

## INTRODUCTION

- During myopic orthokeratology (OK), the central cornea is flattened and the paracentral cornea is steepened by the overnight use of rigid contact lenses of reverse geometry design. The central flattened zone is often referred to as the treatment zone (TZ).
- In order to provide good vision to the patient, the TZ must not only be large enough to encompass the pupillary area but also be well-centered, as a decentered TZ during myopic OK has been shown to increase higher order aberrations and decrease contrast sensitivity.<sup>1</sup>
- The TZ is calculated from corneal topographic maps by subtracting the pre-OK treatment from the post treatment topography. Previous studies determined TZ parameters from different types of maps including axial<sup>2</sup>, tangential<sup>3</sup> or refractive power maps.<sup>1</sup> However, the type of map chosen to display the difference maps may influence measured TZ parameters.

## PURPOSE

- To compare TZ parameters following OK treatment derived from axial, tangential and refractive power maps.

## METHODS

### SUBJECTS

- 19 subjects (6M, 13F; 28 ± 7 years) aged between 20 and 41 years were enrolled in this prospective study.
- Inclusion criteria:
  - Myopia between 1.00 and 4.00 D and astigmatism ≤1.50D.
  - non-rigid contact lens wearers.
- Soft contact lens wearers were instructed to cease lens wear for 24 hours before study.

### STUDY DESIGN

- Subjects were fitted with BE OK lenses (Capricornia Contact Lens, Australia) according to manufacturer's guidelines in both eyes.
- Lens specifications: Boston XO<sub>2</sub> material (B+L Boston, USA; Dk 141 ISO/Fatt); with optic zone diameter of 6.00 mm and total lens diameter of 11.00 mm.
- Study measurements were taken at baseline before lens wear, and after 14 nights of OK treatment. Results from the right eye only are reported.

### STUDY MEASUREMENTS

- Corneal topography was captured using the Medmont-E300 corneal topographer (Melbourne, Australia).

### Determination of TZ:

- A custom written Matlab (The MathWorks, Inc, Version 7.12) program was used to read the raw topography data derived from the topographer.
- The program calculated axial, tangential and refractive power difference maps by subtracting baseline from post wear topographic data.
- TZ edge was defined as the point of no change in power on the difference map measured from the center of the entrance pupil. Twelve such points were located on 6 meridians separated by 30 degrees.
- A best fit ellipse was fitted to these edge points and the distance of the geometric center of the TZ from the center of the entrance pupil was defined as TZ decentration.
- TZ diameter was defined as the distance between two zero power change locations through the map center, along the horizontal and vertical meridians.

### ANALYSIS

- Shapiro-Wilk test: To test parametric distribution of data sets.
- Paired t-test or Wilcoxon signed-rank test: To assess changes in central refraction and corneal topographic parameters.
- Analysis of variance (ANOVA): To determine differences in TZ parameters between map types. Where ANOVA was significant, post hoc pairwise comparisons were made with Bonferroni correction.

## RESULTS

- Baseline and post OK central refraction and corneal topographic parameters are given in Table 1.

	M (D)	J <sub>180</sub> (D)	J <sub>45</sub> (D)	r <sub>o</sub> (mm)	Flat K (D)	Steep K(D)
Baseline	-1.54 ± 0.77	-0.11 ± 0.17	0.00 ± 0.12	7.80 ± 0.22	43.10 ± 1.18	43.78 ± 1.22
Post OK	+0.23 ± 0.63	-0.18 ± 0.22	+0.03 ± 0.19	8.18 ± 0.24	41.53 ± 0.96	42.37 ± 1.01
Significance	p = 0.020*	p = 0.157	p = 0.501	p < 0.001*	p < 0.001*	p < 0.001*

Table 1. Refraction and topographic parameters at baseline and after 14 days of OK treatment. Asterisks indicate statistically significant change over time.

- TZ parameters derived from three types of maps are given in Table 2.

	Axial Power Map	Tangential Power Map	Refractive Power Map	Significance (ANOVA)
TZ decentration (mm)	0.79 ± 0.29	0.54 ± 0.23	0.77 ± 0.28	p = 0.013*
Horizontal TZ diameter (mm)	5.58 ± 0.67	3.67 ± 0.39	5.45 ± 0.57	p < 0.001*
Vertical TZ diameter (mm)	5.67 ± 0.60	3.67 ± 0.39	5.48 ± 0.46	p < 0.001*

Table 2. TZ parameters derived from axial, tangential and refractive power maps. Asterisks indicate statistically significant difference between maps.

- The decentration was largest for the axial power map and smallest for the tangential power map. Post hoc pairwise comparisons showed a significant difference in the TZ decentration between axial and tangential power maps (0.25 ± 0.15 mm, p = 0.022) but no significant difference between axial and refractive power maps (0.02 ± 0.02 mm, p > 0.999).

- The horizontal TZ diameter was largest for the axial power map and smallest in the tangential power map. Post hoc pairwise comparisons showed a significant difference in the horizontal TZ diameter between axial and tangential power maps (1.91 ± 0.47 mm, p < 0.001) but no significant difference between axial and refractive power maps (0.13 ± 0.45 mm, p > 0.999).
- The vertical TZ diameter was largest for the axial power map and smallest for the tangential power map. Post hoc pairwise comparisons showed a significant difference in the vertical TZ diameter between axial and tangential power maps (1.99 ± 0.51 mm, p < 0.001) but no significant difference between axial and refractive power maps (0.19 ± 0.50 mm, p > 0.999).
- An example to compare TZ from the three types of difference maps obtained from the same subject is given in Figure 1.

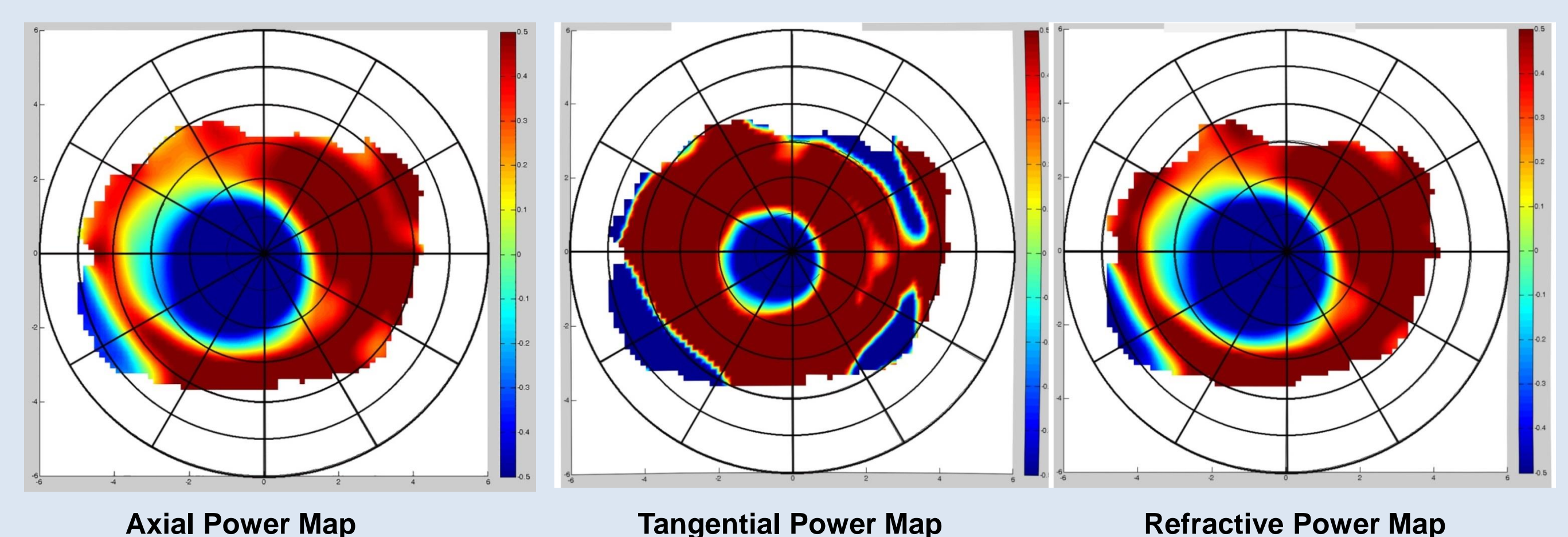


Figure 1. Difference maps derived from axial, tangential and refractive power maps. The blue zone indicates flattening or reduction in the power of the cornea and the red zone indicates steepening or increase in the power of the cornea.

## DISCUSSION AND CONCLUSIONS

- This study shows that the type of corneal topographic map chosen to analyze TZ parameters after OK significantly affects the dimensions of the TZ.
- TZ centration and TZ diameter are significantly less if tangential power maps are used as opposed to axial or refractive power maps.
- TZ decentration and horizontal TZ diameter reported in this study are consistent with previous studies.<sup>2-4</sup>
- Clinicians must be cautious when comparing TZ parameters derived from different types of topographic maps.

## REFERENCES

1. Hiraoka T et al. *JCRS* 2009; **35**: 1918-26
2. Tahhan N et al. *Optom Vis Sci* 2003; **80**: 796-804.
3. Lu et al. *Optom Vis Sci* 2007; **84**: 349-56.
4. Sridharan et al. *Optom Vis Sci* 2003; **80**: 200-06.

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