



Modified Scleral Lens Edge Design for a Keratoconus Patient with Corneal Neovascularization and a Conjunctival Cyst

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Introduction

Keratoconus is a condition in which the cornea degenerates and becomes progressively thin. It gradually protrudes outward to resemble a cone-shaped appearance. Signs and symptoms of this condition include severely reduced vision due to an increase in irregular corneal astigmatism. Secondary to these changes, the cornea may also be susceptible to superficial or stromal neovascularization because of the degenerative condition, increased corneal inflammation, or hypoxia.

Fortunately, scleral lenses have been widely used to improve vision for keratoconus patients by masking the irregular astigmatism and decreasing high order aberrations. With recent advances in lens edge design, modifications (including toric haptics, haptic vaults, and notching) have been developed to improve comfort and lens fit for patients with conjunctival obstacles. In addition, there have also been developments in rigid contact lens material to provide higher oxygen transmissibility to the cornea to manage the ocular health of compromised corneas.

This case report describes a keratoconus patient with a conjunctival cyst and corneal neovascularization who was successfully managed with scleral lenses to enhance comfort and maintain optimal ocular health.

Case

A 32 year old white male, diagnosed with keratoconus worse in the right eye (OD) than the left eye (OS) in 2005, presented with a chief complaint of reduced vision and discomfort with his current gas permeable (GP) corneal contact lenses. He habitually used GP lenses, occasionally with extended wear, instead of using his glasses because of his occupational need for contact lenses as a firefighter. Upon examination, his visual acuity (VA), refraction, and anterior segment evaluation of both eyes (OU) were measured (Table 1).

Clinical Findings

	OD	OS
VA with Glasses	20/200	20/25-
Refraction	-16.00-4.00x055	-8.05-3.00x125
Anterior Segment Evaluation		
Lids and Lashes	Clean and Clear	Clean and Clear
Conjunctiva	Nasal conjunctival cyst ~1.5mm wide at 3 o'clock	Clear and Quiet
Cornea	30% corneal thinning, (+)mild central stromal scarring, inferior Fleischer's ring, Vogt's striae	10% corneal thinning, (+)mild central stromal scarring, inferior Fleischer's ring, (-)Vogt's striae (+)Superficial corneal neovascularization 3mm long inferonasal to temporal region with stromal neovascularization 4mm long nasally, (-)fibrosis; (Figures 1a,b,c)
Iris	Blue, flat and intact	Blue, flat and intact

Table 1) Displays the patient's initial visual acuity, refraction, and anterior segment evaluation OU.



Figure 1a)

Figure 1) Displays the stromal corneal neovascularization and superficial corneal neovascularization in nasal (1a,c) and inferior (1b) regions of the left eye.



Figure 1b)

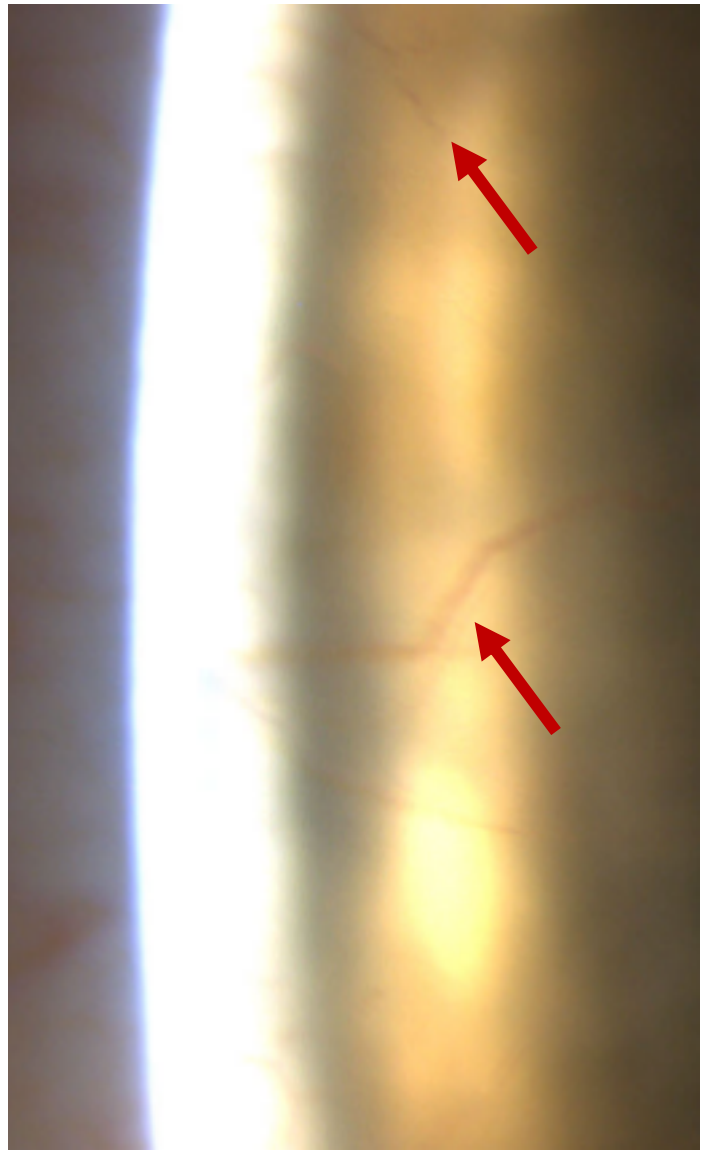


Figure 1c)

Scleral Lens Fitting

Initial Scleral Lens Ordered Parameters:	OD	OS
Lens Design	Zenlens™ Prolate	Zenlens™ Prolate
Material	Boston XO2®	Boston XO2®
Diameter	17.0	17.0
Sagittal Height (SAG)	5550um	5150um
Base Curve	6.90mm	7.30mm
Power	-12.25-3.75x180	-7.75-1.75x165
Limbal Curve	Standard	+25um
Peripheral Curve	Toric Haptic: Flat7/Steep2	Toric Haptic: Flat3/Steep3
Over-refraction	PLANO	PLANO
VA	20/20-1	20/15-2
Lens Evaluation	Apical clearance 525 um, limbal clearance 360, mild blanching nasally due to small conjunctival cyst & slightly lifted surrounding cyst, trace blanching inferonasal, well centered, toric marks 3:15 & 9:15 o'clock	Apical clearance 350 um, limbal clearance thin 360 with possible limbal touch superonasal, mild lift horizontally, well-centered, toric markings 2 & 8 o'clock

Table 2) Displays the parameters of the Zenlens scleral lenses ordered and dispensed to the patient after completing the initial scleral fit OU.

The patient was fit into Zenlens™ Prolate scleral lenses (Table 2) that required front surface torics to aid with his visual correction and back toric haptics to achieve optimal scleral alignment OU. Boston XO2® material was utilized as this material has the highest oxygen transmissibility (Dk) of 141 barrers available for this scleral design. Upon subsequent follow-ups, the lens edges OD were impinging on his nasal conjunctival cyst causing a moderate amount of sectoral hyperemia nasally both during lens wear and after lens removal (Figure 2).

After flattening the scleral edges OD in the horizontal meridian as much as possible to alleviate the nasal hyperemia, a more quadrant specific approach was utilized by incorporating a MicroVault™ (Table 3). It vaulted the nasal conjunctival cyst and decreased the sectoral hyperemia without affecting the edge alignment in the other regions of the sclera (Figure 3a,b).

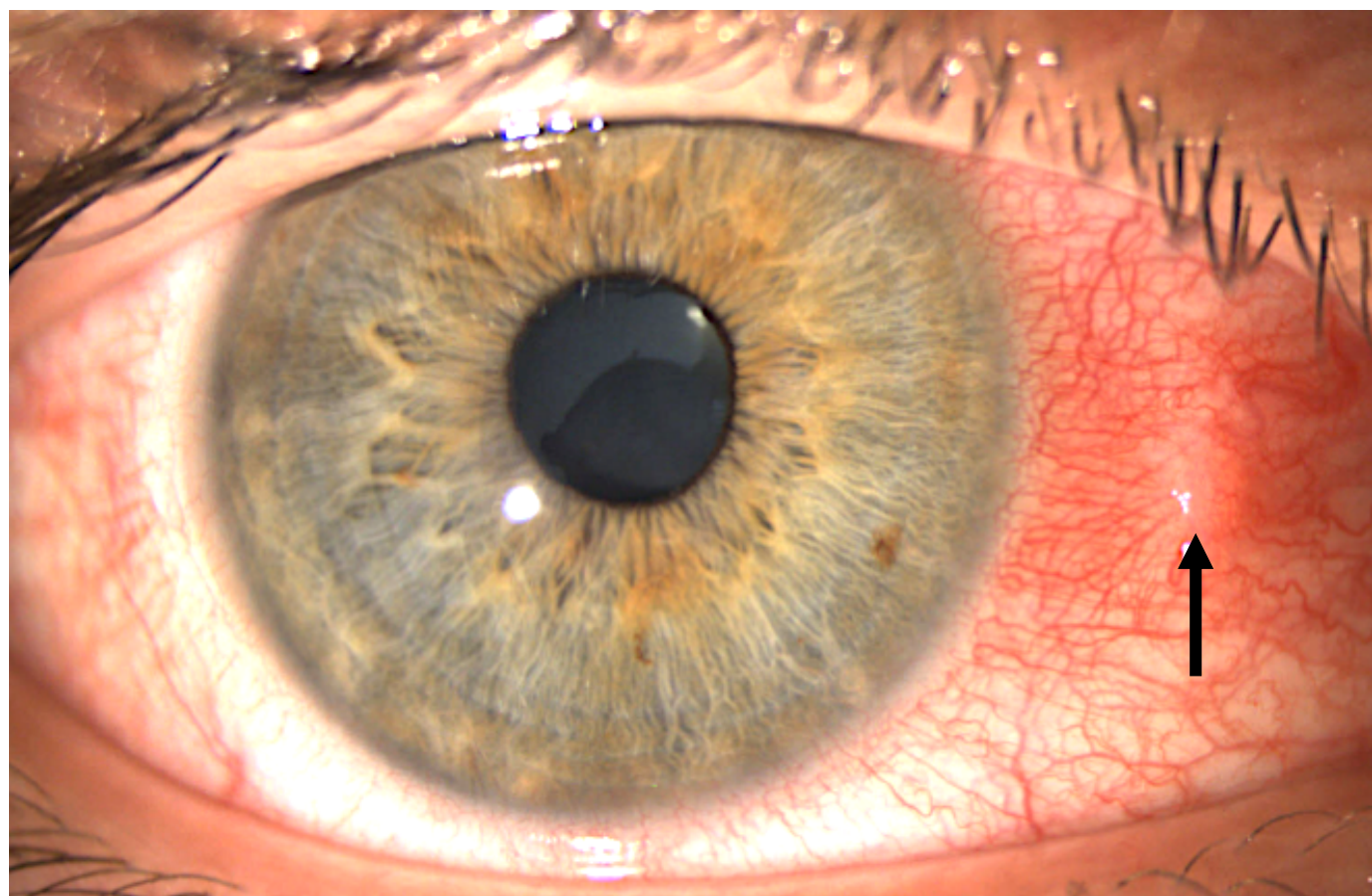


Figure 2) Displays the conjunctival cyst at 3:00 o'clock with associated sectoral nasal hyperemia secondary to scleral edge compression from the initial lens in the right eye.

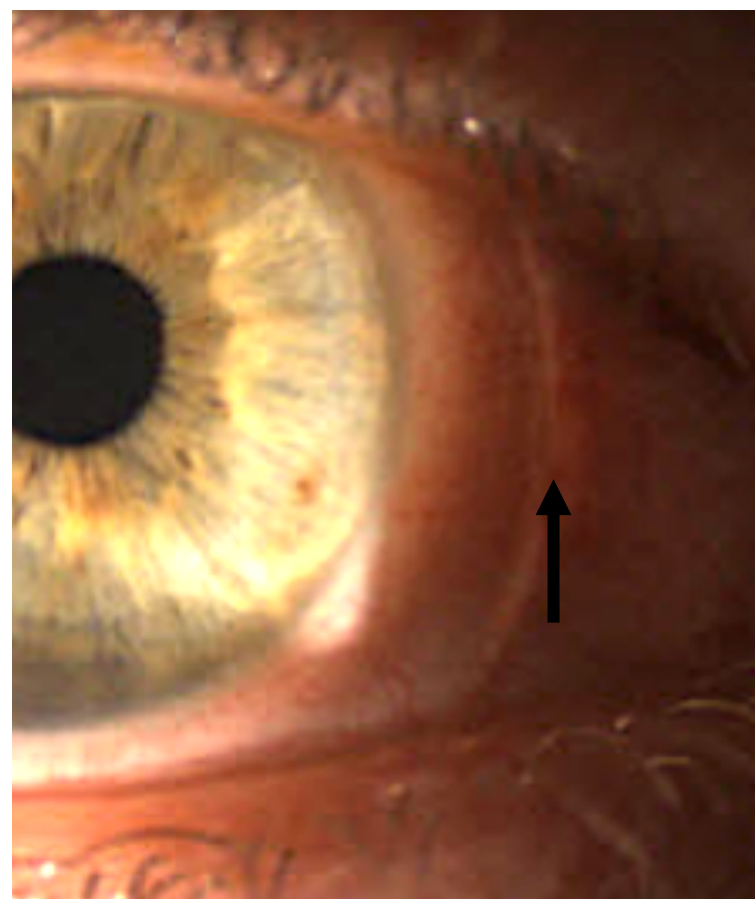


Figure 3a)

Figure 3a,b) Displays the MicroVault™ vaulting over the conjunctival cyst at 3:00 o'clock in order to resolve the hyperemia caused from the prior lens edge compression in the right eye.

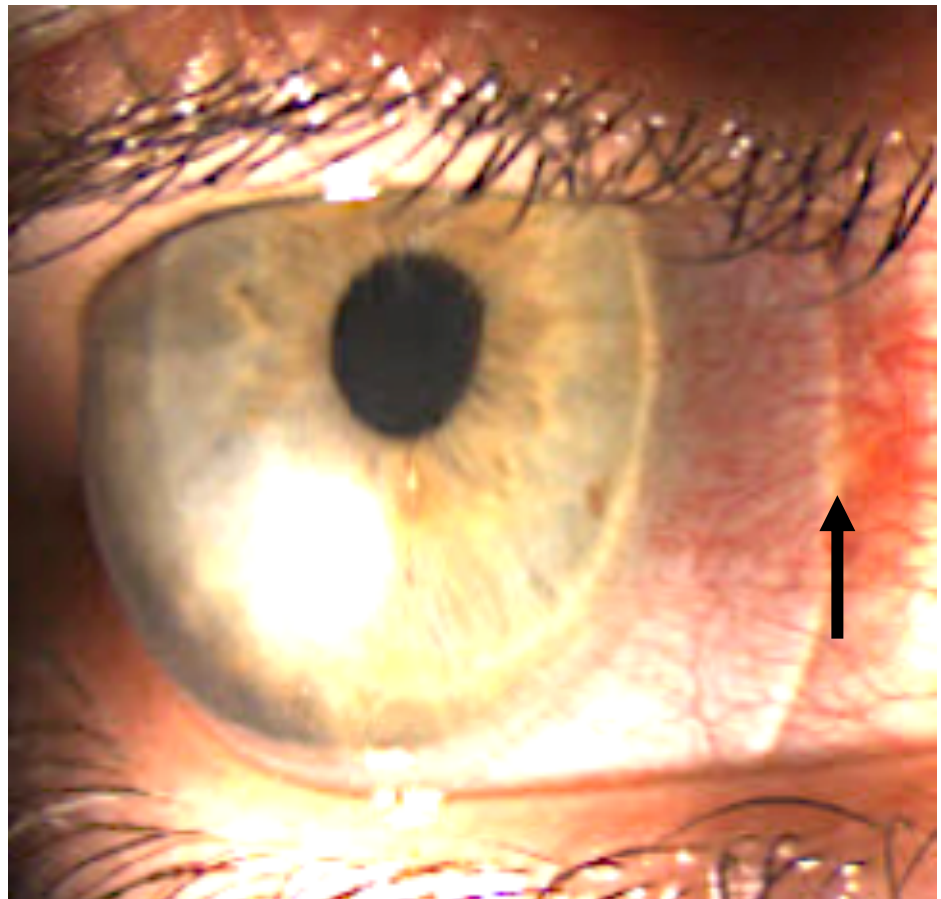


Figure 3b)

Finalized Scleral Lens Ordered Parameters:	OD	OS
Lens Design	Zenlens™ Prolate	Zenlens™ Prolate
Material	Boston XO2®	Boston XO2®
Diameter	17.0	17.0
Sagittal Height (SAG)	5350um	5100um
Base Curve	6.90mm	7.30mm
Power	-11.50-3.75x180	-7.75-1.75x165
Limbal Curve	Standard	+100um
Peripheral Curve	Toric Haptic: Flat7/Steep3	Toric Haptic: Flat3/Steep5
MicroVault™	Width: 1.5mm, Depth: 230um, Axis: 007	None
Over-refraction	PLANO	PLANO
VA	20/20	20/15
Lens Evaluation	Apical clearance 350um, limbal clearance 360, well centered, tr blanching nasal near cyst, toric markings at 4 & 10 o'clock, MicroVault™ aligning with cyst at 3:30 without impingement	Apical clearance 350um, limbal clearance 360, well centered, toric markings at 1:30 & 7:30 o'clock

Table 3) Displays the parameters of the Zenlens scleral lenses ordered and finalized for the patient after achieving optimal fit OU.

Discussion

Scleral lenses are widely used to improve both comfort and visual stability over GP lenses for patients with corneal conditions. However, improper edge alignment causes impingement, redness, or irritation, and may lead to chronic conjunctival staining and inflammation/scarring if not resolved. For this case, a MicroVault™ (focal edge adjustment) was utilized to better avoid the raised nasal conjunctival cyst. This improved his comfort substantially, and objectively improved his nasal hyperemia as well.

Furthermore, another variable to consider with scleral lenses is oxygen transmissibility. Because of the addition of the post-lens-tear-film thickness to the scleral lens thickness, this system may hinder the transmissibility of oxygen to the cornea in suboptimal circumstances. Thus, this can lead to possible hypoxic complications such as corneal neovascularization.

For this patient, his occupation being a firefighter required him the use of contact lenses for occasional extended wear periods in order to be fully-corrected at a moment's notice as a first responder. For this reason, the scleral lenses were made with the highest Dk material (Boston XO2®) available in this design to prevent further progression of his corneal neovascularization OS. In addition, the patient was advised to use back-up glasses instead of sleeping in the lenses. The neovascularization was closely monitored upon follow-up visits and remained stable after intervention.

Conclusion

Scleral lens edge alignment can be difficult to manage for patients with conjunctival obstacles. However, there are many different haptic peripheral modifications available for certain scleral lenses to minimize conjunctival inflammation and improve ocular comfort:

- Overall Diameter Change
- Toric Peripheral Haptic
- Focal Edge Adjustment
 - Focal Haptic Vault
 - Notching
- Customized Lens based on Scleral Mapping
- Impression Lens Design

In addition, there are also many ways to manage corneal neovascularization, some of which include topical non-steroidal anti-inflammatory agents, topical corticosteroids, subconjunctival or topical use of bevacizumab, laser photocoagulation, or fine needle diathermy. Contact lens related, there were developments of higher Dk fluorosilicone acrylate (FSA) material in order to transmit more oxygen to the cornea. However, one must remember that with higher Dk material, typically the wetting angle decreases and the more malleable it may also become depending. An inexhaustive list of FSA material with high Dk include:

Optimum Extra®	Boston XO®	Acuity 100®	Acuity 85®	Optimum Extreme®	Boston XO2®	Menicon Z®	Acuity 200®	Optimum Infinite®
Dk 100 barrers	Dk 100 barrers	Dk 111 barrers	Dk 115 barrers	Dk 125 barrers	Dk 141 barrers	Dk 163-189 barrers	Dk 200 barrers	Dk 200 barrers

Thus, using a higher Dk contact lens material along with the other possible treatment options mentioned may not only prevent progression, but may also regress corneal neovascularization in severe cases. This case reflects how the customization of scleral lenses and edge design make it possible to tailor to patients with multiple ocular conditions to accommodate and manage.

References:

1. Destafeno, John J. "Topical Bevacizumab Therapy for Corneal Neovascularization." *Archives of Ophthalmology*. 125(6): 2007. pp. 834.
2. Efron, Nathan. "Corneal Neovascularization." *Contact Lens Complications*. Saunders. 2012.
3. Fadel, Daddi. "Scleral Lens Issues and Complications Related to a Non-Optimal Fitting Relationship Between the Lens and Ocular Surface." *Eye & Contact Lens: Science & Clinical Practice*. 45(3): 2019. pp. 152–163.
4. "GP Materials List." *GPLI*, www.gpli.info/materials/. Accessed 23 December 2020.
5. Jager, Rama D., and Jeffrey C. Lamkin. *Massachusetts Eye and Ear Infirmary Review Manual for Ophthalmology*. Wolters Kluwer Health. 2015.
6. Norman, Craig. "A New Hyper-Dk Option for GP Lenses". *Contact Lens Spectrum*. 2007.
7. Pearson, Richard M. "Comments on 'Modern Scleral Contact Lenses: A Review' [Van Der Worp Et Al. (2014)]." *Contact Lens and Anterior Eye*. 38(1): 2015. pp. 73–74.
8. Walker, Maria K., et al. "Complications and Fitting Challenges Associated with Scleral Contact Lenses: A Review." *Contact Lens and Anterior Eye*, vol. 39, no. 2, 2016, pp. 88–96.

