Comparison of Peripheral Refraction with Single Vision and Multifocal Center Distance Soft Contact Lenses

Frank Spors*, **Jie Shen**, **Angeline Ngo**, **Dorcas K. Tsang** and **Lance E. McNaughton**
Western University of Health Sciences, College of Optometry, Pomona, California
*fspors@westernu.edu

Introduction

Although some controversy exists in the literature, several studies indicate that myopia progression control is achieved in the presence of a characteristic retinal refractive profile, which involves peripheral myopic defocus. [1, 2]
Currently, two contact lens systems provide such profiles: orthokeratology, which utilizes rigid contact lenses, and soft multifocal contact lenses with an annular center distance design. [3, 4]
A robust body of literature exists about retinal refractive profiles and myopia progression control potentials of orthokeratology and multifocal soft contact lenses. [5]
The *ArtMost SoftOK®* represents a new category of contact lens, which combines design features of an orthokeratology lens with a soft hydrogel contact lens material. No information exists about the retinal refractive profile produced by this contact lens.

Purpose

We determined changes of peripheral refraction at the nasal retina (temporal visual field) with several corrective power values when wearing various designs of commercially available single vision and multifocal soft contact lenses.

Materials and Methods

Instrumentation and set-up

Using a commercial COAS Shack-Hartmann aberrometer, we measured wavefront aberrations (**Fig. 1**) without and with soft contact lenses in an adult subjects right eye. Starting at the patients fovea, we conducted the measurements in 10°increments, extending out to 30°nasal retinal eccentricity.

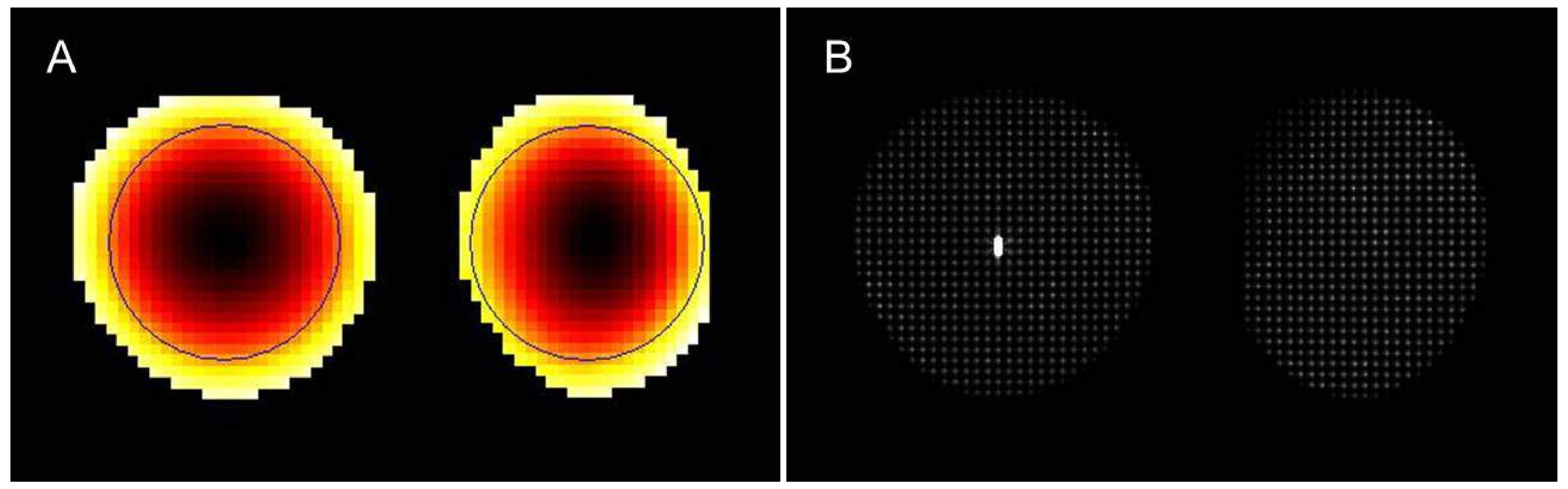

Figure 1: (A) COAS wavefront aberrometry maps of a central measurement (left) and a peripheral measurement (right); (B) Hartmann patterns, detected at a round pupil (left) and an oval pupil (right)

Contact lenses

We fitted three different types of contact lenses:

- *Acuvue Oasys®* Single Vision (*Johnson & Johnson Vision Care*) - **ASV**
- *Proclear®* Multifocal D with +2.50 D add power (*Coopervision*) - **PMD**
- *ArtMost SoftOK®* (*Shinyeyes*) - **SOK**

Each lens type was assessed with corrective power values of -2.00 D, -4.00 D and -6.00 D, and was allowed to settle for 10 minutes prior to the aberrometry measurements.

Data analysis

We calculated power changes at 10°, 20°, and 30°nasal retinal eccentricities, induced by the different lenses for power vector values Defocus M, With-the-rule (WTR)/Against-the-rule (ATR) astigmatism J_0 and Oblique astigmatism J_{45} by reducing corresponding baseline measurements. In addition, M was computed as a relative value. To analyze the data, we performed repeated-measures ANOVA and Dunnett's multiple comparsion test, with the lenses grouped per lens type. For data visualization, we created line plots showing mean changes per lens type and changes by individual lenses. (**Fig. 2, 3, 4**)

Results

Defocus M

When grouped by lens type, statistically significant changes were produced by ASV lenses (**Fig. 2A**) and SOK lenses (**Fig. 2C**), ($p = 0.03$ and 0.02, respectively); not by PMD lenses (**Fig. 2B**) ($p = 0.71$).

- ASV lenses produced a slight relative myopic defocus at 30°retinal eccentricity (-0.32 D ±0.05) without a significant difference between the various lens power values.
- SOK lenses produced significant relative myopic defocus at 20°(-0.61 D ±0.08) and 30°(-1.42 D ±0.15) retinal eccentricity, without significant difference between the various lens power values.

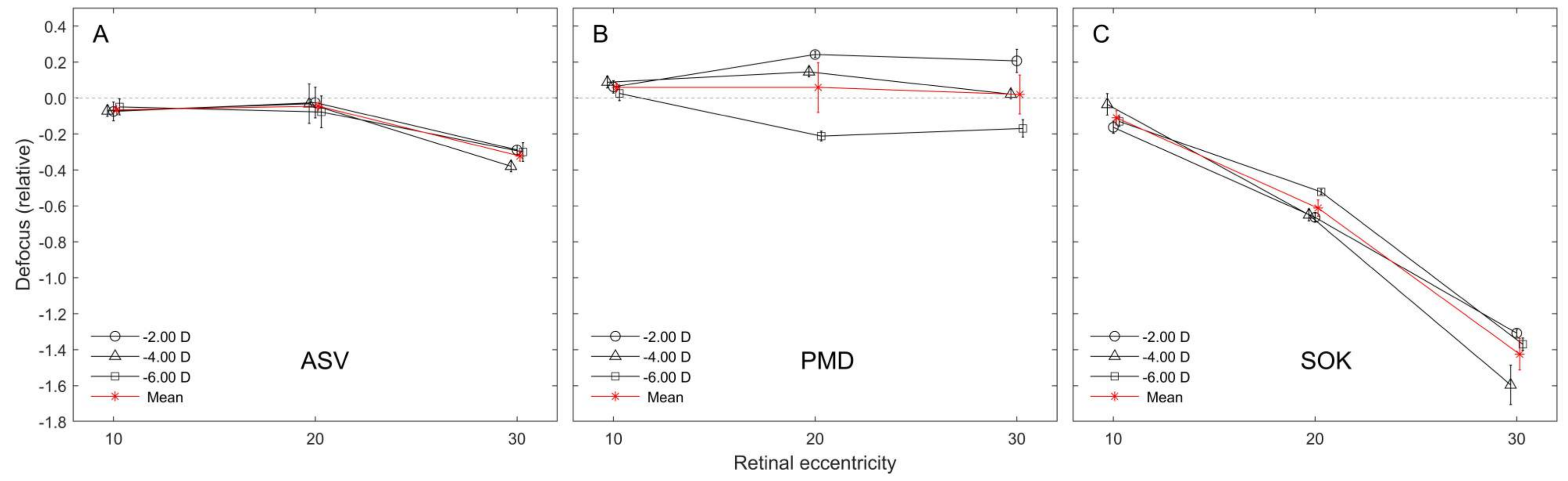

Figure 2: Relative **Defocus** M in diopters, with 3 different contact lens types, each having distance power values of -2.00, -4.00 and -6.00 D, at various degrees of nasal retinal eccentricity. Black line plots show individual lens data. Red line plots show mean data per lens type.

WTR/ATR astigmatism J_0

When grouped by lens type, statistically significant changes were produced by ASV lenses (**Fig. 3A**) and SOK lenses (**Fig. 3C**), ($p < 0.01$ and $= 0.03$, respectively); not by PMD lenses (**Fig. 3B**) ($p = 0.22$).

- ASV lenses slightly impacted J_0 astigmatism at 30°retinal eccentricity (+0.15 D ±0.05).
- PMD lenses did not statistically significantly change J_0 astigmatism when grouped by lens type, however, the -6.00 D lens impacted J_0 at 20°(+0.26 D) and 30°(+0.41 D) retinal eccentricity.
- SOK lenses significantly impacted J_0 astigmatism at 30°retinal eccentricity (-0.71 D ±0.09). In addition, the -6.00 D lens impacted J_0 at 20°retinal eccentricity (-0.25 D).

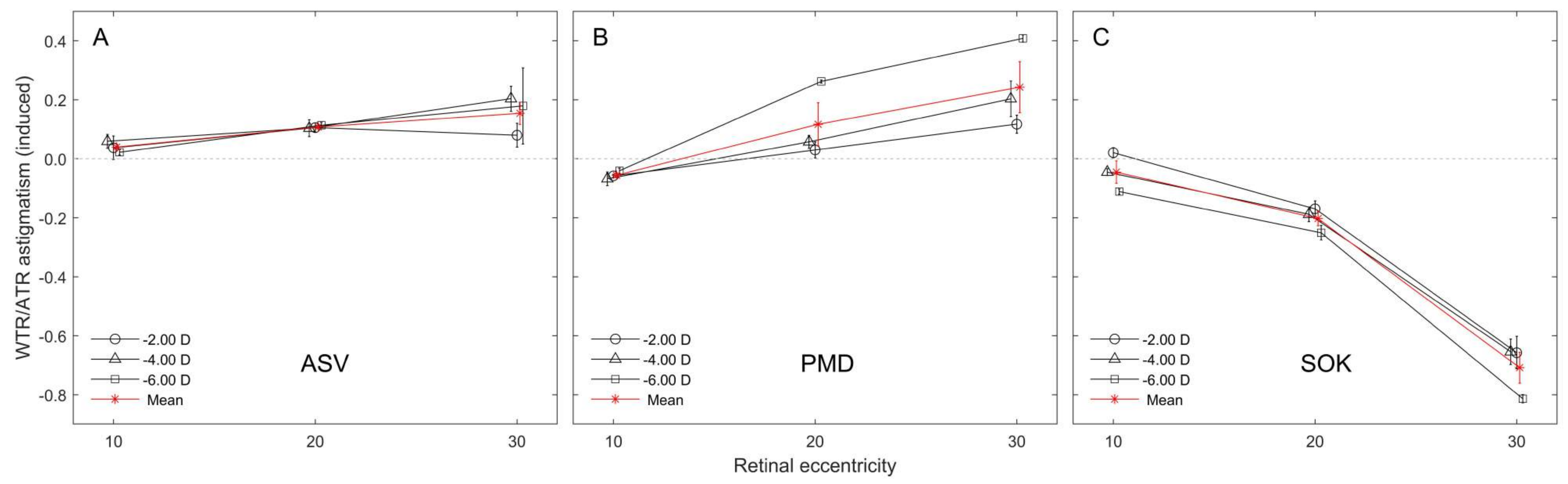

Figure 3: Induced **WTR/ATR astigmatism** J_0 in diopters, with 3 different contact lens types, each having distance power values of -2.00, -4.00 and -6.00 D, at various degrees of nasal retinal eccentricity. Black line plots show individual lens data. Red line plots show mean data per lens type.

Oblique astigmatism J_{45}

When grouped by lens type, statistically significant changes were produced by SOK lenses (**Fig. 4C**), ($p = 0.03$); not by ASV lenses (**Fig. 4A**) and PMD lenses (**Fig. 4B**) ($p = 0.07$ and 0.83, respectively).

- Although not statistically significant when grouped, ASV lenses with -4.00 D and -6.00 D power did increase J_{45} astigmatism at 30°retinal field by -0.26 D.
- SOK lenses only significantly impacted J_{45} astigmatism at 30°retinal field for the -6.00 D power value, which increased J_{45} by -0.27 D.

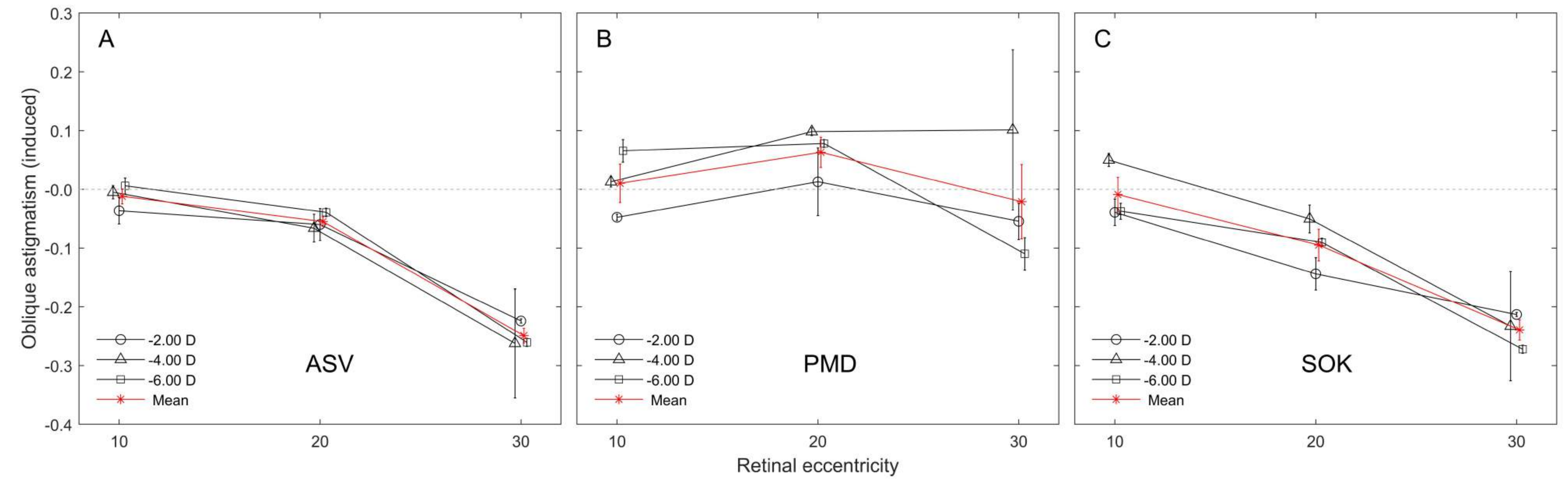

Figure 4: Induced **Oblique astigmatism** J_{45} in diopters, with 3 different contact lens types, each having distance power values of -2.00, -4.00 and -6.00 D, at various degrees of nasal retinal eccentricity. Black line plots show individual lens data. Red line plots show mean data per lens type.

Conclusions

For a particular lens type, changes of peripheral refraction in the nasal retina were independent from central corrective power values of individual lenses.
SOK lenses demonstrated the strongest capability in producing relative peripheral myopic defocus at the outer nasal retinal periphery. However, this lens type also induced higher amounts of peripheral against-the-rule (ATR) astigmatism.
More studies are needed to assess a wider variety of soft contact lens designs with respect to their impact on peripheral refraction.

References

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