



### 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;

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### Holladay Handouts

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1. Pentacam BKFSY Symposium 16x9 - 2018 (1,250 KB)
2. Holladay Report 2018 - Interpretation Guidelines - 2018 (1,100 KB)
3. TORIC IOL CALCULATIONS: Minimizing & Managing Residual Astig - 2017 (1,954 KB)
4. Promise No Glasses and How to Deliver 16x9 - 2018 (900 KB)
5. Phakic IOL Calcs 16x9 - 2016 (288 KB)
6. Analyzing Individual & Aggregate Astigmatism - 2006 (375 KB)
7. New Automated CSF Testing - 2006 (2.6 MB)
8. Advanced IOL Calcs with Outline 16x9 2017 (8,021 KB)
9. EDOF Pinhole Trifocal Promise no glasses and How to Deliver 16x9 - 2017 (1,316 KB)
10. HOLLADAY IOL Outcomes Optics We Need to Know - 2018 (1,820 KB)
- #11 HOLLADAY IOL CALCS JCAPHO - 2018 (2,610 KB)

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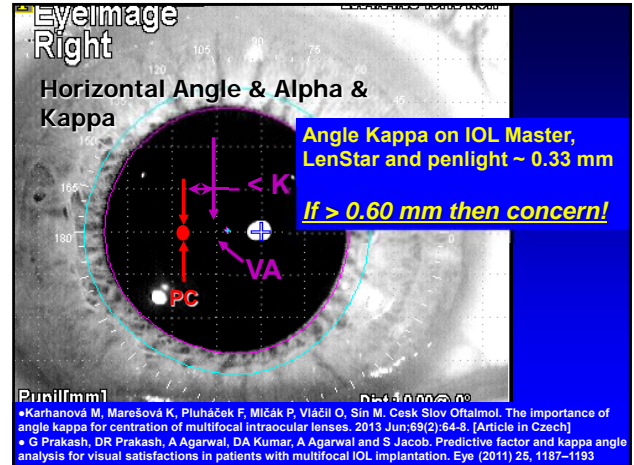
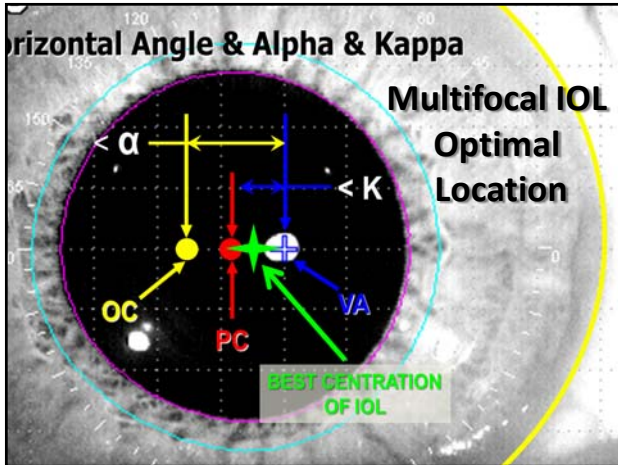
### Total BLUR must be < 0.50 D

- 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

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### Requirements

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



**LENSTAR – HAAG-STREIT**

White to White	WTW	11.78 mm	±0.083 mm	11.58 mm	±0.054 mm
Iris barycenter	ICX	-0.43 mm	±0.147 mm	0.21 mm	±0.109 mm
	ICY	-0.19 mm	±0.155 mm	-0.22 mm	±0.058 mm
Pupil diameter	PD	3.70 mm	±0.208 mm	3.84 mm	±0.193 mm
Pupil barycenter	PCX	-0.31 mm	±0.032 mm	0.20 mm	±0.029 mm
	PCY	-0.25 mm	±0.039 mm	-0.21 mm	±0.021 mm

Ignore Sign ... ADD PCX & PCY MAGNITUDES < 0.6 mm

EyeSuite™ Biometry, V2.1.1  
 LS 900, SN 2470, V 2.1.0  
 HAAG-STREIT DIAGNOSTICS

**IOL MASTER 500 – ZEISS**  
 Version ≥ 7.1

Anterior chamber depth values

ACD: 3.13 mm	ACD: 3.24 mm
3.13 mm   3.13 mm   3.13 mm   3.13 mm   3.13 mm	3.24 mm   3.24 mm   3.26 mm   3.24 mm   3.24 mm

White-to-white values

WTW : 12.3 mm	Pupil: 3.6 mm	WTW : 12.3 mm	Pupil: 3.9 mm
Ix:+0.6mm Iy:+0.4mm	Px:+0.4mm Py:+0.2mm	Ix:-0.8mm Iy:+0.4mm	Px:-0.5mm Py:+0.1mm

Ignore Sign ... ADD Px & Py MAGNITUDES < 0.6 mm

Reference image capture

No image | No image

(\* = value has been edited, ! = borderline value)

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

↓

Test for Dry Eye

↓

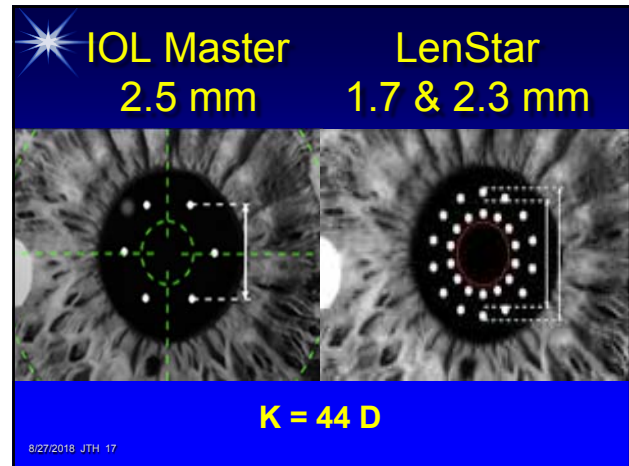
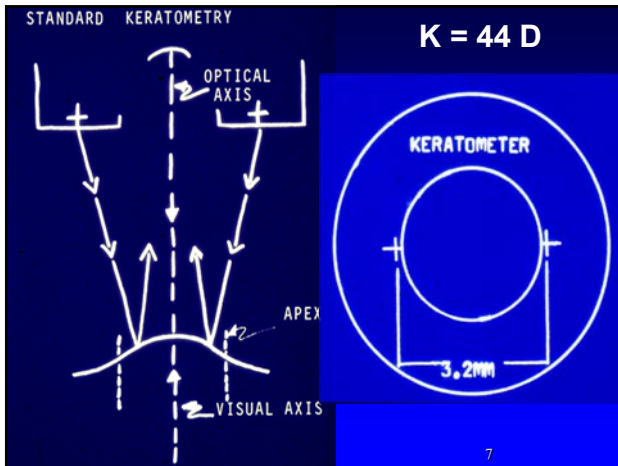
ToPography/ToMography

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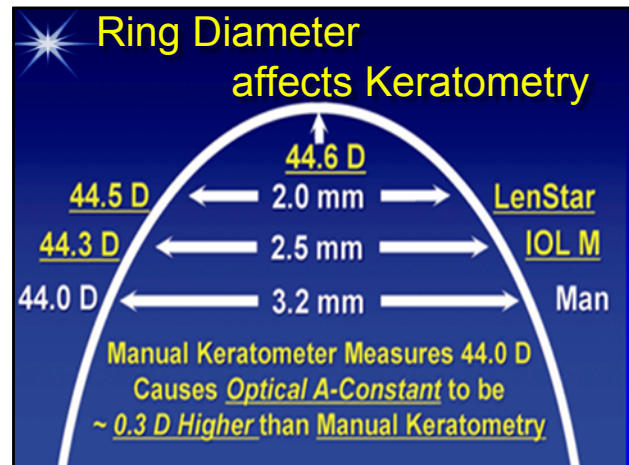
IOL Master		Keratometer values	
MV: 40.54/42.35 D	SD: 0.00 mm	MV: 40.69/42.56 D	SD: 0.00 mm
K1: 40.54 D x 179°	8.19 mm	K1: 40.64 D x 178°	8.17 mm
K2: 42.35 D x 89°	7.84 mm	K2: 42.56 D x 88°	7.80 mm
ΔK: -1.81 D x 179°		ΔK: -1.92 D x 178°	
K1: 40.54 D x 179°	8.19 mm	K1: 40.69 D x 177°	8.16 mm
K2: 42.29 D x 89°	7.85 mm	K2: 42.51 D x 87°	7.81 mm
ΔK: -1.75 D x 179°		ΔK: -1.82 D x 177°	
K1: 40.54 D x 178°	8.19 mm	K1: 40.69 D x 177°	8.16 mm
K2: 42.35 D x 88°	7.84 mm	K2: 42.56 D x 87°	7.80 mm
ΔK: -1.81 D x 178°		ΔK: -1.87 D x 177°	
Anterior chamber depth values			
ACD: 3.13 mm		ACD: 3.24 mm	
3.13 mm	3.13 mm	3.13 mm	3.13 mm
3.24 mm	3.24 mm	3.26 mm	3.24 mm
White-to-white values			
WTW: 12.3 mm	Pup: 3.6 mm	WTW: 12.3 mm	Pup: 3.9 mm
Ix:+0.6mm Iy:+0.4mm	Px:+0.4mm Py:+0.2mm	Ix:-0.8mm Iy:+0.4mm	Px:-0.5mm Py:+0.1mm

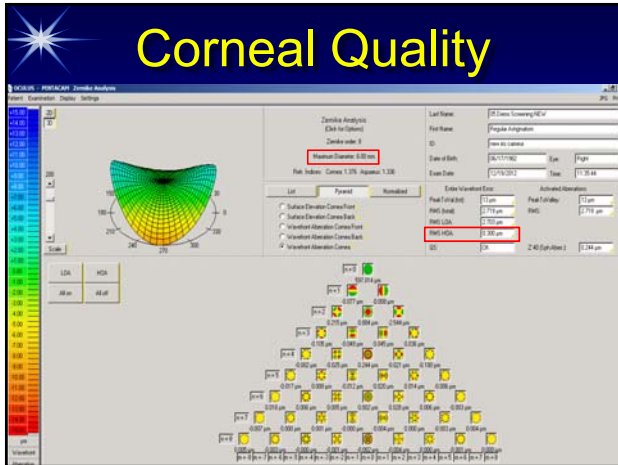
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OD right	LenStar Analysis	
	Measured values	Keratometry values
AL: 22.30 mm (SD = 4 μm)	n: 1.3375	
ACD: 2.99 mm (SD = 5 μm)	R: 7.76 mm (SD = 6 μm)	
LT: 3.96 mm (SD = 23 μm)	R1: 7.83 mm @ 156° (SD = 13 μm)	
	R2: 7.69 mm @ 66° (SD = 3 μm)	
	ΔD: -0.75 dpt @ 156°	
Central corneal thickness	White-to-white values	
CCT: 542 μm (SD = 3 μm)	WTW: 11.9 mm	Ix: +0.4 mm Iy: +0.2 mm
	P: 4.7 mm	Px: +0.4 mm Py: +0.2 mm



- 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, Goeschwitz Str. 51-52, 07745 Jena, Deutschland  
 † Haag-Streit AG, Gartenstadtstrasse 10, 3098 Koeniz, Switzerland
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## 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**

McCormick GJ, Porter J, Cox IG, MacRae S. Higher-order aberrations in eyes with irregular corneas after laser refractive surgery. Ophthalmology. 2005 Oct;112(10):1699-709

## Corneal Power after LASIK, PRK, RK

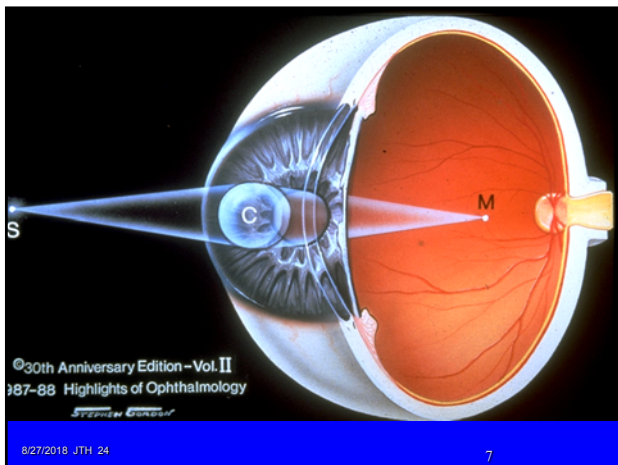
- 1 Ideally, Calculation from both surfaces ...
- 2 Calculation from Prior Data Trial
- 3 Hard Contact Lens
- 4 Corneal Topography
- 5 Automated Keratometry
- 6 Manual Keratometry

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## Corneal Power after LASIK, PRK, RK

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

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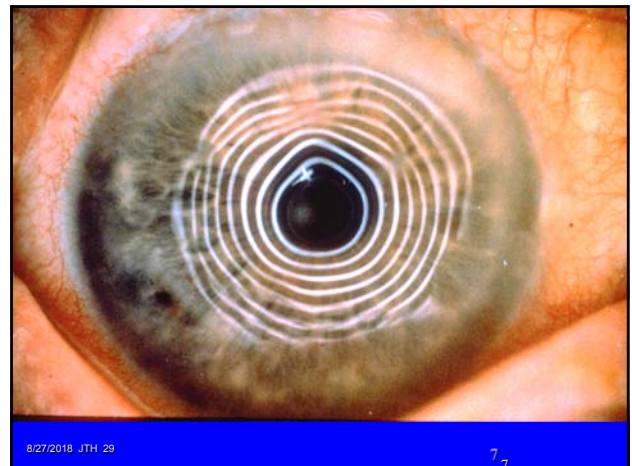
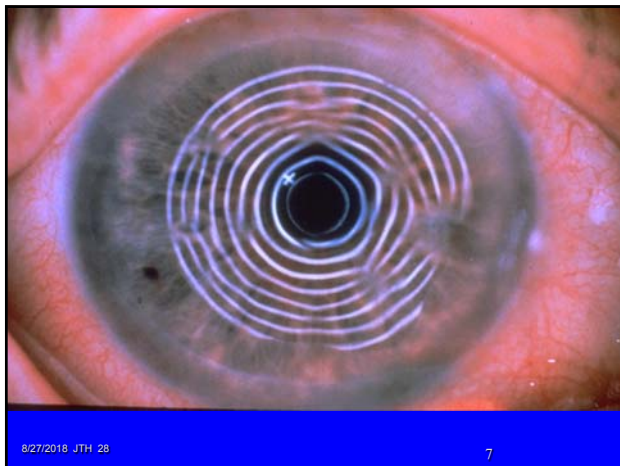
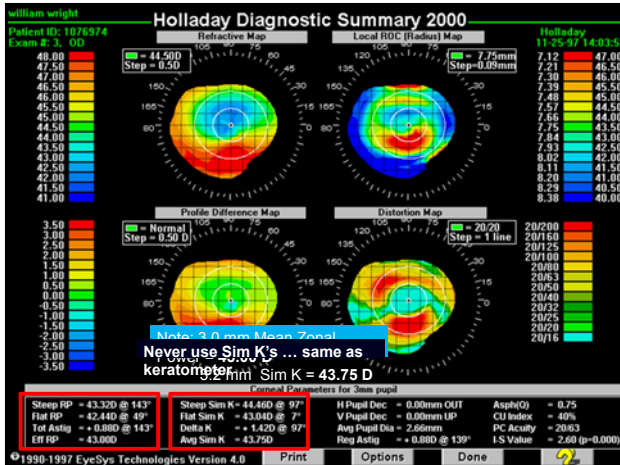


**ToMography:** Measures Total Power and Total Astigmatism of Lenticle

**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.

8/27/201



**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**

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**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**

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### 3. Calculation from Prior Data (Post Ctr Top Power & Δ MR only)

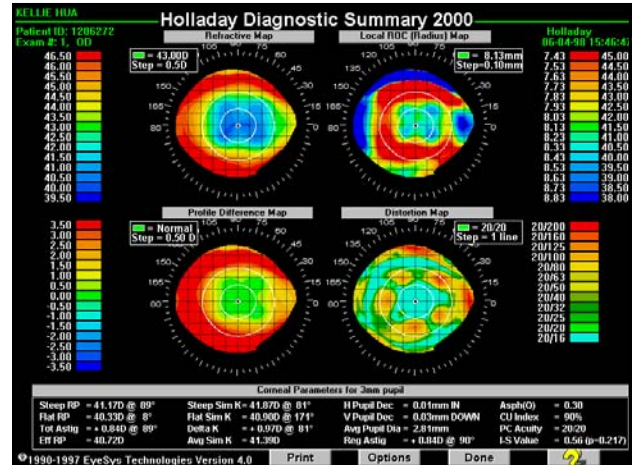
Post Mean K = 40.27 D

Change in SEQ Ref = -4.50 D

Ctr Top:  $-0.15 * \text{SEQ} = -0.77$

Calc Mean K = 39.50 D

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### 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

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### 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

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### Measurements taken for Predictors of ELP

Holladay 2+NReg\*, Olsen 2, Barrett 2

① Axial Length*	⑥ LT
② Average K (Pre R S)	⑦ Pre-op Ref (Adult before Cat)
③ Horizontal WTW	⑧ Age
④ ACD	

\* Use H1 & H2 Non-Linear Regression for Long Eyes (less aggressive than Wang/Koch) so less myopia

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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, OVDs
  - Post op medications
  - Biometer, keratometer, ...

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### Requirements

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### Ideal Toric IOL Calcs

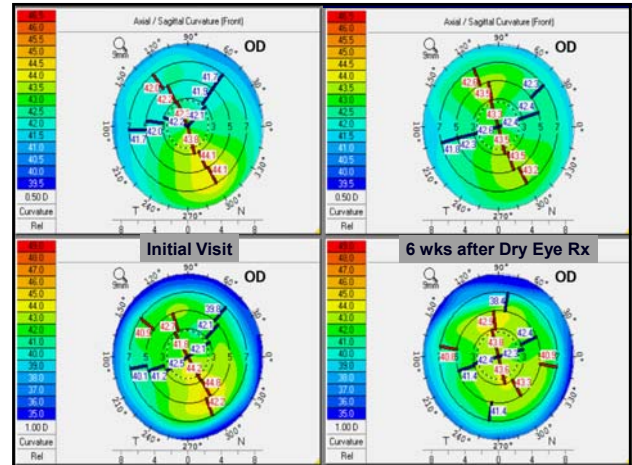
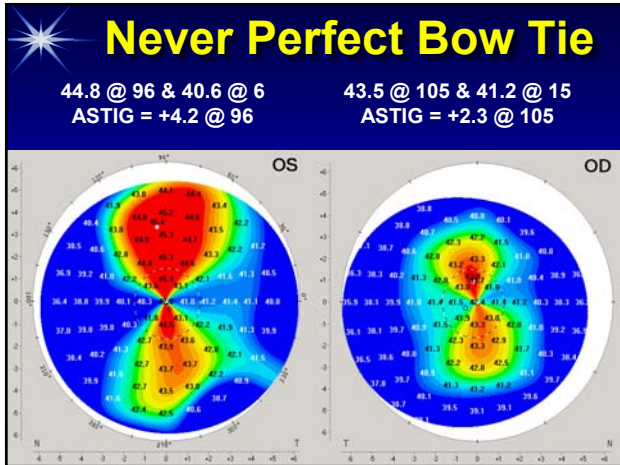
- Accurate corneal power and astigmatism ... repeat is SD > 0.20 D (0.030 mm = 30 μm)
- Exact Toric Calculator (not a constant ratio of corneal astigmatism to toricity 1.46)
- Proper Surgically Induced Astigmatism (SIA) for incision location and magnitude and axis of PreOp astigmatism ... must account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

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### 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)

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## Toric Calculators

<p><u>Exact</u></p> <ul style="list-style-type: none"> <li>● Holladay On-line</li> <li>● AMO Express On-line</li> <li>● Holladay IOL Consult</li> </ul>	<p><u>Approximate</u></p> <ul style="list-style-type: none"> <li>• Alcon On-line</li> <li>• B &amp; L On-line</li> <li>• Barrett On-line</li> </ul>
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8/27/2018 11:44 AM      Jack T. Holladay, MD.      46

## Requirements

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