



## 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;
  - Elenza: C,O;
  - Oculus, Inc.: C;
  - Visiometrics: C,O;

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## WWW.HICSOAP.COM Holladay Handouts

The Holladay Handouts with UNDERLINED titles 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.

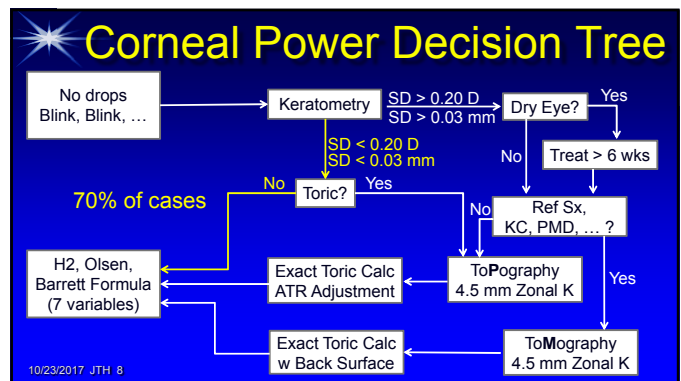
1. Pentacam BKFSST Symposium 16x9 - 2016 (1,361 KB)
2. Holladay Report 2016 - Interpretation Guidelines - 2016 (1,706 KB)
3. TORIC IOL CALCULATIONS: Minimizing & Managing Residual Astig - Fall 2016 (1,286 KB) - 2016 (1,706 KB)
4. Multi Toric Acc IOLs Promise no glasses Biometry for Premium IOLs 16x9 - 2016 (2,934 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)

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## Ideal Toric IOL Calcs

- **Accurate corneal power and astigmatism ...** repeat is  $SD > 0.020 D$  (0.030 mm)
- **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**

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**If SD for K's**  
**> ± 0.20 D (> ± 0.030 mm)**  
 ↓  
**Test for Dry Eye**  
 ↓  
**To Pography/To Mography**

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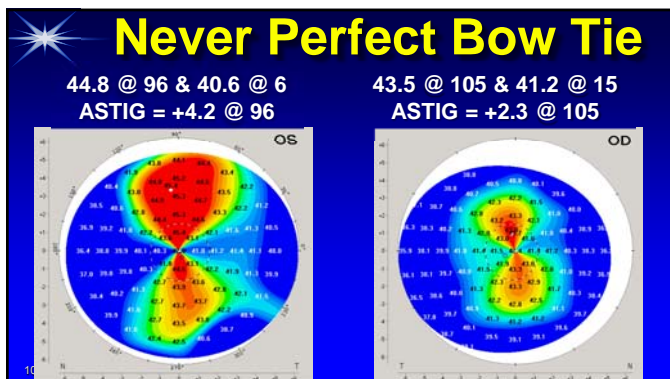
Keratometer values			
MV: 40.54/42.35 D	SD: 0.00 mm	MV: 40.69/42.56 D	SD: 0.00 mm
K1: 40.54 D x 178°	8.19 mm	K1: 40.64 D x 178°	8.17 mm
K2: 42.35 D x 89°	7.84 mm	K2: 42.56 D x 88°	7.80 mm
ΔK: -1.81 D x 179°		ΔK: -1.92 D x 178°	
K1: 40.54 D x 179°	8.19 mm	K1: 40.69 D x 177°	8.16 mm
K2: 42.29 D x 89°	7.85 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	Analysis	
right		
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)
		Δ D: -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

**If SD > ± 0.20 D (> ± 0.030 mm)**  
 ↓  
**Not Dry Eye**  
 ↓  
**To Pography/To Mography**

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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 Calculators

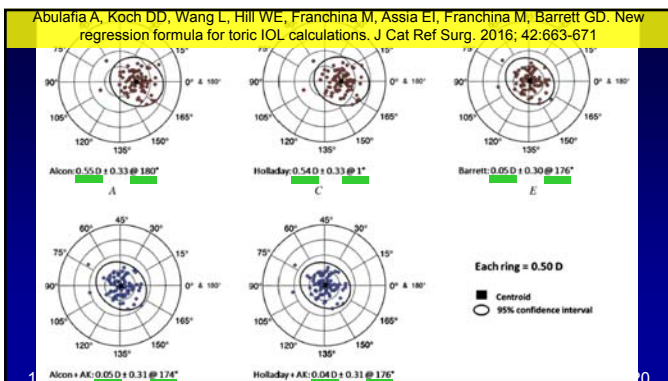
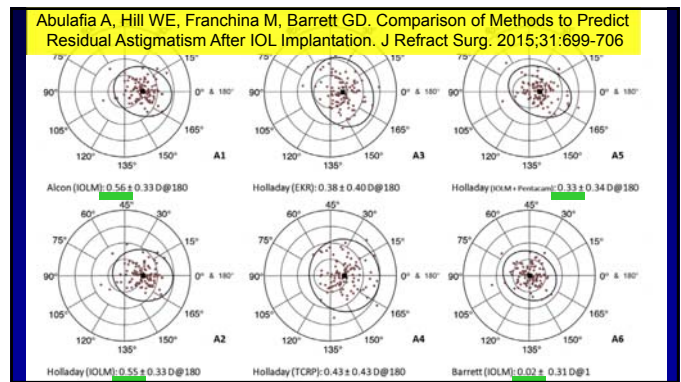
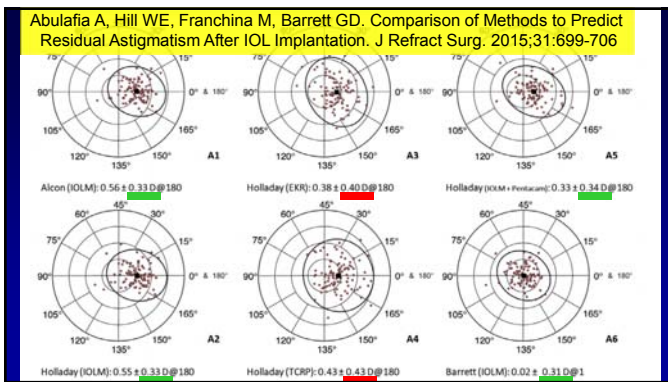
<u>Exact</u>	<u>Approximate</u>
<ul style="list-style-type: none"> <li>• Holladay On-line</li> <li>• AMO Express On-line</li> <li>• Holladay IOL Consult</li> </ul>	<ul style="list-style-type: none"> <li>• Alcon On-line</li> <li>• B &amp; L On-line</li> <li>• Barrett On-line</li> </ul>

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## Dioptric Error vs. Angular Error for a 1.00 D of astigmatism

Angle Error (°)	Dioptric Error (D)	% Error
0°	0.00	0%
15°	0.52	52%
30°	1.00	100%
45°	1.41	141%
60°	1.73	173%
75°	1.93	193%
90°	2.00	200%

**Dioptric Error = 2 \* Cyl \* sin (angular error)**



## Surgically Induced Astig (SIA)

- Critical to use correct value
- Not ~0.35 D WTR for small (2.5 mm), near-clear temporal incision
- Better to use Zero SIA and Baylor Nomogram
  - ↓ WTR (steep 90) by ONE Toric Size (T4 → T3)
  - ↑ ATR (steep 180) by ONE Toric Size (T3 → T4)
  - No change in Oblique
- Equivalent to ADDING ~ 0.51 D ATR as SIA

### Wang/Koch Recommendation

- WTR: Subtract 0.6 D from measured
- ATR: Add 0.2 D to measured
- Oblique: No change

Equivalent to:

$$SIA = 0.2 + 0.4 \sin^2(\text{Steep axis of astigmatism})$$

$$0^\circ = 0.2@90 \quad 45^\circ = 0.4@90 \quad 90^\circ = 0.6@90$$

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### SIA

Steep Axis ( ° )	Magnitude (D)	Axis of Flattening ( ° )
0	0.20	90
10	0.21	90
20	0.25	90
30	0.30	90
40	0.37	90
45	0.40	90
50	0.43	90
60	0.50	90
70	0.55	90
80	0.59	90

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### Additional Factors (Wang/Koch)

- Posterior cornea has ~ 0.25 D WTR
- WTR decays ~ 0.50 D WTR
- ATR decays ~ 0.00 D ATR
- **Result:** ↓ K WTR by 0.75 D  
↑ K ATR by 0.25 D

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**RIGHT**  
 Surgeon: **ToricSurg, Coax** PreOp Date: **04/30/2012**  
 Ref: **+1.00 +0.50 X** VTX: **12.00** Target SEQ Ref: **-0.25**  
 BCVA: **20/40** UCVA: **20/50** AL(Opt): **23.50** Adj AL:  
 Flat K: **42.00 @ 90** Steep K: **45.00 @ 0** Astigm.: **+3.00 @ 0**  
 Avg. K: **43.50** Adj. K: n: **1.3375**  
 Active Lens List: **SN6ATx (Std Phaco)** Optimize...  
 2.5mm Temporal Incision ? SIA: **0.14** D SIA Axis: **179** ° Incision: **180** °  
 (Magnitude) (Flattening)  
 Post SIA Flat K: **42.07 @ 90°** Steep K: **44.93 @ 0°** Astigm.: **2.86 @ 0°**  
 Formula: **Holladay II**

**RIGHT**  
 Surgeon: **ToricSurg, Coax** PreOp Date: **04/30/2012**  
 Ref: **+1.00 +0.50 X** VTX: **12.00** Target SEQ Ref: **-0.25**  
 BCVA: **20/40** UCVA: **20/50** AL(Opt): **23.50** Adj AL:  
 Flat K: **42.00 @ 0** Steep K: **45.00 @ 90** Astigm.: **+3.00 @ 90**  
 Avg. K: **43.50** Adj. K: n: **1.3375**  
 Active Lens List: **SN6ATx (Std Phaco)** Optimize...  
 2.5mm Temporal Incision ? SIA: **0.78** D SIA Axis: **91** ° Incision: **180** °  
 (Magnitude) (Flattening)  
 Post SIA Flat K: **42.39 @ 180°** Steep K: **44.61 @ 90°** Astigm.: **2.22 @ 90°**  
 Formula: **Holladay II**

Flat K: **42.00 @ 90** Steep K: **45.00 @ 0** Astigm.: **+3.00 @ 0** Avg. K: **43.50** Adj. K: n: **1.3375**  
 Toric Lens from Active Lens List: **SN6ATx (Std Phaco)** Optimize... Toric Lens from Active Lens List: **SN6ATx (Std Phaco)** Optimize...  
 2.5mm Temporal Incision ? SIA: **0.78** D SIA Axis: **91** ° Incision: **180** °  
 (Magnitude) (Flattening) (Flattening)  
 Post SIA Flat K: **42.39 @ 180°** Steep K: **44.61 @ 90°** Astigm.: **2.22 @ 90°**  
 Formula: **Holladay II** Formula: **Holladay II**

**ATR** **Right Eye** **Left Eye**

Alcon SN607x Procedure: Std Phaco  
 MFG AC(D)@D: 5.39 SEQ Ref.  
 IOL SEQ 21.00 0.19  
 21.50 -0.15  
 21.65 -0.25  
 22.00 -0.45  
 22.50 -0.83

LES Res. Astigm.  
 SN6074 +1.31 D x 90°  
 SN6075 +0.80 D x 90°  
 SN6076 +0.29 D x 0°  
 SN6077 +0.22 D x 90°  
 SN6078 +0.71 D x 90°  
 SN6079 +1.24 D x 90°

IOL Placement Axis: **0°** IOL Ideal Toricity: **4.120 @ 00L**  
 Expected Residual RX: **+0.26 +0.22 @ 90°**  
 Expected Post Op Flat K: **42.07 @ 90°** Steep K: **44.93 @ 0°** Astigm.: **2.86 @ 0°**

Alcon SN6ATx Procedure: Std Phaco  
 MFG AC(D)@D: 5.72 SEQ Ref.  
 IOL SEQ 22.00 -0.03  
 22.50 -0.36  
 22.71 -0.50  
 23.00 -0.69  
 23.50 -1.03

LES Res. Astigm.  
 SN6AT2 +1.53 D x 90°  
 SN6AT3 +1.21 D x 90°  
 SN6AT4 +0.71 D x 90°  
 SN6AT5 +0.21 D x 90°  
 SN6AT6 +0.29 D x 0°  
 SN6AT7 +0.79 D x 0°  
 SN6AT8 +1.29 D x 0°

IOL Placement Axis: **90°** IOL Ideal Toricity: **3.310 @ 00L**  
 Expected Residual RX: **-0.47 +0.21 @ 90°**  
 Expected Post Op Flat K: **42.39 @ 0°** Steep K: **44.61 @ 90°** Astigm.: **2.22 @ 90°**



## Post Op Toric Calculators

- **Holladay IOL Consultant**  
● [www.hicsoap.com](http://www.hicsoap.com)
- **Berdahl & Hardten Toric IOL Calculator**  
● [www.astigmatismfix.com](http://www.astigmatismfix.com)

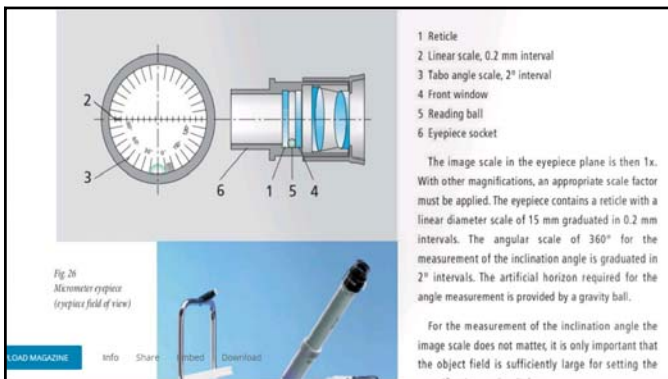
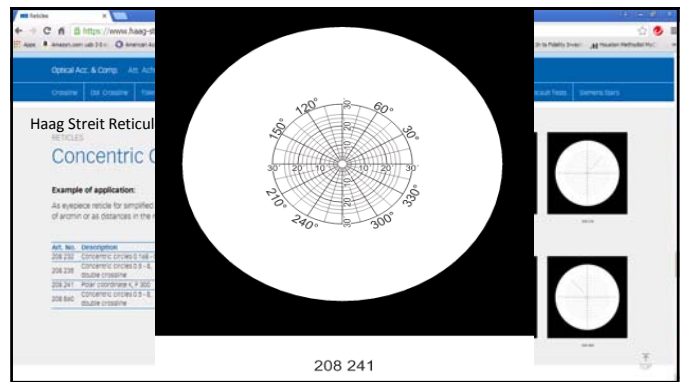
## Two Sources of Error

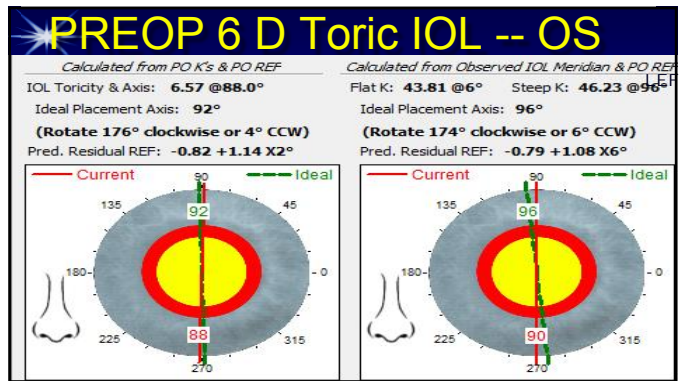
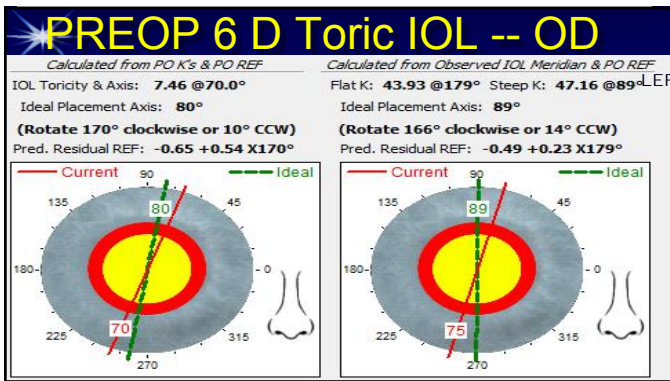
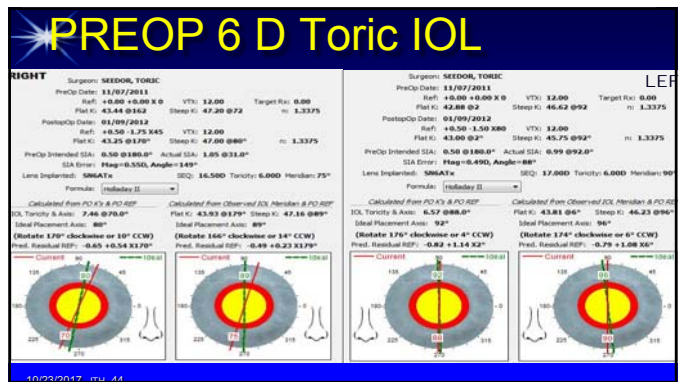
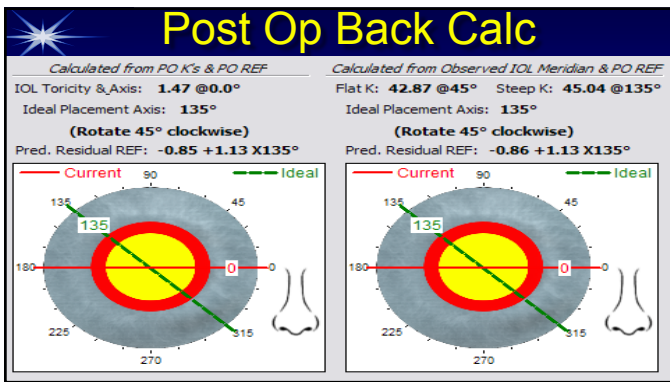
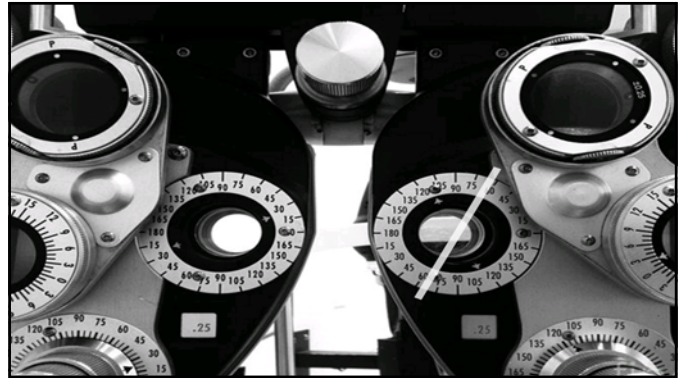
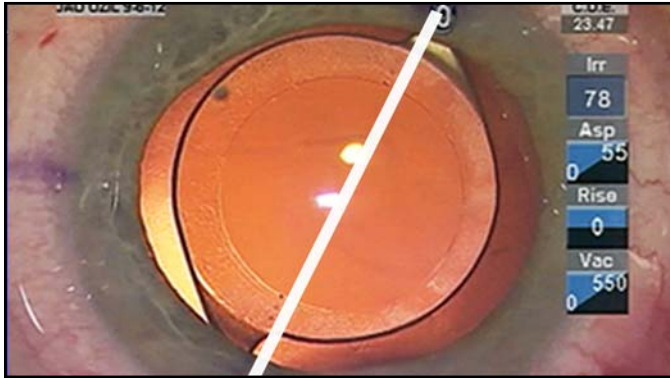
- IOL misaligned (wrong axis)
- IOL Toricity wrong (over/under)

Or

- Both

## Measuring Current Axis





## Toric Calc Example 2

Witness: \_\_\_\_\_  
 Date: \_\_\_\_\_

Crystalens: OD \_\_\_\_\_ OS \_\_\_\_\_  
 Symfony: OD \_\_\_\_\_ OS \_\_\_\_\_  
 Symfony Toric: OD \_\_\_\_\_ OS \_\_\_\_\_  
 Astigmatism: OD \_\_\_\_\_ OS \_\_\_\_\_

BAT: 20/60 OD  
 20/200 OS

MAN. K's: 170  
 42.00 x 42.57 x 85.60  
 42.00 x 42.12 x 84.05

DOM. EYE: \_\_\_\_\_

VA: OD 20/70  
 OS 20/150

Check all symptoms experienced since last visit.

- Blurry Vision
- Redness
- Burning
- Itching
- Light sensitivity
- Excessive tearing/watery eyes
- Tired eyes/eye fatigue
- Stringy mucous in or around the eyes
- Foreign body sensation
- Contact lens discomfort
- Scratchy, feeling of sand or grit in eye
- Fluctuating Vision

Have you used any eye drops in the last 2 hours?  
 \_\_\_\_\_

## Toric Calc Example 2

**Standard palette Axial Curvature** OD 7/13/2017 4:11:53 PM

Steep K: 42.73 D @ 90°  
 Flat K: 42.04 D @ 180°  
 Astigmatism: 0.69 D  
 Eccentricity: 0.30  
 Q: -0.09  
 Shape Factor: 1.24  
 Pub. diam: 12.4 mm  
 HV/D: 12.4 mm

Sim Ks (3 mm): 42.23 D (7.90 mm) @ 60°, 42.23 D (8.03 mm) @ 150°, 42.23 D (8.15 mm) @ 240°, 41.98 D (8.04 mm) @ 100°

Total astigmatism: 0.69 D

Central (0-3 mm): 44.36 D (7.61 mm) @ 220°, 41.43 D (8.15 mm) @ 84°, 40.06 D (8.42 mm) @ 320°, 41.17 D (8.25 mm) @ 342°, 42.63 D (7.92 mm) @ 116°

Periphery (6-9 mm): 44.27 D (7.65 mm) @ 220°, 41.21 D (8.01 mm) @ 84°, 41.85 D (8.06 mm) @ 342°, 41.85 D (8.06 mm) @ 342°

**Keratometry** OD 7/13/2017 4:11:53 PM

Central (0-3 mm): 41.34 @ 128°, 42.80 @ 38°

Midperiphery (3-6 mm): 41.34 @ 128°, 42.80 @ 38°

Periphery (6-9 mm): 41.34 @ 128°, 42.80 @ 38°

**Standard palette Axial Curvature** OS 7/13/2017 4:12:18 PM

Steep K: 42.88 D @ 90°  
 Flat K: 42.81 D @ 138°  
 Astigmatism: 0.07 D  
 Eccentricity: 0.36  
 Q: 0.16  
 Shape Factor: 1.18  
 Pub. diam: 12.3 mm  
 HV/D: 12.7 mm

Sim Ks (3 mm): 41.18 D (8.21 mm) @ 81°, 41.18 D (8.21 mm) @ 81°, 41.18 D (8.21 mm) @ 81°, 41.18 D (8.21 mm) @ 81°

Total astigmatism: 1.90 D

Central (0-3 mm): 44.18 D (7.68 mm) @ 110°, 42.88 D (7.87 mm) @ 110°, 40.77 D (8.64 mm) @ 220°, 40.55 D (8.32 mm) @ 70°

Midperiphery (3-6 mm): 44.18 D (7.68 mm) @ 110°, 42.88 D (7.87 mm) @ 110°, 40.77 D (8.64 mm) @ 220°, 40.55 D (8.32 mm) @ 70°

Periphery (6-9 mm): 44.18 D (7.68 mm) @ 110°, 42.88 D (7.87 mm) @ 110°, 40.77 D (8.64 mm) @ 220°, 40.55 D (8.32 mm) @ 70°

**Keratometry** OS 7/13/2017 4:12:18 PM

Central (0-3 mm): 41.18 @ 128°, 42.88 @ 38°

Midperiphery (3-6 mm): 41.18 @ 128°, 42.88 @ 38°

Periphery (6-9 mm): 41.18 @ 128°, 42.88 @ 38°

## Toric Calc Example 2

Manual: 2.42.00 @ 170 & 42.87 @ 85

3. LenStar: 41.34 @ 128 & 42.80 @ 38 (40°) (146°)

Visually: Steep @ 40 and Flat @ 0 So optimal @ 20

## Toric Calc Example 2

Formula: Holladay II

Active Lens List: SN6ATx (Std Phaco)

Post SIA Flat K: 39.38 @ 0°

Formula: Holladay II

Lens	Res. Refraction
ZXT150 (1.500 @ IOL)	-0.06 +0.45 D x 38°
ZXT225 (2.250 @ IOL)	-0.46 +0.06 D x 128°
ZXT300 (3.000 @ IOL)	-0.72 +0.56 D x 128°
ZXT375 (3.750 @ IOL)	-0.97 +1.07 D x 128°

### HicSoapPro - Toric IOL Back-calc Report

Patient: Freddie, Miska

Date: 07/13/2017

Surgeon: Wilkinson, W. Scott

Refraction: AL(Optical): 24.36

BCVA: K1: 41.34 @ 128

UCVA: K2: 42.80 @ 38

Astigm.: +1.46 @ 38

Average K: 42.07

Alternate K: n: 1.3375

Vertex: 12.00

Adj. AL: Hor W-I-W: 12.51

Phakic ACD: 3.37

Phakic Lens Th: 5.27

Target SEQ Ref: -0.50

Tgt Add: n: 1.3375

Date: 08/22/2017

Refraction: -2.25 +2.75X5

Flat K: 42.00 @ 110°

Astigm.: 0.37 @ 20

PreOp Intended SIA: 0.00

SIA Error: Mag=-1.18D, Angle=137°

Implanted Lens: ZXT225

SEQ: 21.60D Toricity: 2.26D Meridian 38°

### HicSoapPro - Toric IOL Back-calc Report

Date: 07/13/2017

Surgeon: Wilkinson, W. Scott

Refraction: AL(Optical): 24.36

BCVA: K1: 41.34 @ 128

UCVA: K2: 42.80 @ 38

Astigm.: +1.46 @ 38

Average K: 42.07

Alternate K: n: 1.3375

Vertex: 12.00

Adj. AL: Hor W-I-W: 12.51

Phakic ACD: 3.37

Phakic Lens Th: 5.27

Target SEQ Ref: -0.50

Tgt Add: n: 1.3375

Date: 08/22/2017

Refraction: -2.25 +2.75X5

Flat K: 42.00 @ 110°

Astigm.: 0.37 @ 20

PreOp Intended SIA: 0.00

SIA Error: Mag=-1.18D, Angle=137°

Implanted Lens: ZXT225

SEQ: 21.60D Toricity: 2.25D Meridian 59°

## Exchange Toric Case #2 Lessons

- Irregular Astigmatism – outcomes unpredictable
- Post Op: measure the orientation of the IOL at slit lamp (reticule)
- Run Exact Post Op Back Calc with CURRENT AXIS for ideal axis and resulting refraction

## Ideal Toric IOL Calcs

- Accurate corneal power and astigmatism ... repeat is SD > 0.020 D (0.030 mm)
- 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



!Thank You!