IOL Power Calculations

Jack T. Holladay, MD, MSEE, FACS
Clinical Professor of Ophthalmology
Baylor College of Medicine
Houston, Tx

hicsoap.com
Doc Holladay/HANDOUTS

IOL Power Calculations

Total BLUR must be < 0.50 D

- SEQ + CYL < 0.50 D
- 0.25 + 0.25 = 0.50 D
- 0.50 + 0.00 = 0.50 D
- 0.00 + 0.50 = 0.50 D

Requirements

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

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;
  - Zeiss Inc: C;
  - Elenza: C,O;
  - M & S Technologies: C;
  - Oculus, Inc.: C;
  - Visiometrics: C,O;

#11

Holladay Handouts

The Holladay handouts with UNDEFINED files are available for download. You must have Adobe Acrobat Reader to view our PDF files on this page. If you do not have the Adobe Acrobat Reader, click on the Acrobat Reader icon below and get your free reader.

1. Pentacam RP5 Symposium 1.0 – 2018 (1.250 KB)
2. Holladay Report 2018 - Interpretation Guidelines - 2018 (1.100 KB)
3. Topik IOL Calculations: Minimizing & Managing Residual Astigmatism - 2017 (1.554 KB)
4. Promise No Glasses and How to Deliver 16k - 2018 (600 KB)
5. Phakic IOL Calculs 16k - 2016 (200 KB)
6. Analyzing Individual & Aggregate Astigmatism - 2006 (375 KB)
7. New Automated OFF Testing - 2006 (2.6 MB)
8. Advanced IOL Calculs with Outline 16k 2017 (0.021 KB)
9. EDOF Pentacam Trifocal Premature glasses and how to deliver 16k - 2017 (1.316 KB)
10. Holladay IOL Outcomes Optics We Need to Know - 2018 (1.520 KB)
11. Holladay IOL Calculs JCAPHO - 2016 (2610 KB)

If document does not work, please download Adobe Acrobat Reader and try again.
**Multifocal IOL Optimal Location**

- **Horizontal Angle & Alpha & Kappa**
- **Angle Kappa on IOL Master, LenStar and penlight ~ 0.33 mm**
- **If > 0.60 mm then concern!**

**LENSTAR – HAAG-STREIT**

- Ignore Sign … ADD PCX & PCY MAGNITUDES < 0.6 mm

**IOL MASTER 500 – ZEISS**

- **Version ≥ 7.1**
- **Anterior chamber depth values**
- **White-to-white values**
- **Ignore Sign … ADD Px & Py MAGNITUDES < 0.6 mm**

**Requirements**

1. Centration
2. Accurate Biometry – Optical (IOL Master or LenStar, …)
3. Accurate K’s- Repeatable
4. Data Screening
5. 4th Generation Formula (WTW)
6. Personalized Lens Constant
7. Eliminate Corneal Astigmatism

**If SD for K’s > ± 0.20 D (0.030 mm = 30 µm)**

- Test for Dry Eye
- **ToPography/ToMography**
Measurement for a 44 D Cornea

- **Manual Keratometer**
  - 3.2 mm Diameter
- **IOL Master** Keratometer
  - 2.5 mm Diameter
- **LenStar** Keratometer
  - 2.35 & 1.65 mm Diameters
    - (Average 2.0 mm Diameter)

*Carl Zeiss Meditec AG, Goessweinstein Str. 51-52, 07745 Jena, Deutschland
Haag-Streit AG, Gartenstadtstrasse 10, 3098 Koeniz, Switzerland

Ring Diameter affects Keratometry

Manual Keratometer Measures 44.0 D
Causes Optical A-Constant to be
~ 0.3 D Higher than Manual Keratometry
Corneal Quality

HO RMS CORNEAL wavefront error over a 6 mm zone < 0.50 µm

- Normal = 0.38 ± 0.14 µm
- PO Lasik Happy = 0.58 ± 0.21 µm
- PO Lasik Unhappy = 1.31 ± 0.58 µm


Corneal Power after LASIK, PRK, RK

- Ideally, Calculation from both surfaces ...
- Calculation from Prior Data Trial
- Hard Contact Lens
- Corneal Topography
- Automated Keratometry
- Manual Keratometry

Methods listed in order of reliability

- Methods 3, 4 and 5 almost always exceed true power & result in hyperopic error
- Use lowest reliable value

Topography: Measures Total Power and Total Astigmatism of Lenticle

Topography: Measures Front Surface Power of Lenticle and then uses back radius of 0.82 of front radius for Total Power and can ADD 0.22 D ATR for Total Astigmatism

Keratometry: Measures Front Surface Ring or annulus Power of Lenticle nominal 2.0 to 3.2 mm for 44 D cornea then uses back radius of 0.82 of front Radius for Total Power. Should ADD 0.22 D ATR for Total Astigmatism.
1. Calculation from Prior Data
(Pre K & Δ MR known)

Pre KR Mean K = 44.00 D

Change in SEQ Ref = -4.50 D

Calc Mean K = 39.50 D

2. Calculation from Prior Data
(Post Std. K’s & Δ MR only)

Post Mean K = 40.58 D

Change in SEQ Ref = -4.50 D

STD K’s: -0.24 * SEQ = -1.08

Calc Mean K = 39.50 D
3. Calculation from Prior Data
(Post Ctr Top Power & Δ MR only)

Post Mean K = 40.27 D
Change in SEQ Ref = -4.50 D
Ctr Top: -0.15 * SEQ = -0.77
Calc Mean K = 39.50 D

4. Trial Hard Contact Lens
(Rigid Contact lens only)

Plano HCL Base Curve = 41.50 D
SEQ Ref without CL = +0.50 D
SEQ Ref with CL = -1.00 D
Front K = 41.50 - 1.50 = 40.00 D
40.00 D – 10% (4.50) = 39.50 D
Mean K = 39.50 D

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

Data Screening Identifies Measurement Error - Repeat
- Binocular
  - AL difference > 0.3 mm
  - K difference > 1.0 D
  - IOL power difference > 1.0 D
- Monocular
  - AL Signal/Noise (S/N) Ratio < 2.0
  - K Std Dev (σ) > 0.20 D

Requirements
- Centration
- Accurate Biometry – Optical (IOL Master or LenStar, …)
- Accurate K’s- Repeatable
- Data Screening
- 4th Generation Formula (WTW)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism
Measurements taken for Predictors of ELP
Holladay 2+NReg*, Olsen 2, Barrett 2
- Axial Length*
- Average K (Pre R S)
- Horizontal WTW
- ACD
* Use H1 & H2 Non-Linear Regression for Long Eyes (less aggressive than Wang/Koch) so less myopia

Requirements
1. Centration
2. Accurate Biometry – Optical (IOL Master or LenStar, …)
3. Accurate K’s- Repeatable
4. Data Screening
5. 4th Generation Formula (WTW)
6. Personalized Lens Constant
7. Eliminate Corneal Astigmatism

Personalized Lens Constant
- Never use Manufacturer’s Constant except to start
- 20 to 40 cases and continue
- Factors
  - IOL Style
  - Lens placement, OVDs
  - Post op medications
  - Biometer, keratometer, …

Requirements
1. Centration
2. Accurate Biometry – Optical (IOL Master or LenStar, …)
3. Accurate K’s- Repeatable
4. Data Screening
5. 4th Generation Formula (WTW)
6. Personalized Lens Constant
7. Eliminate Corneal Astigmatism

Ideal Toric IOL Calcs
- Accurate corneal power and astigmatism … repeat is SD > 0.20 D (0.030 mm = 30 µm)
- Exact Toric Calculator (not a constant ratio of corneal astigmatism to toricity 1.46)
- Proper Surgically Induced Astigmatism (SIA) for incision location and magnitude and axis of PreOp astigmatism … must account for ATR over 3 to 6 months PostOp
- Results will be greater than 80% within 0.50 D of residual astigmatism

Always Topography/ Tomography if Correcting Astig
- To determine if REGULAR and does not change radially
- Tomography can confirm if posterior astig is WTR (~ 0.22D)
**Toric Calculators**

<table>
<thead>
<tr>
<th>Exact</th>
<th>Approximate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holladay On-line</td>
<td>Alcon On-line</td>
</tr>
<tr>
<td>AMO Express On-line</td>
<td>B &amp; L On-line</td>
</tr>
<tr>
<td>Holladay IOL Consult</td>
<td>Barrett On-line</td>
</tr>
</tbody>
</table>

**Requirements**

- Centration
- Accurate Biometry – Optical (IOL Master or LenStar, …)
- Accurate K’s- Repeatable
- Data Screening
- 4th Gen Formula (WTW/ACD/LT)
- Personalized Lens Constant
- Eliminate Corneal Astigmatism

**Never Perfect Bow Tie**

44.8 @ 96 & 40.6 @ 6
ASTIG = +4.2 @ 96

43.5 @ 105 & 41.2 @ 15
ASTIG = +2.3 @ 105

---

Initial Visit | 6 wks after Dry Eye Rx

---

!Thank You!