Case Series: Visual Performance of Impression-based Scleral Contact Lenses with Wavefront-Guided Optics

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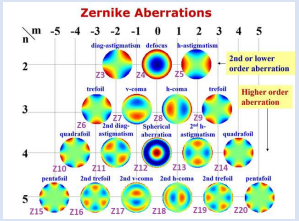
Introduction

High order aberrations (HOAs) reduce vision performance and cannot be corrected with a traditional spherocylindrical approach. Wavefront-guided contact lenses can correct for HOAs, but a stable platform is also desirable to provide adequate correction. Here we use a highly-stable scleral contact lens in combination with wavefront-guided optics. There is limited documentation on the ocular conditions where a wavefront-guided (HOA) lens are recommended for a high-success rate. This case series reports the outcome with wavefront guided lenses on cases with keratoconus, high pathological myopia, pinguecula, central serous retinopathy and apical scarring.



Individual ocular aberrations represented by Zernike polynomials.

Methods

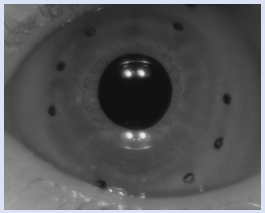
An OVITZ® **x**wave system measured the wavefront aberrations and design wavefront-guided lens profiles. These design profiles were used to create wavefront-guided scleral lenses on an EyePrint Pro lens. Visual performance of the wavefront-guided lens was compared to the baseline scleral lens and the patient's habitual correction..

(1) Fit baseline scleral lens → (2) Wavefront measurement → (3) Customized lens design → (4) Manufacture wavefront-guided lens

Fig 2. *Step-by-step process of wavefront-guided lens creation*

Technologies used: OVITZ xwave EyePrint PROSTHETICS

OVITZ xwave system used for aberrometry measurement and wavefront-guided lens design



Baseline scleral lens with index marks used as an intermediary for fitting wavefront-guided lens.

Conclusion

All patients in this case series subjectively preferred the wavefront-guided correction over the conventional correction. Across all patients we saw an average reduction in HOA RMS of 56%. This combined technology can significantly enhance visual performance while maintaining a low number of lens fits.

Case 1 – HOAs reduced in Keratoconus patient by 70%

Description

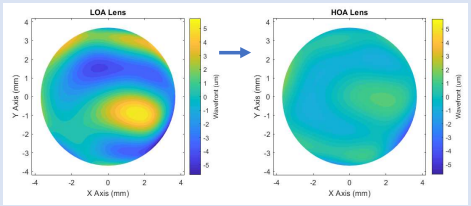
Patient 1 is a 60-year-old female with keratoconus.

Visual Acuity

	OS
GP Lens	20/100
Pinhole	20/80
Baseline (LOA) Lens	20/40+2
HOA Lens	20/20

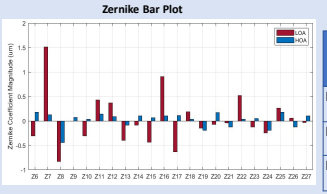
Visual performance comparison between best correct lens before starting HOA fit, pinhole, low order aberration (LOA) and wavefront-guided scleral lens (HOA lens).

LOA and HOA Lens Wavefront Maps

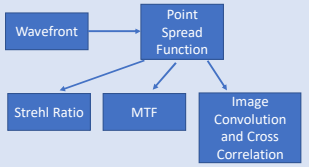


HOA RMS	OS 7.4 mm pupil
LOA Lens	2.35 µm
HOA Lens	0.71 µm
Reduction	70 %

Zernike Bar Plot



Fourier Optics Quality Metrics Computation



Fourier Optics Quality Metrics

	Strehl Ratio Ratio	Area Under the MTF	Cross Correlation Metric
LOA Lens	0.001	0.09	0.45
HOA Lens	0.014	0.29	0.73
Improvement	1300 %	210 %	62%

Fourier Optics metrics computed over a 6 mm pupil

Case 2 – HOAs reduced in high pathological myopia patient by 65% OD and 44% OS

Description

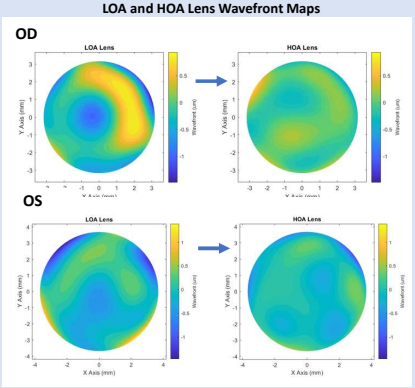
Patient 2 is a 38-year-old male with high pathological myopia, posterior staphyloma, retinal detachment, nystagmus and anisometropia. This patient had a refraction of -19 D OD and -14 D OS.

Visual Acuity

	OD	OS
Habitual Scleral	20/30-2	20/25-2
Pinhole	20/30	20/30
Baseline (LOA) Lens	20/25	20/25-2
HOA Lens	20/25	20/25

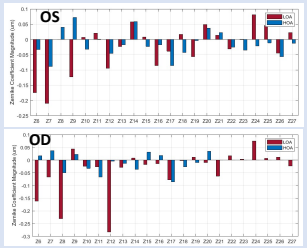
Visual performance comparison between best correct lens before starting HOA fit, pinhole, low order aberration (LOA) and wavefront-guided scleral lens (HOA lens).

LOA and HOA Lens Wavefront Maps



HOA RMS	OD 6.3 mm pupil	OS 7.3 mm pupil
LOA Lens	0.43 µm	0.36 µm
HOA Lens	0.15 µm	0.2 µm
Reduction	65 %	44 %

Zernike Bar Plots



Fourier Optics Quality Metrics

OD	Strehl Ratio Ratio	Area Under the MTF	Cross Correlation Metric
LOA Lens	0.033	0.36	0.77
HOA Lens	0.038	0.61	0.86
Improvement	15%	69%	11%

OS	Strehl Ratio Ratio	Area Under the MTF	Cross Correlation Metric
LOA Lens	0.035	0.54	0.81
HOA Lens	0.058	0.68	0.88
Improvement	65%	26%	8.6%

Fourier Optics metrics computed over a 6 mm pupil

Case 3 – HOAs reduced in patient with Keratoconus, pinguecula, central serous retinopathy and apical scarring by 57% OS and 42% OS

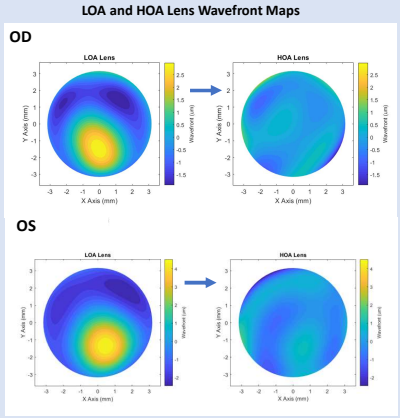
Description

Patient 3 is a 65-year-old male with keratoconus, pinguecula, a history of central serous retinopathy and apical scarring in both eyes.

Visual Acuity

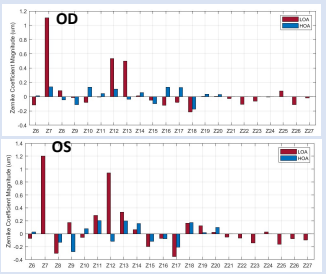
	OD	OS
Habitual Contacts		20/50
Pinhole		20/40
Habitual Scleral	20/30+1	20/25-2
Best Corrected EPP	20/20-2	20/25
Baseline (LOA) Lens	20/20-2	20/25
HOA Lens	20/20	20/20-2

LOA and HOA Lens Wavefront Maps



HOARMS	OD 6.3 mm pupil	OS 6.3 mm pupil
LOA Lens	0.89 µm	0.98 µm
HOA Lens	0.38 µm	0.57 µm
Reduction	57 %	42 %

Zernike Bar Plots



Fourier Optics Quality Metrics

OD	Strehl Ratio Ratio	Area Under the MTF	Cross Correlation Metric
LOA Lens	0.005	0.20	0.61
HOA Lens	0.017	0.38	0.75
Improvement	240%	90%	23%

OS	Strehl Ratio Ratio	Area Under the MTF	Cross Correlation Metric
LOA Lens	0.004	0.17	0.60
HOA Lens	0.008	0.27	0.72
Improvement	200%	59%	20%

Fourier Optics metrics computed over a 6 mm pupil

References

1. Sabesan et al. Optometry and Vision Science **90**, p.314-323 (2013)
2. Kim et al. J Cataract Refract Surg **37**, 1305–1312 (2011)