

Introduction

Scleral lenses (SL) have been shown to decrease higher order (HO) aberrations 60-65% in highly aberrated eyes¹. The improvement in optical quality results in improved visual performance in patients such as those with keratoconus, pellucid marginal degeneration, post-penetrating keratoplasty (PKP), and post-radial keratotomy (RK).

Purpose

To report a case where visual dissatisfaction experienced by a patient with keratoconus, achieving 20/20 vision with scleral lenses, is rooted in the presence of residual, uncorrected higher order aberrations.

Case Details

- 40 yo ♂ participated in a SL study
- Hx bilateral keratoconus
- Hx spectacle wearer
- Cc smearing, shadowing and glare with his habitual spectacle correction
- Snellen VA (with spectacles) was 20/50⁻¹ OD and 20/25⁻² OS
- Residual HO root mean square (RMS) wavefront error (WFE) over a 4 mm pupil, with application of his spectacle prescription was 1.25 μm OD and 0.72 μm OS (aged-matched normal = 0.21 μm)

Figure 1. Simulated retinal image and point spread function (PSF) from the patient perspective, habitually with spectacles

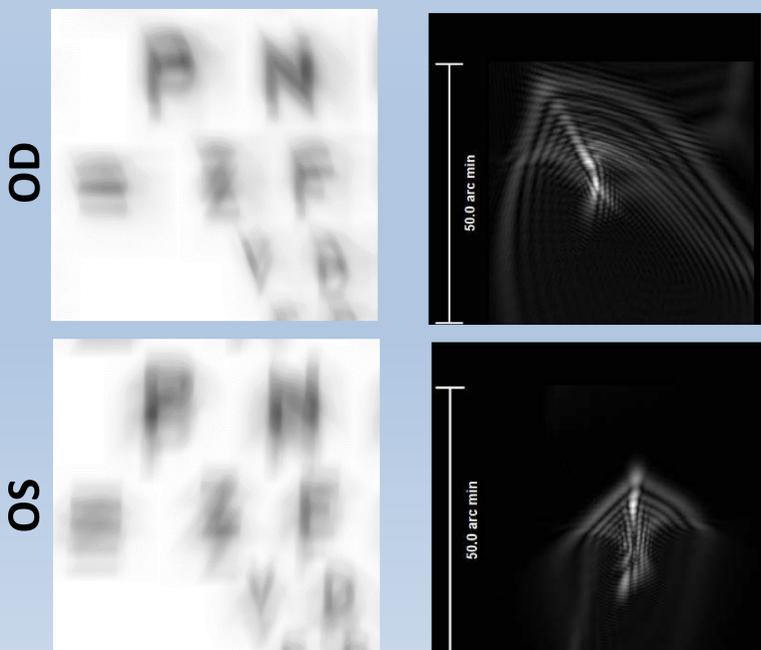
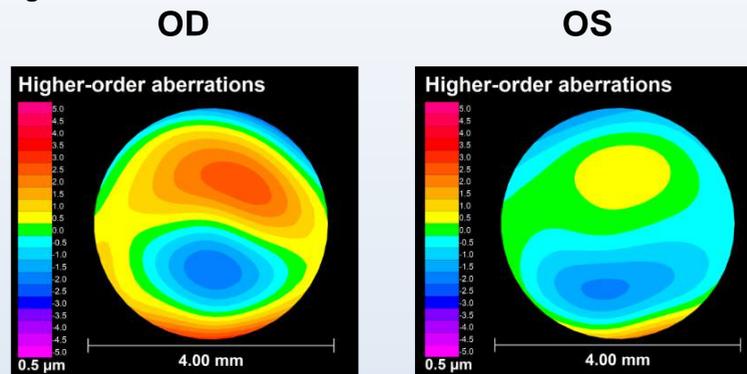


Figure 2. HO WFE with habitual correction



Following study protocol, a conventional spherocylindrical scleral lens was fit

- Snellen VA was 20/20⁺² OD and 20/16⁺² OS
 - Residual HORMS WFE over a 4 mm pupil reduced to 0.49 μm OD and 0.39 μm OS
 - Cc smearing and shadowing, albeit to a lesser degree and in the inverted orientation²
- monocular perception as a 'Ferris wheel' shadow in the right eye and a 'U' shape in the left eye

Figure 3 Patient's illustration of his shadow image of a point source in both eyes with conventional scleral lenses

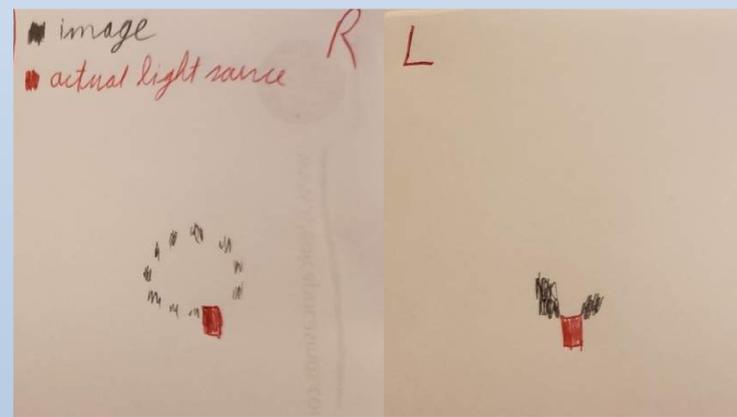
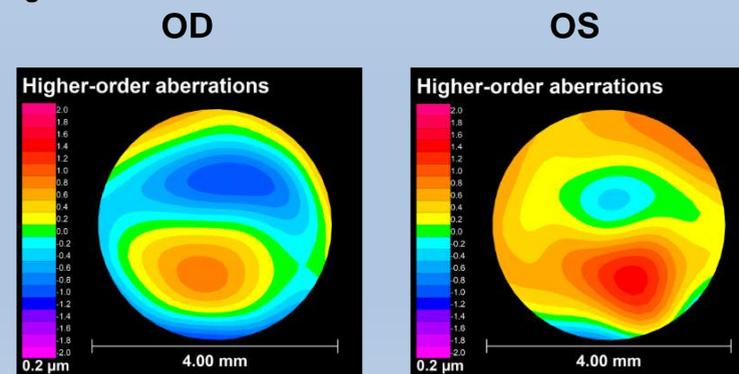


Figure 4 Residual HO WFE with conventional SL



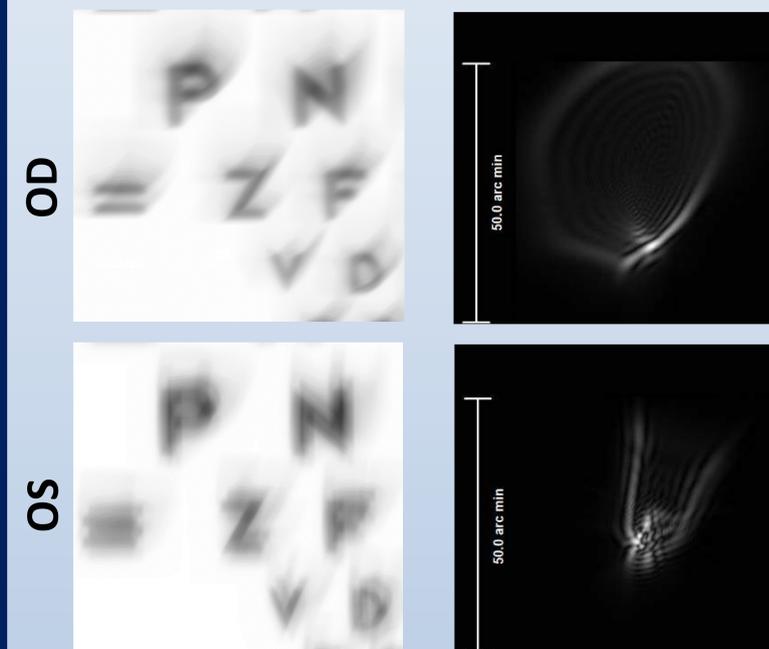
Analysis of his residual wavefront aberration structure (4 mm pupil) over the conventional scleral lenses revealed levels of coma >3 times higher in the right eye (0.47 μm) and >2 times higher in the left eye (0.30 μm) than age-matched norms (0.14 μm).

Table 1. HORMS WFE and total coma value for habitual and SL comparing to age-matched normal

	Habitual		SL		Age-matched normals
	OD	OS	OD	OS	
HORMS WF	1.25 μm	0.72 μm	0.49 μm	0.39 μm	0.21 μm
Total coma	1.19 μm	0.65 μm	0.47 μm	0.30 μm	0.14 μm

Simulated retinal image and point spread function (PSF) calculated from WFE measurement illustrated and was consistent with the patient's complaint.

Figure 4. Simulated retinal image and point spread function from the patient perspective with conventional scleral lenses



Conclusions

SL are a favorable option for patients with highly aberrated eyes. However, achieving 20/20 does not necessarily indicate that all optical deficits are alleviated, or that the patient is visually satisfied. Residual aberrations that are not quantified with typical visual acuity tools, can continue to exist at levels that cause patient dissatisfaction. This is an example of a patient where a successfully fit wavefront guided scleral lens has a higher probability of achieving patient desired vision.

Acknowledgements

¹Jinabhai A, Charman W, O'Donnell C, Radhakrishnan H. Optical quality for keratoconic eyes with conventional RGP lens and simulated, customised contact lens corrections: a comparison: Simulating customised corrections for keratoconus patients. *Ophthalmic Physiol Opt* 2012;32:200-12

²Choi J, Wee W, Lee J, Kim M. Changes of ocular higher order aberration in on-and off-eye of rigid gas permeable contact lenses. *Optom Vis Sci* 2007;84:42-51.

