The Promise of No Glasses or Contact Lenses!

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Financial Disclosure

- I have the following financial interests or relationships to disclose:
  - Abbott Medical Optics: C;
  - AcuFocus, Inc.: C,O;
  - Alcon Laboratories, Inc.: C;
  - ArcScan: C,O;
  - Carl Zeiss Inc: C;
  - Elsia: C,O;
  - Oculus, Inc.: C;
  - Visiometrics: C,O;
  - Wavetec: C;

Requirements

- Centration
- Accurate Biometry – Optical (IOL Master or LenStar)
- Accurate K’s- Repeatable
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism

Multifocal IOL

Optimal Location

- Cannot place on Pupil Center & Visual Axis (near P1) where axial ray is perpendicular to foveola.
- Optimal location is different for each patient and somewhere between Pupil Center & P1.
Horizontal Angle & Alpha & Kappa

Decentration: halos
Poor vision for far and near

Good centration, optimal optical performance?

Diffraction Rings are perfectly concentric with patient’s pupil

Incident light
Diffractive structures
Focal point 2
Focal point 1

Intensity of diffraction pattern

Grapher Pictorial
Regression plot between the photic phenomenon of haloes (x axis) and the kappa angle (y axis).

\[ R^2 = 0.26, \quad P = 0.029 \]

\[ N = 37 \]
\[ \text{Zero} = 25 \]
\[ \text{Non zero} = 12 \]

Regression plot between the photic phenomenon of glare (x axis) and the kappa angle (y axis).

\[ R^2 = 0.26, \quad P = 0.033 \]

\[ N = 37 \]
\[ \text{Zero} = 30 \]
\[ \text{Non zero} = 7 \]

Ideal Location

Left Eye

Between Pupil Center and Purkinje Image 1 (Vertex Normal Light Reflex)

Slightly NASAL to Pupil Center (~ 0.15 mm)
Subtract from Ascan measured Axial Length ~ 0.8 mm

- Zaldivar-Holladay JCRS May 2000
- Zeiss - IOL Master - 2000

Measured 36 → 34 mm

Linear Regression to compensate for AVERAGE Index of Refraction in Long Eyes

Requirements
- Accurate Biometry – IOL Master
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IOL Power Calculations

- Pentacam can measure FRONT & BACK SURFACE POWER
- Can Calculate:
  - Equivalent K-Reading (EKR)
    - 65% Mean, Peak & Average
  - NET POWER

EKR

- Reports Keratometry value but adjusts for Back Surface Power from Normal (Current IOL Formulas)
  - If corneal front surface is 7.5 mm (45 D), but if back surface -0.3 D > normal:
    \[ \text{EKR} = 45.0 - 0.3 = 44.7 \text{ D} \]
    
    Note: Net Power = 43.3 D

New algorithm for intraocular lens power calculations after myopic laser in situ keratomileusis based on rotating Scheimpflug camera data

Richard Potvin, OD, Warren Hill, MD

J Cataract Refract Surg Feb 2015; 41:339–347

IOL Calcs – Abnormal Cornea (Use 65% MEAN EKR)

- Post Refractive Surgery
- Post PKP
- Keratoconus
- Corneal Scar
- Any Irregular Astigmatism
Use 65% Mean EKR ( @ 4.5, 4 & 3 mm zones)

- EKR – Use 65% Mean for all IOL Calcs
- Look @ smaller zones than 4.5 mm if pupil very small (< 3.0 mm in dim light)

Normal
- 41 to 44 D
- 3 D Range

LASIK
- 36 to 41 D
- 5 D Range

RK
- 32 to 45 D
- 13 D Range

POST LASIK

Post LASIK CALC
- $K_{\text{mean}} = 39.8 \text{ D}$
- Used 39.8 D => SEQ = +1.12 D
  
  (+1.00 + 0.25 \times 155 = 20/20)
- 65\% mean = 38.8 D => +0.12 D
- Use 65\% mean $K$

Conclusions

- Accurate Biometry – IOL Master
- Accurate K’s- Repeatable
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism
**Vergence Formula**

\[
IOL = \frac{1336}{AL-ELP} - \frac{1336}{1000} - \frac{ELP}{1000} + K(\text{Post } R)
\]

**CONCLUSION: 9 EYES**

<table>
<thead>
<tr>
<th>Anterior Segment Size</th>
<th>Megalocornea + axial hyperopia (0%)</th>
<th>Megalocornea Large Eye</th>
<th>Megalocornea + axial myopia (10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>(2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>axial hyperopia (80%)</td>
<td>Megalocornea normal</td>
<td>axial myopia (20%)</td>
</tr>
<tr>
<td>Small</td>
<td>Small eye nanophtalmia (20%)</td>
<td>Microcornea</td>
<td>Microcornea + axial myopia (5%)</td>
</tr>
<tr>
<td>Short</td>
<td>Normal</td>
<td>Long</td>
<td></td>
</tr>
</tbody>
</table>

**Measurements taken for Predictors of ELP**

- Axial Length
- Average K (Pre Ref)
- Horizontal WTW
- ACD
- LT
- Pre-op Refraction
- Age

**FORMULA PERFORMANCE**

- Holladay 1
- SRK/T
- Holladay 2

**Requirements**

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### Personalized Lens Constant
- Never use Manufacturer’s Constant except to start
- 20 to 40 cases and continue

### Factors
- IOL Style
- Lens placement
- Post op medications
- Biometer, keratometer, ...

### Requirements
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### TORIC IOL Calculations
- Commercial Calculators use a constant ratio (1.46) for the corneal cylinder to the IOL cylinder
- Exact Calculation depends on IOL SEQ Power and ELP … to correct 2D of corneal astigmatism
  - 10 D IOL => 3.5 D Cylinder
  - 22 D IOL => 2.9 D Cylinder
  - 34 D IOL => 2.4 D Cylinder

A **1.1 D difference** from 10 D to 34 D!

### Toric Optimization
- Use different software for toric optimization
- Includes toric IOL and toric intraocular lens

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**TORIC IOL Calculations**

- Calculated from FO x’s & FO y’s
  - Ideal Placement: 135°
  - Predicted Residual Refr.: -0.85 ± 1.12 ± 1.12

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**Requirements**

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**Toric Optimization**

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**TORIC IOL Calculations**

- Calculated from FO x’s & FO y’s
  - Ideal Placement: 135°
  - Predicted Residual Refr.: -0.85 ± 1.12 ± 1.12
PREOP 6 D Toric IOL

PREOP 6 D Toric IOL -- OD

PREOP 6 D Toric IOL -- OS

Thank You!