Post Refractive Surgery Interface Fluid Syndrome in Scleral Lenses
The 'Break Ups & Make Ups' of Corneal Layers

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Introduction

Corneal ectasia is a potential complication that occurs after refractive surgery. Post-LASIK conditions have been associated with a higher likelihood of inducing corneal ectasia due to differences in post-procedural corneal tensile strength and space between the LASIK flap and residual stromal bed, leaving a theoretical space for fluid accumulation. This accumulation is often referred to as interspace fluid syndrome (IFS). IFS can be caused either by increase in IOP or corneal endothelial dysfunction.

The factors involved in endothelial cell damage contributing to IFS include oxygen permeability of the cornea, integrity of the endothelial cells and the overall metabolic capacity of the corneal layers, especially in hypoxic environments. The following case presentation will highlight how each of these components affect ectatic corneas in semi-controlled and potentially hypoxic environments of scleral lenses.

Case History

A 43-year-old black female presented for a scleral lens evaluation after reaching a plateau in success with rigid gas permeable lenses. She had a history of LASIK refractive surgery 17 years ago with a noticeable decrease in vision 5 years post-procedure. She was diagnosed with post-LASIK corneal ectasia, BCVA with Rose- K lenses was 20/70 OD and 20/60 OS. Ocular examination and OCT imaging showed apical touch of GPs and areas of epithelial and stromal interface disruption. She was to be fit into Blanchard OneFit Med scleral lenses, a tisilfocon lens.

Contact Lens Exam

	Parameters	VA	Clearance Values (um)	Plan
Initial Lenses	**OD:** -5.62 D BC 6.93 CT 0.20 DIA 15.60	At dispense: 20/40-2	At dispense: 257 (T), 131 (C), 174 (N)	At 1 week follow up, it was recommended to discontinue lens wear for three days due to epithelial-stromal disruption. She was to return in 1 week for follow up.
		At 1 week: 20/40-2	At follow-up|7 hrs of wear: 252 (T), 124 (C), 229 (N)	
	OS: -5.87 D BC 6.69 CT 0.20 DIA 15.60	At dispense: 20/70-3	At dispense: 355 (N), 342 (C), 482 (T)	
		At 1 week: 20/40-1	At follow-up|7 hrs of wear: 262 (N), 102 (C), 304 (T)	
At the 1-week follow-up, patient had reported stabilization of her vision and increased comfort. She reported injection OU 2 out of 7 days of the week while wearing the lenses with resolution upon removal. OCT imaging of the landing curves were obtained and compared to those taken at the dispensing appointment. A new set of trial lenses were ordered and dispensed 3 weeks later after confirmation of central clearance less than 100 um OU.				
Subsequent Lenses	**OD:** -8.37 D BC 6.56 CT 0.19 DIA 15.60	At dispense: 20/40-2	At dispense (not pictured): 701 (T), 400 (C), 344 (N)	Initially, the patient was scheduled for a follow up after two weeks of lens wear. However, she returned a few days prior to for an urgent appointment.
		At 12 days: 20/50-1	At follow-up|7 hrs of wear: 600 (T), 379 (C), 288 (N)	
	OS: -8.37 D BC 6.37 CT 0.19 DIA 15.60	At dispense: 20/50-2	At dispense (not pictured): 385 (N), 284 (C), 589 (T)	
		At 12 days: 20/50-2	At follow-up|7 hrs of wear: 386 (N), 233 (C), 527 (T)	
At the urgent appointment 12 days after the dispense of her second set of lenses, the patient presented with redness and foreign body sensation for the last 4 days. Upon examination, giant papillary conjunctivitis (GPC) was diagnosed in both eyes. After further evaluation of lens wear and care, it was brought to our attention that the patient had misunderstood her cleaning and storage instructions and was using preservative free saline to store her lenses over night. After the 12 days of wear in these new lenses, there was notable debris and mucus buildup on both lenses. The patient was re-educated on hygiene and care, with emphasis on appropriate solution usage. She was advised to discontinue lens wear for 5 days while administering TobraDex®0.3 %-0.1 % eye suspension QID OU for 5 days. She returned 3 days later with notable improvement in symptoms and decrease in the size of the papillae in both eyes. She finished her course of TobraDex® and was recommended Pataday® for regular maintenance.				

Inflammatory debris on both sets of lenses with the initial injection and later GPC play a role in the analysis of the lenses' effect on the epithelial-stromal interface. This will be reviewed in the discussion section.

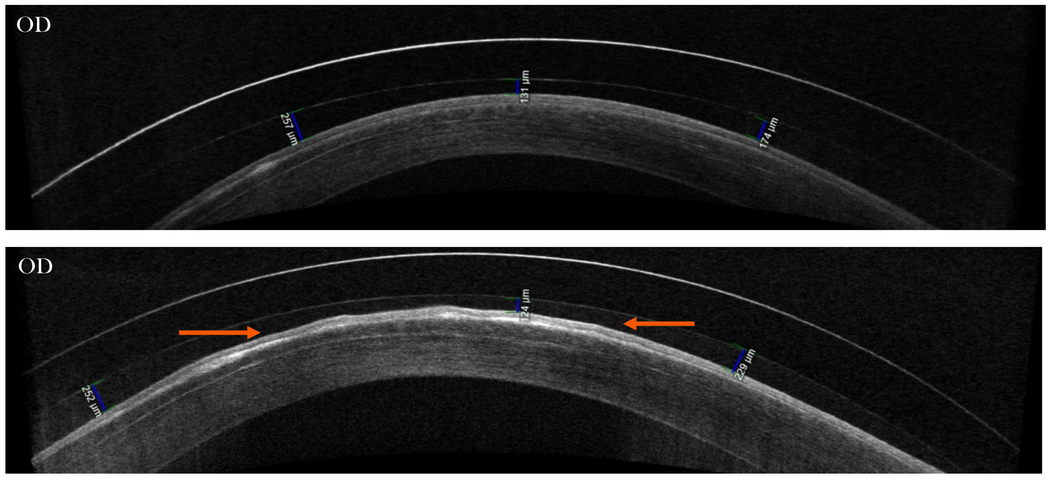

FIGURE 1: OCT images of OD with initial lens parameters at dispense (top) followed by OD with initial lens at 1 week follow up (bottom).

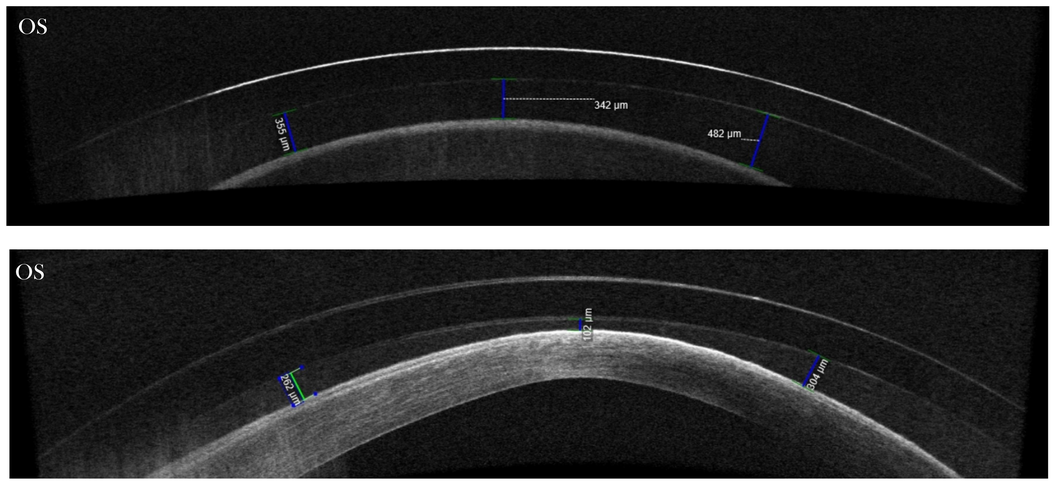

FIGURE 2: OCT images of OS with initial lens parameters at dispense (top) followed by OS with initial lens at 1 week follow up (bottom).

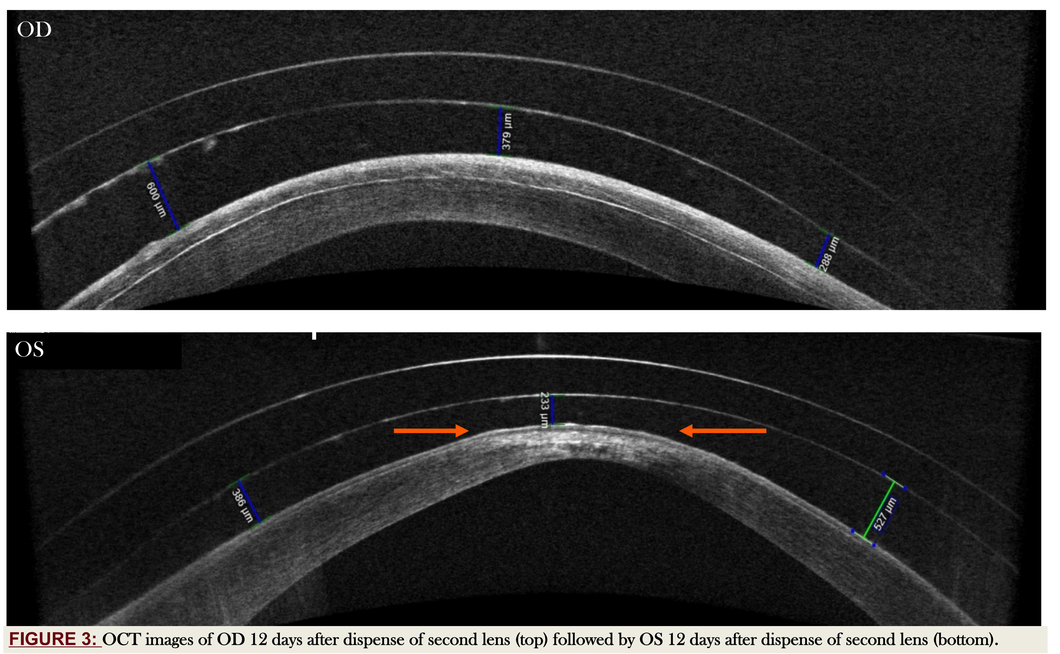

FIGURE 3: OCT images of OD 12 days after dispense of second lens (top) followed by OS 12 days after dispense of second lens (bottom).

Note: IFS will appear as a clear cleft of fluid in between endothelial and stromal layers, where as edema will present as loss of transparency.

This case was completed under the supervision and guidance of John Burns, OD and reviewed by Nicholas Gidosh, OD.

Discussion

A systemic analysis found that between major refractive surgeries, LASIK had the most reports of post-surgery ectasia. It is believed that LASIK may be more likely to cause post-procedural ectasia due to the resultant difference in corneal tensile strength. It is estimated that the stroma only regains 2.4-28.1% of its original strength in the central portion of the cornea. With regards to corneal swelling in normal or non-ectatic corneas, it is important to note that 1-3% of swelling is noted.

The incidence of swelling and interface fluid is higher in post-refractive surgery and ectatic corneas due to a variety of factors. When the cornea becomes deprived of oxygen, such as in an enclosed environment of a scleral lens, the endothelium can be affected in a variety of ways. This in turn can affect the post-surgical interface leading to IFS. The three main factors of fitting post-refractive surgery patients in scleral lens susceptible to IFS that will be discussed here include (1) Dk and lens thickness (2) hypoxia with increased fluid reservoir (3) debris in fluid reservoir relating to hypoxic-related corneal stress.

In this case, the transmissibility of our patient's lenses were 180 Dk with central thicknesses of 0.20 mm and 0.19 mm. As the Dk of a lens is increased and the thickness is decreased, the amount of central corneal swelling will be reduced as well. Generally, a lens thickness of 0.15 mm is too thin for adequate use, making it vulnerable to damage via handling or even flexure. However, in this case, these two factors are in support of allowing adequate oxygen flow to the cornea, indicating that there are other potential factors creating post hypoxia swelling and interface fluid.

Adverse endothelial response has been noted with hypoxia-related stress associated with scleral lens wear. In this case, the patient experienced a range of reservoir clearance surrounding the central cornea. The patient had interface fluid in the initial OD lens with greater clearance compared to OS with less clearance. However, the second episode with the most updated lenses occurred OS with lesser ranges of clearance as compared to OD. It is important to consider tear reservoir thickness centrally (< 200µm) and over the limbus (< 70µm) and its contribution to eliminating additional debris accumulation in the reservoir from normal wear.

Pro-inflammatory white blood cells may predispose the ocular surface to inflammation and can be identified within the reservoir of scleral lens wearers. In this case, inflammatory components and deposits accumulated as no cleanser was used to rid of the buildup of for 12 days. The interface in the left eye became affected after this episode, despite BVCA remaining symmetrical in both eyes and the diagnosis or GPC OU. Additionally, conjunctival prolapse can also create stagnation of the pre-corneal tear and fluid reservoir, leading to epithelial toxicity. Overall, the accumulation of inflammatory components in the enclosed space of a scleral lens can cause adverse effects in multiple ways.

Conclusion

Consideration of high transmissibility, decreased thickness, and overall range of clearance of scleral lenses is imperative when being fit for any post-refractive ectatic corneas, especially post-LASIK. Endothelial integrity and metabolism of the cornea in scleral lenses is easily manipulated so caution must be taken with those more susceptible to post hypoxia swelling causing endothelial dysfunction, ultimately leading to interface fluid syndrome.

References

Available upon request.