What do we know about the shape of the peripheral cornea?

Randy Kojima, Patrick Caroline, Matthew Lampa OD, Mari Fujimoto OD, Mark Andre, Beth Kinoshita OD, Sissi He OD

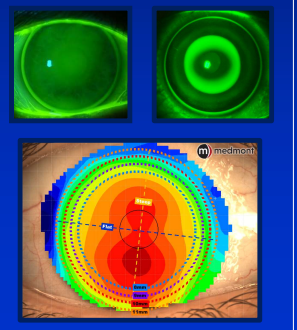
Pacific University College of Optometry, Forest Grove, Oregon

Introduction

Both corneal GPs and orthokeratology lenses have increased in diameter over their history. Today we are fitting larger lenses that land farther out on the cornea, with the goal being to improve stability, centration, comfort and performance. When increasing lens diameter, does the alignment zone or peripheral curve system need to change? What do we know about the shape of the outer cornea and if it alters from the mid-periphery to the periphery? This study set out to better understand topographical differences in corneal shape across various chord diameters.

Methods

This retrospective study evaluated 143 consecutive patients that presented for orthokeratology treatment in Q1 of 2020. Inclusion criteria required that the subject's baseline topographies must provide flat and steep meridian data to an 11.0mm chord diameter. From this cohort, 164 eyes were eligible for inclusion. The anterior surface topographic eccentricity was collected along an 8, 9, 10 and 11mm chord diameter for the flat and steep meridians (Medmont Corneal Topographer).

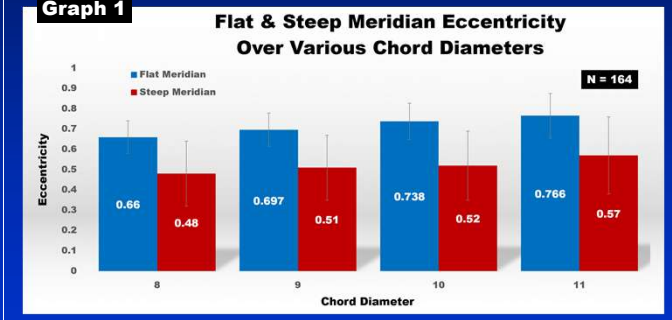


Flat and Steep meridian eccentricity data collected at 8, 9, 10 & 11mm chord diameters

Results

The collected data is displayed below on Graph 1. The Flat Meridian data is presented in blue and the Steep Meridian data in red for the four chord diameters of measure.

Graph 1



Discussion

This study found the rate of flattening increases with larger chord diameters of measurement for both the flat and steep meridians. In other words, the peripheral cornea does not exhibit a constant eccentricity. Rather, there is an increasing rate of change through the mid-peripheral and peripheral cornea which reached statistical significance in both meridians (Flat: $P = 0.002$, Steep: $P = 0.033$). To determine if these eccentricity differences would impact lens construction, three globally branded orthok lens fitting modules were employed to calculate lens parameters. Based on a median radius eye of 7.80mm (43.25Dp), the differences in eccentricity between chords would suggest the parameter compensations listed in Table 1.

Table 1: Calculated Zone Adjustments

Reverse zone Adjustment:
Lens 1 -Height or Depth: 4 microns
Lens 3 -Radius: 0.037mm

Alignment Zone Adjustment:
Lens 1 -Tangent angle: 0.24 degrees
Lens 2 -Radius: 0.043mm

Peripheral Curve Adjustment:
Lens 3 -Radius: 0.213mm

These zone adjustments might be considered small and possibly clinically insignificant when comparing chords separated by 1mm. However, when comparing chords that are ≥2mm, these differences would be expected to have clinical significance.

Conclusion

When increasing the diameter of corneal GP or orthok lenses, this study would suggest parameter compensation needs to be made both for the increased lens size but also for the higher rate of flattening of the peripheral cornea. Further in vivo testing would be recommended.

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