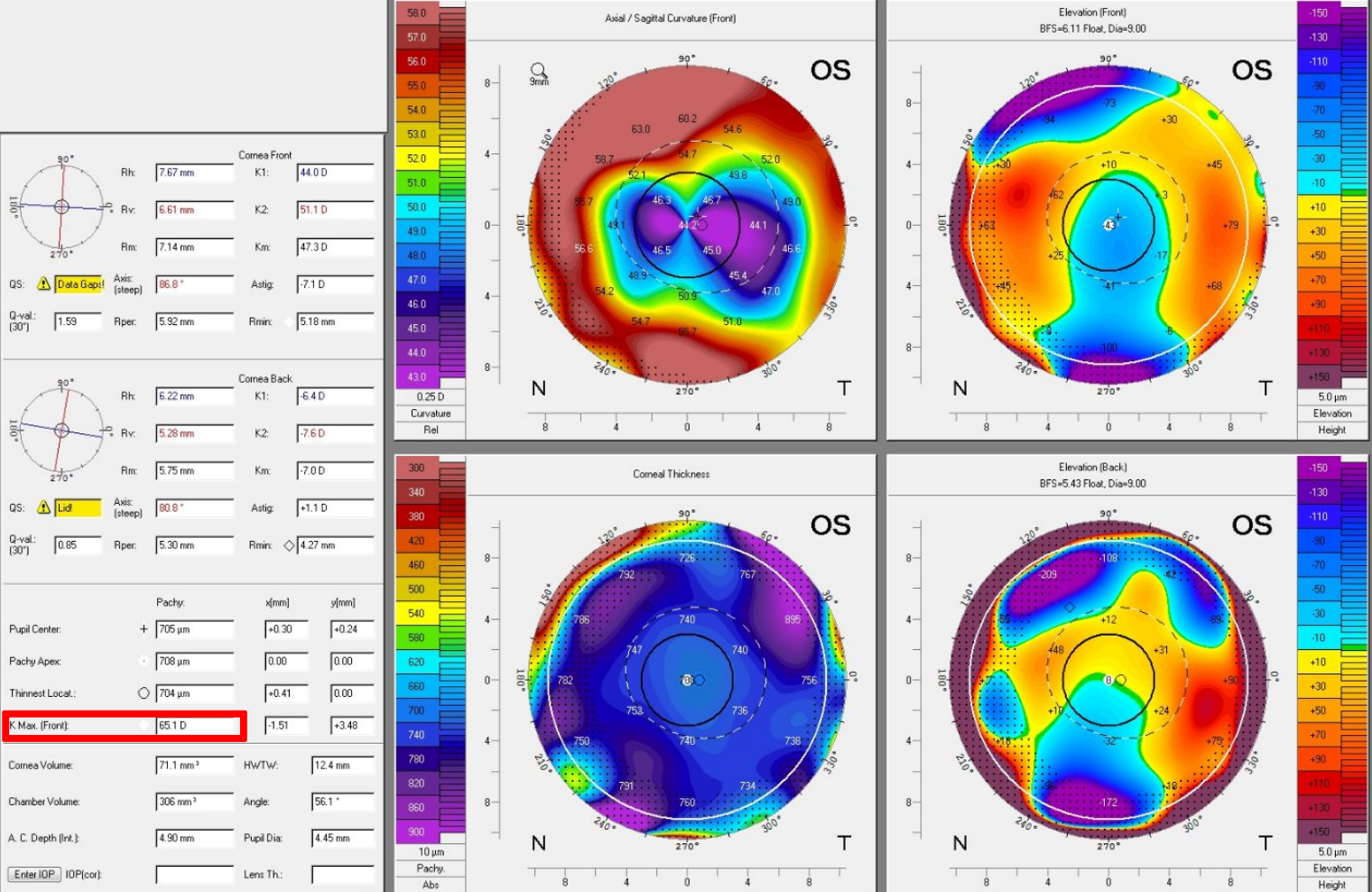


Figure 3:: Scheimpflug imaging of the right (above) and left (below) highlighting the highly irregular corneal topography



DISCUSSION

From a clinical perspective, this patient was not a candidate for scleral contact lenses due to his endothelium quality (his grafts were over 50 years old!), and from a scleral lens insertion & removal perspective (the patient did not feel he could adequately perform insertion/removal). Traditional RGP lenses are also not a good option, due to the massive amount of ectasia and corneoscleral irregularities (trial lenses were not able to stay in the eye for more than a few seconds).

From a laboratory perspective, the elevation variations of the corneal surface are too extreme for traditional RGP or even bitoric fitting. Lens centration and stability would also be extremely challenging on an eye this irregular. Similarly, the needed sagittal depth is near-impossible with conventional designs. The use of a freeform profile is necessary to combat these issues, particularly in grafts as highly ectatic and irregular as these.

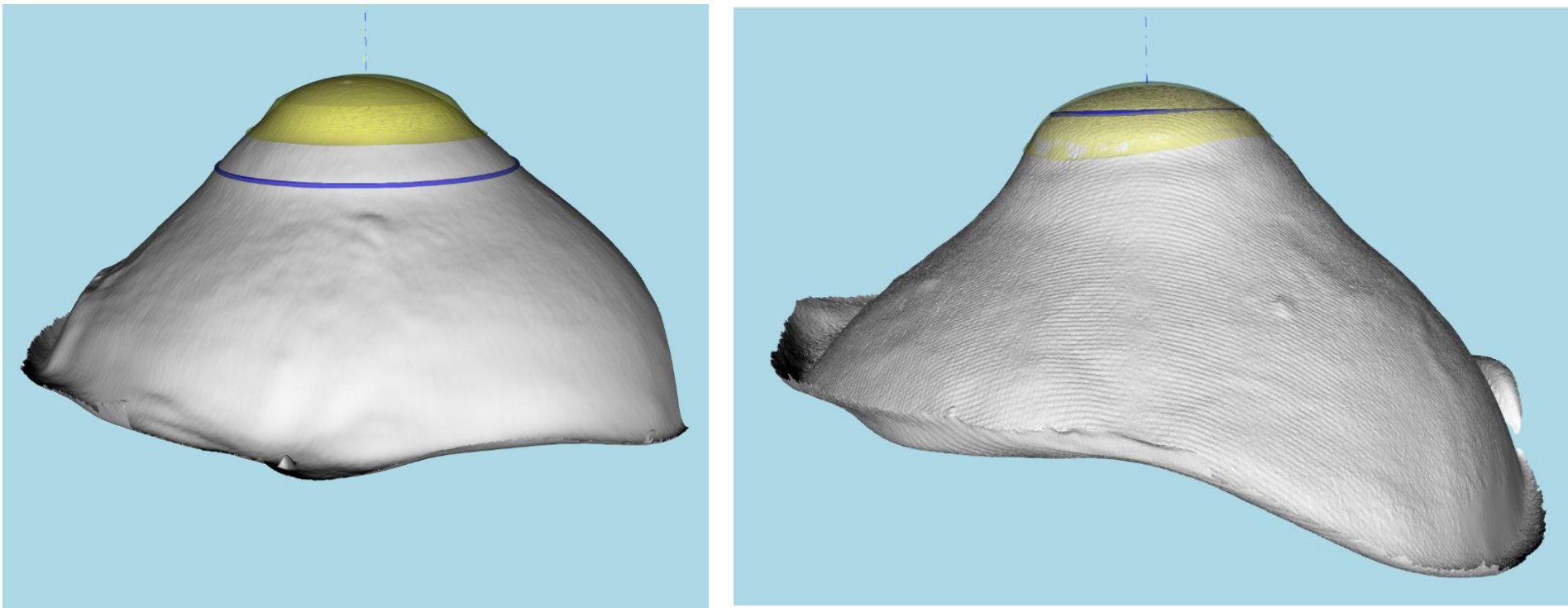


Figure 4: EyePrint Designer software imaging of the right and left eyes (respectively) showing the highly irregular corneoscleral topography. The highlighted area indicates the design of the freeform RGP lenses

CONCLUSIONS

This case report shows a novel design of free-form RGP lenses, with a level of success surpassing even our expectations! This truly unlocks the door for a much wider range of RGP fits, even in the cases of scleral lens contraindication! These lenses are a new tool we can use to help further improve the life and vision of our patients.

Brand	Overall Diameter	Base Curve	Power	Sag	Material	Additional Modifications
EyePrint GP (OD)	10.0mm	7.104mm	-7.00 DS	2539um	Optimum Extra	HydraPeg
EyePrint GP (OS)	9.0mm	6.323mm	-13.75 DS	2677um	Optimum Extra	HydraPeg

ACKNOWLEDGEMENTS

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