Treatment Success Using Large Back Optic Zone Diameter (BOZD) in Adult Orthokeratology

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Introduction

Orthokeratology (OK) lenses today are primarily prescribed in children to slow the progression of axial myopia. Clinical experiences have taught us that small back optic zone diameter (BOZD) lead to increased higher order aberrations (HOAs) beneficial to providing a strong signal for myopia control but likely a primary reason for drop out in young adults with distance specific demands.[2] This case discusses the use of custom OK lenses comparing 6.8mm and 6.0mm BOZD used off-label in overnight OK treatment in an adult patient.

Case Report

TS is a 26-year-old Caucasian male interested in ortho-K lens wear.

- Spectacle Rx:
  - Right Eye: -1.25 DS; BCVA 20/15
  - Left Eye: -1.50 -0.50 x 083; BCVA 20/15
- Corneal topography revealed that the corneal sagittal height differential at a chord of 8mm, a toric lens periphery would be indicated.
- Custom toric ortho-k lens was designed:
  - OD: 8.75 BC/+1.50D/6.8mm BOZD/11.20mm DIA
  - OS: 8.65 BC/+1.00D/6.0mm BOZD/11.20 mm DIA
- After one night of wear, VA was 20/20-2 OD and OS with well-centered treatment zones despite irregular central epithelium.
- At the one week follow-up, VA was 20/15 OD and OS with well-centered treatment zones. TS reported that his vision was “the best he ever had” in both eyes but experienced mild halos and glare when driving at night in OS.

Baseline Topographies

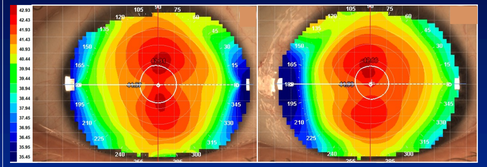

Figure 1. Baseline axial topographical map of right eye in primary gaze.
K's: 41.37/42.31 @ 094
Spherical aberration: 0.39 microns

Figure 2. Baseline axial topographical map of left eye in primary gaze.
K's: 41.93/42.66 @ 088
Spherical aberration: 0.47 microns

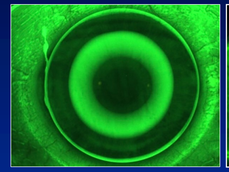

Figure 3. Fluorescein pattern of right lens with 6.8mm BOZD at dispense.

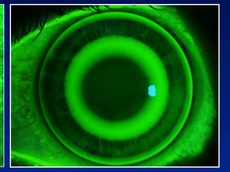

Figure 4. Fluorescein pattern of left lens with 6.0mm BOZD at dispense.

Follow-up Topographies

Day 1 Post Treatment

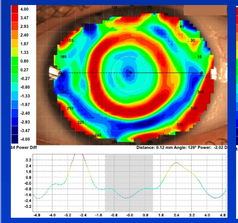

Figure 5. Tangential topographical map of the right eye with 6.8mm BOZD. Well-centered treatment zone.
OD VAsc: 20/20-2

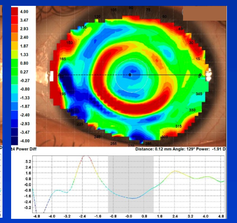

Figure 6. Tangential topographical map of the left eye with 6.0mm BOZD. Smaller treatment zone can be appreciated when compared to the right eye.
OS VAsc: 20/20-2

Day 10 Post Treatment

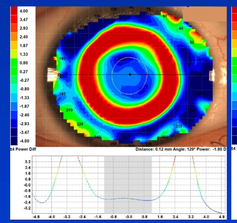

Figure 7. Tangential topographical map of the right eye. Overcorrected by ~0.50 D.
OD VAsc: 20/15

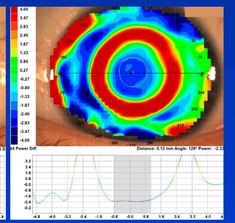

Figure 8. Tangential topographical map of the left eye. Overcorrected by ~0.50 D.
OD VAsc: 20/15

Orthokeratology Considerations

Decentration of optics and treatment zone diameter in ortho-k lens design for children are arguably the greatest retardants of axial elongation as a result of increased HOAs induced into the visual system.[1] Using clinical data from five children wearing ortho-k lenses with 5.0mm BOZD, we found the average corneal spherical aberration (SA) post-treatment one week had positively quadrupled from baseline measurements. In contrast, increasing BOZD from the standard ≤ 6.0mm used for myopia control serves to decrease spherical aberration (see figure 9) resulting in visual success even with pupillary variations in adult patients.

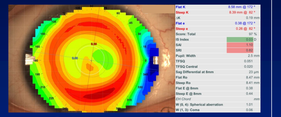

Figure 9. Axial map of the right eye post-treatment 1 week. 6.8mm BOZD.
+2.59 um change in SA from baseline.

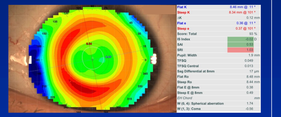

Figure 10. Axial map of the left eye post-treatment 1 week. 6.0mm BOZD.
+3.70 um change in SA from baseline.

Conclusion

While pediatric patients may be more likely to accept a higher degree of higher order aberrations associated with the plus power induced within the pupil by ortho-k lens wear, adults have more difficulty adjusting to the HOAs that occur with myopia controlling back optic zone diameter.[3] Designing a custom OK lens allows for specific parameters that match the patient's corneal shape. Assuming that refractive error stabilizes by early twenties, incorporating OK for the purpose of myopia correction using a > 6.0mm BOZD can be considered for those wanting daytime freedom from visual correction, live an active lifestyle, or have ocular surface disease.

References

1. Biyue Guo, Sin Wan Cheung, Randy Kojima, Pauline Cho; Myopia control effect of small back optic zone diameter orthokeratology lenses over two years. Invest. Ophthalmol. Vis. Sci. 2022;63(7):1464.
2. Lau JK, Vincent SJ, Cheung SW, Cho P. Higher-Order Aberrations and Axial Elongation in Myopic Children Treated With Orthokeratology. Invest Ophthalmol Vis Sci. 2020;61(2):22.
3. Ren Q, Yang B, Liu L, Cho P. Orthokeratology in adults and factors affecting success: Study design and preliminary results. Cont Lens Anterior Eye. 2020;43(6):595-601.