

Abstract

The goal of this research was to determine if increasing the vault of the scleral contact lenses (SCLs) correlates to an increase in higher-order aberrations (HOAs), which may coincide with patient dissatisfaction. Aberrations are a vital consideration in the design of ophthalmic lenses, including scleral contact lenses. As a result of vault, SCLs allow for a significant liquid reservoir between the lens and cornea. Because of this and anecdotal reports from clinicians of patient visual complaints with greater vault, we suspected an increase in higher order aberrations as vault increased.

Introduction

Scleral contact lenses are innovative lenses that have become popular due to their various applications. These large diameter contacts provide the best vision correction option for those with irregular corneas, because they completely vault the cornea and lay on the sclera. Additionally, the fluid reservoir formed by the corneal vault is therapeutic in cases of ocular surface disease.. If vault is increased, the result is a larger tear reservoir, but possibly at a cost of an increase in higher order aberrations or other detrimental consequences for the patient.

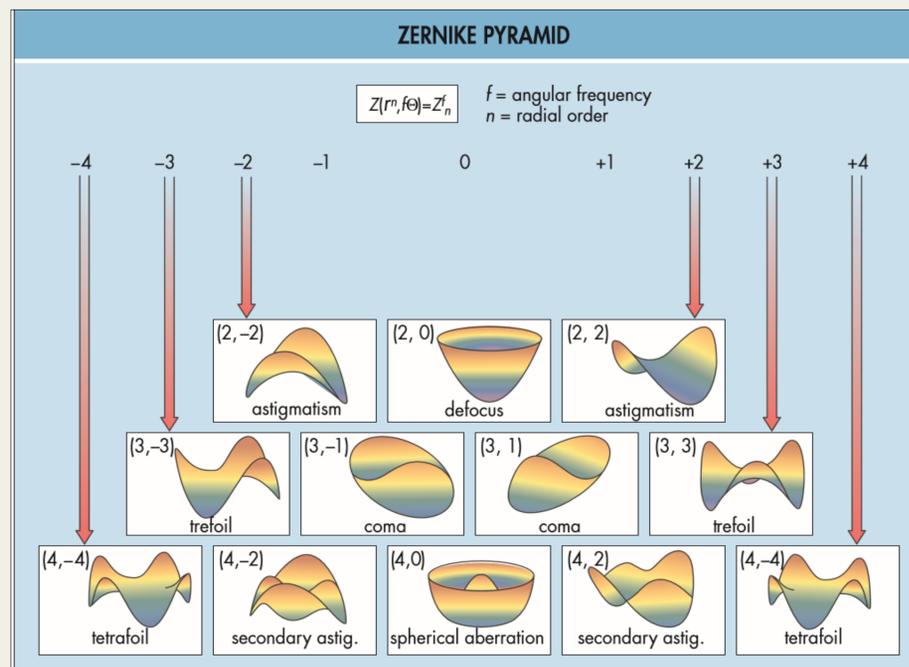


FIGURE 1.
Zernike Pyramid of second through fourth orders.

Methods

In this controlled clinical trial of 20 subjects, Truform® Digiform scleral contact lenses were initially fit on the left eye of each subject according to the fitting set instructions. Subjects were then fit with the next two larger vaults in the fitting set. Vault (Image 1), HOAs (Image 2) and subjective quality of vision following a refraction in the phoropter were tested after each lens was applied and allowed to settle for ten minutes. Differences in HOAs and subjective responses were analyzed using ANOVA and pairwise t-testing. In the analysis, Zernike coefficients of the third to the seventh order were examined.

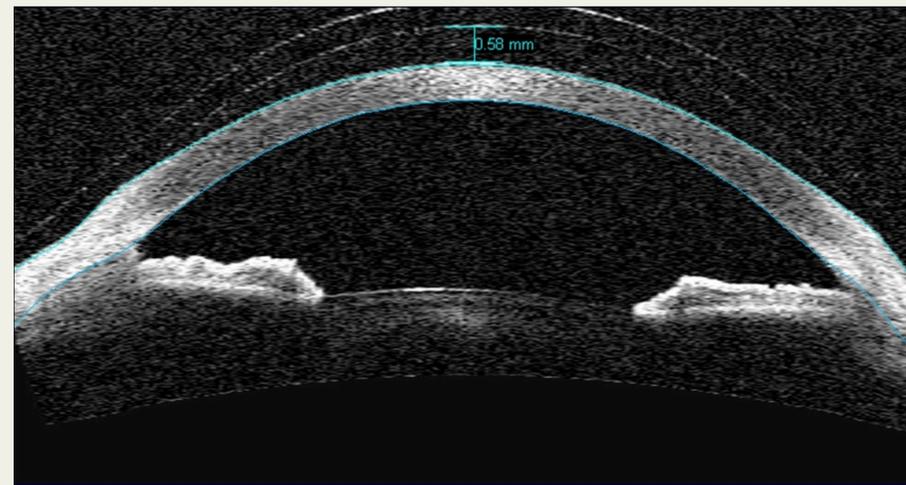


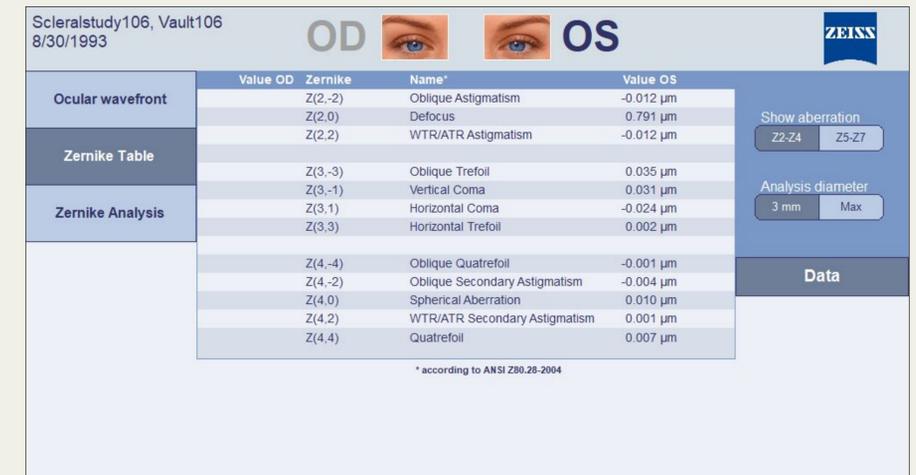
IMAGE 1.
Visante OCT Image example showing the method used to measure vault.

Results

In our trial patients subjectively rated quality of vision better for the lens with the largest vault compared to the initial lens applied ($p = 0.047$). The average corneal vaults for the three lenses were 173 microns, 260 microns and 376 microns. There was no statistically-significant increase in HOAs as lens vault increased.

Conclusion

As altering corneal vault does not induce an increase in HOAs, corneal vault is yet another variable for clinicians to utilize to provide an accurate, comfortable scleral contact lens fit for both regular and irregularly shaped corneas.



Ocular wavefront	Value OD	Zernike	Name*	Value OS
		Z(2,-2)	Oblique Astigmatism	-0.012 μm
		Z(2,0)	Defocus	0.791 μm
		Z(2,2)	WTR/ATR Astigmatism	-0.012 μm
Zernike Table		Z(3,-3)	Oblique Trefoil	0.035 μm
		Z(3,-1)	Vertical Coma	0.031 μm
		Z(3,1)	Horizontal Coma	-0.024 μm
		Z(3,3)	Horizontal Trefoil	0.002 μm
Zernike Analysis		Z(4,-4)	Oblique Quatrefoil	-0.001 μm
		Z(4,-2)	Oblique Secondary Astigmatism	-0.004 μm
		Z(4,0)	Spherical Aberration	0.010 μm
		Z(4,2)	WTR/ATR Secondary Astigmatism	0.001 μm
		Z(4,4)	Quatrefoil	0.007 μm

* according to ANSI Z80.28-2004

IMAGE 2.
iProfiler® Zernike Table with HOAs (orders 2-4; 3.0-mm pupil shown).

Discussion

This research attempted to investigate the current literature and anecdotal evidence supporting the notion that increased corneal vault results in decreased visual clarity and increased higher order aberrations. However, the data we collected and resulting statistics do not support any difference in higher order aberrations with variations in corneal vault. In fact, the t-test analysis demonstrated with approaching statistical significance that larger corneal vault had less average higher order aberrations. As a result of this new data, we may now use corneal vault as yet another parameter that may be altered to provide a personalized fit without visual degradation due to higher order aberrations.

References

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