“Evaluation of the Geometry of the Anterior Segment of Postmortem Human Eyes with two Imaging Systems”

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Anterior Chamber
Phakic Intraocular Lens Designs

Two major concerns:
- Interaction with corneal endothelium
- Pupil ovalization

Courtesy: Dr. G. Baikoff, Marseilles, France

Cataract Formation after Implantation of Phakic Posterior Chamber IOLs

Courtesy: Dr. P. Koch, Koch Eye Surgicenter, Inc., Warwick, RI, USA

ICL – Pigment Deposition/Dispersion

Case of Dr. R. Gerl, Germany
3-9 o’clock

11.75 ± 0.43
11.88 ± 0.25
11.32 ± 0.34


INTRODUCTION

• Rotation of angle-fixated or posterior chamber phakic IOLs: IOL maller than the axis of fixation, until it finds a more stable position*

• Internal dimensions of the eye anterior segment may be significantly different, if different meridians are measured


OBJECTIVE

• Measure internal dimensions of the human eye along 4 different meridians

1. High-frequency ultrasonography: Artemis 2 (Ultralink LLC); 50 MHz
2. Anterior segment optical coherence tomography (OCT); slitlamp-adapted system (SL-OCT, Heidelberg Engineering)

MATERIAL AND METHODS: ULTRASOUND STUDY

20 human eyes obtained postmortem
Fixation in 10% neutral buffered formalin
John A. Moran Eye Center, University of Utah

MATERIAL AND METHODS: ULTRASOUND STUDY
MATERIAL AND METHODS:
ULTRASOUND STUDY

- 24 human eyes obtained postmortem
- Fixation in 10% neutral buffered formalin
- Berlin Eye Research Institute

OCT STUDY

- Angle-to-angle dimensions (microns); 24 human cadaver eyes; anterior segment optical coherence tomography; 4 meridians

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean +/- SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP length (mm)</td>
<td>23.97 +/- 0.60</td>
<td>22.81</td>
<td>25.27</td>
</tr>
<tr>
<td>AA vertical</td>
<td>11814.9 +/- 542</td>
<td>10959</td>
<td>12775</td>
</tr>
<tr>
<td>AA horizontal</td>
<td>11548.7 +/- 401</td>
<td>10819</td>
<td>12175</td>
</tr>
<tr>
<td>AA oblique 1</td>
<td>11631.0 +/- 522</td>
<td>10627</td>
<td>12350</td>
</tr>
<tr>
<td>AA oblique 2</td>
<td>11573.8 +/- 409</td>
<td>10840</td>
<td>12239</td>
</tr>
<tr>
<td>SS vertical</td>
<td>11107.4 +/- 563</td>
<td>10202</td>
<td>12123</td>
</tr>
<tr>
<td>SS horizontal</td>
<td>10889.4 +/- 489</td>
<td>10200</td>
<td>11957</td>
</tr>
<tr>
<td>SS oblique 1</td>
<td>10974.4 +/- 541</td>
<td>10098</td>
<td>11878</td>
</tr>
<tr>
<td>SS oblique 2</td>
<td>10900.2 +/- 480</td>
<td>10180</td>
<td>11755</td>
</tr>
</tbody>
</table>

AA in different meridians: P = 0.003 (Huynh-Feldt test for within-subjects differences)
SS in different meridians: P = 0.009 (Huynh-Feldt test for within-subjects differences)

• Drawbacks of studies with human cadaver eyes:
  - Post-mortem changes
  - Variations in enucleation/fixation time
  - Shrinkage due to fixation
  - Difficulty in controlling intraocular pressure

• Confirmation of results in patients

DISCUSSION
CONCLUSIONS

- Human eye not geometrically round:
  - Postoperative rotation of phakic lenses ("
  - Differences significant for IOL sizing/manufacture ("

- Largest measurements: ("

Clinical Study with Dr. Carlo Lovisolo (Milan, Italy)

- 50 eyes of living patients
- High-frequency (50 MHz) digital ultrasound system: Artemis (Ultralink)

<table>
<thead>
<tr>
<th>Eyes (N = 50)</th>
<th>Meridian 1: AA</th>
<th>Horizontal SS</th>
<th>Meridian 2: AA</th>
<th>Vertical SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Mean +/- SD</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Oblique 2</td>
<td>11049.3 +/- 546.66</td>
<td>11670.96 +/- 491.00</td>
<td>11226.66 +/- 527.08</td>
<td>11830.38 +/- 540.17</td>
</tr>
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<td>11049.3 +/- 546.66</td>
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</tr>
<tr>
<td>Meridian 3:</td>
<td>11109.62 +/- 492.55</td>
<td>11645.24 +/- 444.12</td>
<td>11088.14 +/- 501.38</td>
<td>11641.36 +/- 407.62</td>
</tr>
<tr>
<td>Meridian 4:</td>
<td>11109.62 +/- 492.55</td>
<td>11645.24 +/- 444.12</td>
<td>11088.14 +/- 501.38</td>
<td>11641.36 +/- 407.62</td>
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Mean +/- SD (N = 50)

AA in different meridians: P = 0.001 (Huynh-Feldt test)
SS in different meridians: P < 0.001 (Huynh-Feldt test)

Other Clinical Studies in the Literature

  - 28 eyes of 14 patients; Artemis (Ultralink)
  - Sequential meridional scan planes at 30 degrees increments
  - Circular statistics used to compare the orientation of the largest diameter
  - General trend for orientation of the meridian of largest diameter: horizontal meridian

  - 36 eyes: OCT system (Carl Zeiss, Meditec)
  - Vertical, horizontal and 2 major oblique anterior chamber diameters
  - Horizontal and vertical diameters: 12.10 +/- 0.40 and 12.40 +/- 0.45 mm
  - Statistical analyses of the data not provided

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