Role of Optic Zone Diameter on Spherical Aberrations in Orthokeratology: A Pilot Study

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Introduction

It is known that the incidence of myopia is on the rise globally. It is also known that an axial length greater than 26.0 mm increases the risk of developing devastating ocular complications. While there are many interventions available for slowing axial elongation, this study focuses on orthokeratology. The purpose of this pilot study is to further explore the relationship between optic zone diameter of reverse geometry lenses and measured corneal spherical aberration induced by overnight orthokeratology.

Methods

This pilot study included three adult subjects that were fit into reverse geometry lenses for the purpose of overnight orthokeratology. Inclusion criteria consisted of subjects with refractive errors between -1.00 D and -6.00 D with less than -1.50 D of astigmatism, simple refraction errors between right and left eyes, and a lack of corneal pathology. Subjects reported for a baseline visit, a dispensing visit, one-day follow-up, one-week follow-up, and one-month follow-up. At the day of the one-day and one-week follow-up visits, wavefront aberrometry data were collected using the Medmont and Nidek OPD-Scan III. Corneal topography subtractive maps were repeated at the day of the one-day and one-week follow-up visits. At the one-month follow-up visit, all three subjects had no complications reported related to the fellow eye with the larger optic zone diameter over a one-month follow-up visit. Baseline corneal wavefront spherical aberrometry of the 4th order was compared to the one-week post-orthokeratology data collected over a 4.0 mm, 5.0 mm, and 6.0 mm pupil.

Results

Topography:

Figure 1: This figure shows the axial subtractive map for the right eye of subject A wearing the 5.0 mm OZD lens. The treatment zone for the left eye of subject A is 3.75 D of flattening after one-week of overnight orthokeratology wear.

Figure 2: This figure shows the axial subtractive map for the left eye of subject A wearing the 6.0 mm OZD lens. The treatment zone for the left eye of subject A is 3.99 D of flattening after one-week of overnight orthokeratology wear.

At the one-month follow-up visit, all three subjects had centered treatment zones with similar amounts of flattening between their right and left eyes as measured by the corneal topography subtractive map. A general trend showed that the eye wearing the lens with a smaller optic zone diameter had incurred a larger amount of corneal spherical aberrations compared to the fellow eye with the larger optic zone diameter over a 4.0 mm, 5.0 mm, and 6.0 mm pupil size. Additionally, there were no complications reported related to overnight orthokeratology lens wear.

Table 1: This table lists the corneal spherical aberration data collected from the NIDEK OPD Scan III. Note that for Subject B the 4 mm OD, Mari Fujimoto OD FAAO, Randy Kojima FAAO, Patrick Caroline FAAO, Matthew Lampa OD FAAO, Mark Andre FAAO, Beth Kinoshita OD FAAO

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Discussion

It appears that a higher amount of corneal spherical aberration is induced into the optical system with a smaller optic zone diameter. Other studies have suggested that increased spherical aberrations contribute to better myopic control and slowing of axial elongation. Should we be designing all orthokeratology lenses (for myopia control) with a smaller optic zone diameter to increase the amount of corneal spherical aberration?

Table 1. This table lays out the corneal spherical aberration data collected from the NIDEK OPD Scan III.

<table>
<thead>
<tr>
<th>Subject</th>
<th>OZD</th>
<th>Pupil</th>
<th>Difference</th>
<th>Difference</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>OD: 5.0mm</td>
<td>0.040</td>
<td>0.516</td>
<td>0.200</td>
<td>0.516</td>
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<tr>
<td>1 week</td>
<td>OD: 5.0mm</td>
<td>0.296</td>
<td>0.754</td>
<td>1.030</td>
<td>0.754</td>
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<td>Difference</td>
<td>OD: 5.0mm</td>
<td>0.256</td>
<td>0.238</td>
<td>1.230</td>
<td>0.238</td>
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<tr>
<td>Baseline</td>
<td>OD: 6.0mm</td>
<td>0.026</td>
<td>0.530</td>
<td>0.504</td>
<td>0.530</td>
</tr>
<tr>
<td>1 week</td>
<td>OD: 6.0mm</td>
<td>0.036</td>
<td>0.819</td>
<td>0.783</td>
<td>0.819</td>
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<tr>
<td>Difference</td>
<td>OD: 6.0mm</td>
<td>0.010</td>
<td>0.290</td>
<td>0.280</td>
<td>0.290</td>
</tr>
</tbody>
</table>

Table 2. This table lays out the corneal spherical aberration data collected from the NIDEK OPD Scan III. Note that for Subject B the 4 mm OD, Mari Fujimoto OD FAAO, Randy Kojima FAAO, Patrick Caroline FAAO, Matthew Lampa OD FAAO, Mark Andre FAAO, Beth Kinoshita OD FAAO

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References