Does Age Influence the Relationship Between Corneal and Refractive Astigmatism?

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Introduction

The tissue changes in orthokeratology (OK) occur secondary to fluid beneath the lens that creates a hydraulic force that alters the shape and density of the corneal epithelium. The hydraulic forces result in geographically specific tissue changes (thinning apically and thickening mid peripherally) (Fig. 1). The epithelial changes are dictated by:

1. the posterior design/shape of the lens
2. the presence of a semi-closed, fluid-filled reservoir beneath the lens.

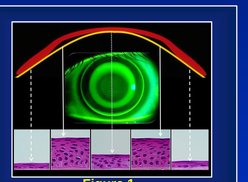


Figure 1

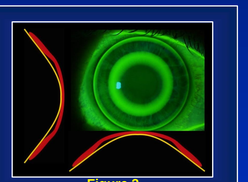


Figure 2

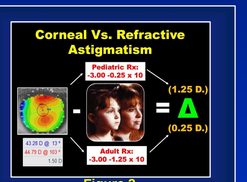


Figure 3

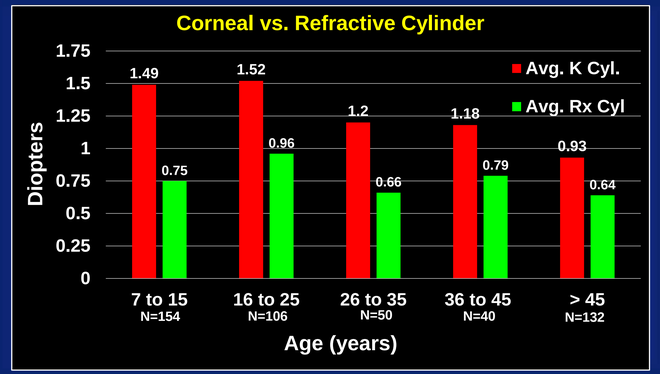
To create the semi-closed system and maintain the hydraulic forces beneath the lens, it is often necessary to design OK lens with a toric landing/alignment zone that seals the fluid reservoir both horizontally and vertically (Fig. 2).

Historically, clinicians have used patients' refractive cylinder as a guide to determine if a toric OK design is indicated. However, we have observed that children show a higher differential between their corneal and refractive astigmatism compared with adults (Fig. 3). This study sought to determine how age influences the relationship between corneal and refractive astigmatism.

Methods

Retrospective data on 241 subjects (482 eyes) free of corneal or refractive pathology were analyzed. Corneal topography (Medmont E300) and manifest refractive data were collected. Patients were separated into five age groups (Fig. 4). The differences between corneal and refractive astigmatism were compared by age.

Results



The results of this study indicate that younger subjects display greater corneal versus refractive astigmatism/cylinder. While older subjects display a more similar corneal to refractive astigmatism/cylinder.

Discussion

This study suggests that refractive cylinder may be a poor guide in determining whether or not a child may require a toric OK lens design. The fit of an OK lens is influenced most by the height of the cornea along the principle meridians. Therefore, corneal height data at a chord of approximately 8.0 mm (where the lens lands) may provide the best guide in determining the need for toric OK lenses.

If we use a corneal height differential of 25 microns (difference in height between the principle meridians) as a guide to determine when a toric OK lens is indicated, then even though the youngest and oldest subjects had similar refractive cylinder values (0.75 D. and 0.64 D., respectively):

1. 60% of eyes in the subjects less than 16 years of age would require a toric OK lens.
2. 30% of eyes in the subjects 46 years of age or greater would require a toric OK lens.

Therefore, if children have higher corneal versus refractive astigmatism, does this indicate that the adaptability of the crystalline lens may play a greater role in neutralizing the corneal cylinder in children? Conversely, do adults require greater cylinder correction due to crystalline lens changes with age?

Conclusions

If our study population represents that of the general population, the results indicate that a majority of children under the age of 16, who are candidates for orthokeratology, might benefit from a toric OK lens design.