The Optical Evaluation of Monofocal and Multifocal IOLs in Clinically Verified Eye Models

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Comparison between Calculated and Measured IOL Performance

Through Focus MTF

ACE2 Eye Model
Pupil 3-mm
White light

1 M. van der Mooren, H. Weeber, and P. Piers
Verification of the Average Cornea Eye ACE Model
Comparison between Calculated and Clinical IOL Performance

Through Focus performance

Study with Pseudophakic patients:

- Contrast Sensitivity
  - Monofocal, spherical IOLs (Nio et al. 2003)
- Visual Acuity
  - Multifocal, spherical IOLs (Walkow et al. 2001)
Through Focus CSF

11 patients
Photopic CSF
1,2,4,8,16 cpd
6 defocus values
Pupil 2, 4 and 6 mm

Through Focus CSF

46 Eye Models

- Eyes from a cataract population data
  - Cornea Topography (Zernike description)
  - Axial length
  - K values
- Corneal astigmatism <1.5D

- Eye geometry used as input for OSLO
- Biconvex PMMA IOLs are placed:
  - IOL position determined by LHP concept
  - IOL power determined by SRK/T formula
- Add spectacles if needed.
Eye Models

1. IOL power selection (same method used by surgeons in lens selection)
2. Spectacle correction, based on image plane metrics.

LHP concept:
Resulting Spectacle Powers

MAE = 0.53 Diopters

≤0.5D: 67%
≤1.0D: 91%
Mimic the Clinical Test Setup

- Target distance of 2 meters
- Artificial pupil at 12 mm in front of the cornea
- Refraction with a wide pupil
- Through focus, using trial lenses

Metric for comparison: **Area under the log-log curve**
- Clinical situation: log CS – log frequency
- Eye models: log Modulation – log frequency
- Up to 16 cpd
- Normalized
Clinical Results

Nio et al.

Defocus [diopter]

Area under the Curve
Calculated Results for the 46 Eye Models

Defocus [diopter]

Area under the Curve
46 Eye Models versus Clinical Results

Normalized AUC [-]

Defocus [diopter]

Eye Models
Nio et al.
Eyes with Multifocal IOLs

Defocus Curves of Visual Acuity:

Walkow, 2001

Monocular
69 eyes
50 patients
IOL: PMMA Diffractive Bifocal

46 Eye models - Calculation of VA

Example: MTFs of eye model #1

Defocus:
- -2.75 D
- -2.06 D
- -1.38 D
- -0.69 D
- 0.00 D
- 2.06 D

Threshold
46 Eye models - Calculation of VA

Visual Acuity [logMAR]

Defocus [diopter]
46 Eye Models versus Clinical Results

Walkow 2001
46 Eye Models versus Clinical Results

![Graph showing visual acuity and defocus for eye models compared to Walkow 2001 results.](image)
Summary

• Eye models can give an estimate of through focus characteristics of pseudophakic eyes
  – Monofocal IOLs
  – Multifocal IOLs

• Further improvements may be possible by including:
  – Threshold info
  – Phase info
  – Non-optical info