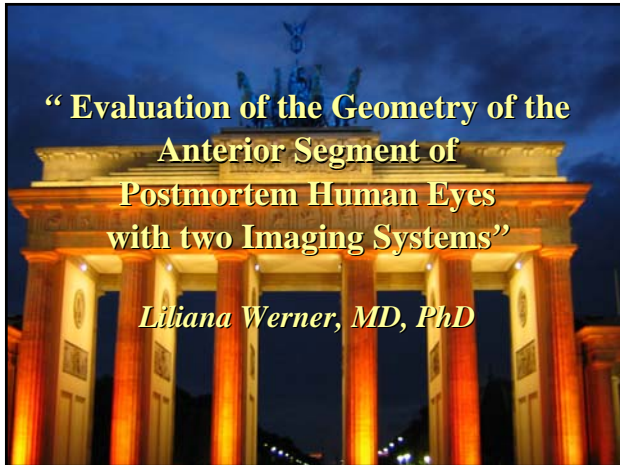


**“ Evaluation of the Geometry of the Anterior Segment of Postmortem Human Eyes with two Imaging Systems”**


*Liliana Werner, MD, PhD*



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John A. Moran Eye Center  
University of Utah  
Salt Lake City, UT, USA



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**Anterior Chamber Phakic Intraocular Lens Designs**

Two major concerns:

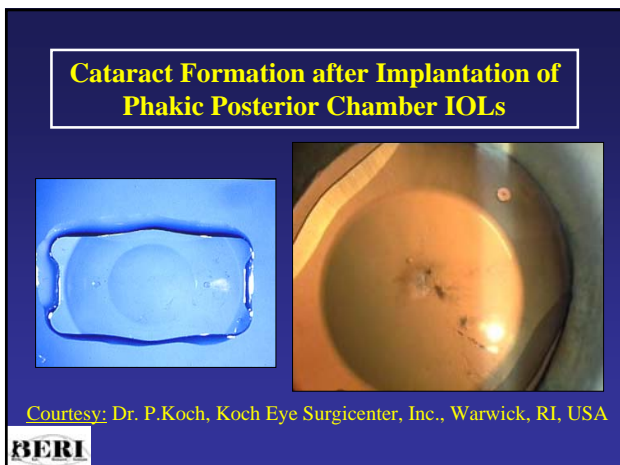
- Interaction with corneal endothelium
- Pupil ovalization

Courtesy:  
Dr. G. Baikoff,  
Marseilles, France

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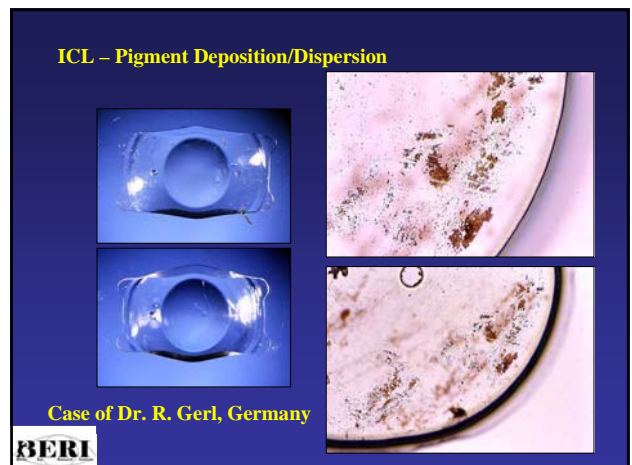
**Cataract Formation after Implantation of Phakic Posterior Chamber IOLs**



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

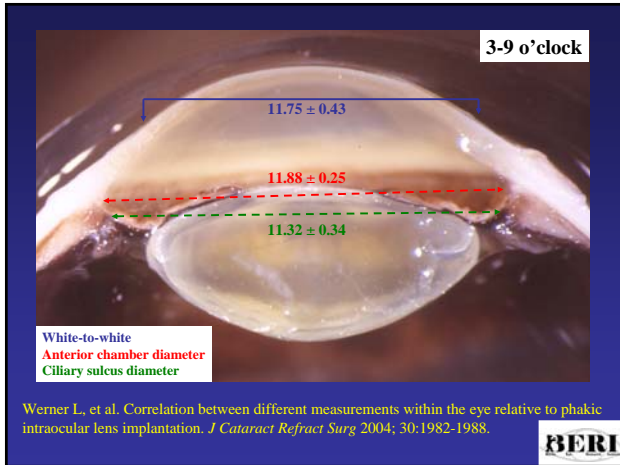
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**ICL – Pigment Deposition/Dispersion**



Case of Dr. R. Gerl, Germany

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## 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

\*Baumeister M, Terzi E, Ekici Y, Kohnen T. Comparison of manual and automated methods to determine horizontal corneal diameter. *J Cataract Refract Surg* 2004; 30:374-380.

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## 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)

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## MATERIAL AND METHODS: ULTRASOUND STUDY

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

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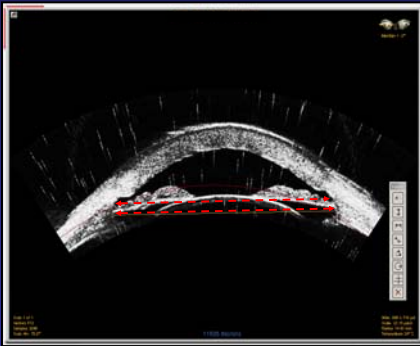
## MATERIAL AND METHODS: ULTRASOUND STUDY

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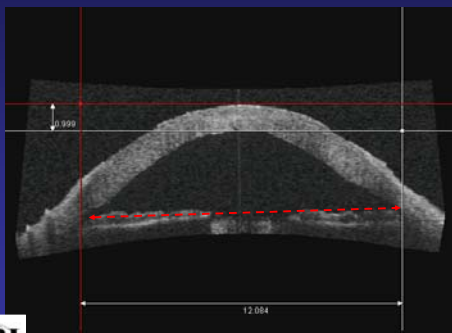
## MATERIAL AND METHODS: OCT STUDY



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

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## MATERIAL AND METHODS: OCT STUDY



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Angle-to-angle and sulcus-to-sulcus dimensions (microns); 20 human cadaver eyes; high-frequency ultrasound; 4 meridians

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

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AA in different meridians:  $P = 0.002$  (Huynh-Feldt test for within-subjects differences)  
SS in different meridians:  $P = 0.009$  (Huynh-Feldt test for within-subjects differences)

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

Parameter	Mean +/- SD	Minimum	Maximum
AP length (mm)	24.41 +/- 0.64	23.00	25.90
AA vertical	11205.0 +/- 583	10517	12778
AA horizontal	11287.5 +/- 472	10591	12295
AA oblique 1	11107.0 +/- 476	10380	12274
AA oblique 2	11160.0 +/- 524	10412	12652

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AA in different meridians:  $P = 0.005$  (Huynh-Feldt test for within-subjects differences)

## DISCUSSION

- 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*

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

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

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

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

- Rondeau MJ, et al. Very high frequency ultrasound biometry of the anterior and posterior chamber diameter. *J Refract Surg* 2004; 20:454-464.
- 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
- Baikoff G, et al. Measurement of the internal diameter and depth of the anterior chamber: IOLMaster versus anterior chamber OCT. *J Cataract Refract Surg* 2005; 31:1722-1728.
- 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



## CONCLUSIONS

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



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