Spherical Aberration with Small vs. Large Orthok Optical Zones

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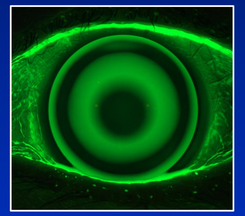
Introduction

Recent orthokeratology research employing smaller optical zones in their construction would suggest that better myopia control efficacy is possible in children[1]. Spherical aberration has been proposed as a metric to predict when a higher or lower myopia control signal is presented to the retina in order to regulate eye growth[2]. This pilot study set out to measure the spherical aberration induced by small versus large optical zones across a range of refractive changes.

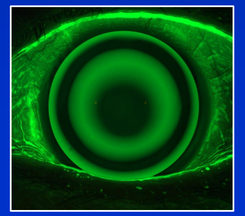
Methods

Adult optometric students with normal, disease-free eyes and myopic refractive error between -1.00 and -6.00D were eligible for enrollment in the study. Thirteen subjects met the requirements and were randomly fit with one eye in a 5.0mm optical zone (OZ) and the fellow eye in a 6.0mm OZ (Moonlens, Art Optical, Grand Rapids, MI). The lenses were evaluated at the dispensing visit then following 1 night of wear and again after 7 consecutive nights of treatment. Subjects with unremarkable slit lamp findings and centered bulls-eye topographies (Medmont meridia™) were then analyzed on the aberrometer (Nidek OPD Scan III, Nidek Co. Ltd., Gamagori, Japan). Twelve eyes in the 5.0mm OZ and 11 eyes in the 6.0mm OZ successfully completed the study.



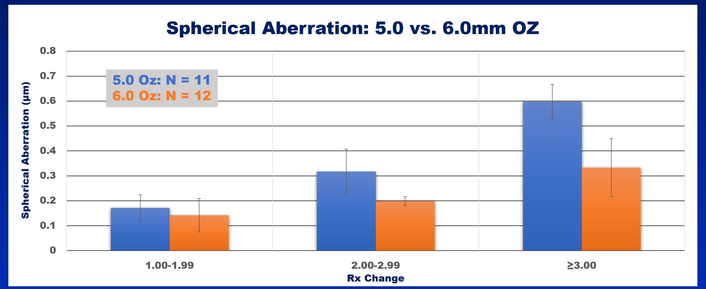
5.0mm Optical Zone

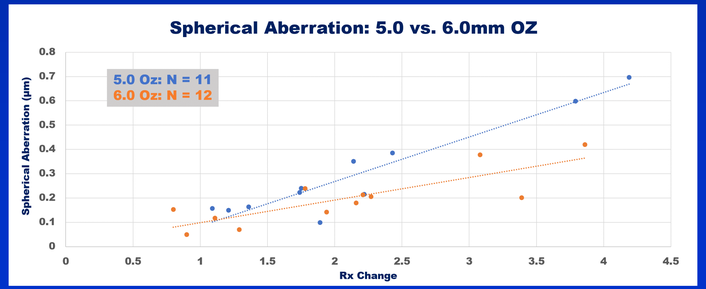
6.0mm Optical Zone



Results

The spherical aberration (Z_4^0) findings by optical zone (OZ) size and Rx change are shown in the graphs below. This data is presented following seven consecutive nights of wear in the 5.0 versus 6.0mm OZs.





Discussion

In each refractive group, the smaller 5.0mm OZ exhibited a higher spherical aberration response compared to the 6.0mm OZ. Additionally, the lower the Rx change, the lower the differential between the two optical zones. Conversely the higher the Rx change, the higher the difference between the OZs. There is a statistically significant difference between the two study groups (P = 0.013). However, specifically comparing the lowest Rx change cohorts (≤1.99 D), statistical significance was not reached (P = 0.572).

Limitations of this pilot study include the small sample size analyzed as well as the age of the cohorts. Measuring the spherical aberration response and its potential influence on myopia control would be best studied on myopic children.

Conclusion

This pilot study shows that decreasing the optical zone size of orthokeratology lenses can impact the magnitude of spherical aberration induced. Further testing with a large cohort of children would provide insight on the influence lens construction has in myopia control orthokeratology.

References

1. Guo B, Cheung SW, Kojima R, Cho P. One-year results of the Variation of Orthokeratology Lens Treatment Zone (VOLTZ) Study: a prospective randomised clinical trial. Ophthalmic Physiol Opt. 2021 Jul;41(4):702-714.
2. Lau JK, Vincent SJ, Cheung SW, Cho P. Higher-Order Aberrations and Axial Elongation in Myopic Children Treate With Orthokeratology, Investigative Ophthalmology & Visual Science February 2020, Vol.61, 22.