Changes in Corneal and Total wavefront aberrations in Phakic and Pseudophakic Eyes

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No financial interest

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Purpose

A lot of pseudophakic eyes suffer from visual disturbance even after removal of capsular opacities

Are higher order optical aberrations increased in pseudophakic eyes compared to phakic?
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Method

Measurement of Corneal and total wave front aberration in Phakic and Pseudophakic eyes and compare them from 2\textsuperscript{nd} up to 6\textsuperscript{th} order Zernike Coefficients
Method

Group 1

Twenty nine Pseudophakic eyes
Acrysoft®, monofocal, AlconLabs
Measurement at least 2 months postoperatively
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Method

Group 2

Thirty three normal eyes
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Demographic and clinical data

<table>
<thead>
<tr>
<th></th>
<th>Pseudophakic</th>
<th>Phakic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>67 ± 11 years</td>
<td>39 ± 9 years</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>M: 14</td>
<td>M: 15</td>
</tr>
<tr>
<td></td>
<td>F: 14</td>
<td>F: 7</td>
</tr>
<tr>
<td><strong>Eye</strong></td>
<td>Right: 14, Left: 15</td>
<td>Right: 16, Left: 17</td>
</tr>
<tr>
<td><strong>Refraction</strong></td>
<td>Sph: -0.48 ± 0.95 D, Cyl: -1.06 ± 0.57D</td>
<td>Sph: -4.41 ± 2.76 D, Cyl: -0.84 ± 0.71D</td>
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</tbody>
</table>
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Method

Equipment
Corneal topography:
    Placido based Oculus Keratograph® 70600, Oculus Wetzlar, Germany

Total wavefront:
    Allegro WAVE Analyzer®, WaveLight Laser Technology, Erlangen, Germany
## Method

### Calculation

Total wave front aberrations as well as the corneal aberrations were expressed by Zernike coefficients.

### Data preparation

Plotting the total wavefront aberrations over the corneal wavefront aberrations in both groups for each Zernike coefficient.
Changes in Corneal and Total wavefront Aberrations Phakic and Pseudophakic Eyes

Method

Total wavefront aberration

- $m > 1$ (total aberration greater than corneal aberration)
- $m < 1$ (corneal aberration is partially compensated by other structures within the eye)

$m = 1$ (total aberration caused by corneal aberration)
Method

Correlation (R)

No significant correlation is found (p>0.05)
- Corneal aberration is totally compensated
- Total wavefront aberrations are caused by internal eye structures

or

Significant correlation (p<0.05)
Results

In C3 – C9 linear regression demonstrates a significant correlation between corneal aberrations and those of the entire eye.

The imaging errors of the total eye are determined mostly by the corneal aberration for these coefficients.
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

**Results**

**Phakic eyes**

- C3: Astigmatism
- C5: Astigmatism

$m<1$: Corneal aberration is partially compensated by other structures within the eye

Corneal aberration exceeds total Aberration
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Results

Pseudophakic eyes

_ C3: Astigmatism

_ C5: Astigmatism

m<1: Corneal aberration is partially compensated by other structures within the eye

m: closer to 1 than in phakic eyes (total aberration caused by corneal aberration)

Corneal aberration exceeds total Aberration
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Results

Phakic eyes
  _ C7: Coma
  _ C8: Coma

m<1: Corneal aberration is partially compensated by other structures within the eye

Corneal aberration exceeds total aberration
Changes in Corneal and Total wavefront Aberrations in Pseudophakic Eyes

**Results**

**Pseudophakic eyes**

- **C7**: Coma
- **C8**: Coma (not statistically significant)

- \( m < 1 \): Corneal aberration is partially compensated by other structures within the eye
- \( m \): closer to 1 than in phakic eyes. Difference in both groups are more moderate than in C3 and C5 (total aberration caused by corneal aberration)

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Results

Phakic eyes

_ C12: Spherical aberration

m<1: Corneal aberration is partially compensated by other structures within the eye

Corneal aberration exceeds total aberration
Results

Pseudophakic eyes

$C_{12}$: Spherical aberration

$m < 1$: Corneal aberration is partially compensated by other structures within the eye

Corneal aberration exceeds total aberration
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Results

Difference in Zernike coefficients between the corneal and total wavefront aberrations for the phakic group

Zernike Coefficient No.
Changes in Corneal and Total wavefront Aberrations in Phakic and Pseudophakic Eyes

Results

Difference in Zernike coefficients between the corneal and total wavefront aberrations for the pseudophakic group

Zernike Coefficient No.
Results

Phakic eyes:

In general corneal astigmatism (C3&C5), coma (C7&C8), and spherical aberrations (C12) exceeded the corresponding values for the total wavefront aberration.
Conclusion

Wave front analysis and corneal topography enable to determine the source of higher order aberration in phakic and pseudophakic eyes and can be useful for optimizing IOL designs.
Changes in Corneal and Total wavefront Aberrations in Normal and Phakic and Pseudophakic Eyes

Thank you for your attention
Phakic

Cornea

PseudoPhakic

Cornea

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