Taming the Toric Cornea with Toric Soft Contact Lenses

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Soft Lens New Fits

<table>
<thead>
<tr>
<th>Year</th>
<th>Spherical</th>
<th>Toric</th>
<th>Multifocal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>2014</td>
<td>66%</td>
<td>25%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Toric Soft Lenses - 1980

- Original Soft Toric Lenses
  - Several Base Curves
  - Several Diameters
  - Hydrogel Material
  - Fit Using Small Diagnostic Set

Toric Soft Lenses - Today

- Several Toric Lens Options (off the rack)
  - One or Two Base Curves
  - One Diameter
  - Hydrogel or Silicone Hydrogel Material
  - Fit Using Large Inventory Sets
  - All Modalities

- Custom Toric Options (made to order)
  - Any Base Curve
  - Any Diameter
  - Any Power or Axis
  - Any Thickness

“Off the Rack” Lenses
Toric Soft Contact Lens Fitting

- Physical fit of the lens
- Appropriate optics
- Proper alignment

Base Curve Radius Evolution
0.3, 0.2 mm or Single Increments
Overall Lens Diameter = 14.0 mm

- Steep Base Curve = 8.30 mm
- Med. Base Curve = 8.60 mm
- Flat Base Curve = 8.90 mm
  or
- Steep Base Curve = 8.40 mm
- Flat Base Curve = 8.60 mm
  or
- Med. Base Curve = 8.60 mm

Sagittal Depth and Soft Contact Lens Fitting

- Sagittal Depth: 40.00 (8.44 mm) Sag @ 3.0 mm 135 um
- Sagittal Depth: 47.37 (7.12 mm) Sag @ 3.0 mm 159 um

Scanning Electron Microscopy
Average Human Hair
“75 microns thick”

- Apical Radius: Steep 46.00 D 7.34 mm
- Apical Radius: Flat 41.00 D 8.23 mm

Steep does not always equal deep!
Apical Radius 46.00 D 7.34 mm
Apical Radius 41.00 D 8.23 mm

Corneal Diameter 10.2 mm
Corneal Diameter 13.0 mm

“E” Values from .28 to .84 only showed a difference in depth of 39 um along an 8.0 mm chord.

Contact Lens Diameter 14.0 mm
HVID 12.8 mm  HVID 10.5 mm

Corneal Eccentricity and Sagittal Height
Central Radius = 43.00 D 7.85 mm

Corneal Diameter

Corneal Diameter (HVID)
Toric Soft CL Diameter

Too Small often times equals Too Flat

DVID Distribution

Measuring Sagittal Height Using OCT

When measuring the height from the Apex down to a chord of 14.5 mm, the “sags” are very different in the small, medium, and large corneas.
212 Right Eyes  Ave. 11.8 mm

Cornea angle at 10.0 mm chord

Corneal Diameter = 12.2 mm
Sag at 14.5 mm = 3,240 microns

Corneal Diameter = 11.0 mm
Sag at 14.5 mm = 3,530 microns

Low Angle Low Sag.

High Angle High Sag.

HVID 11.1 mm

HVID 11.8 mm

HVID 12.5 mm

#1 Corneal topography angle at 10.0 mm = 39.2
#2 Corneal topography height at 10.0 mm = 1,694 microns
### Sagittal Height Calculator

- **Topography Chord Diameter:** 10.0 mm
- **Topography Corneal Sag:** 1,694 microns
- **Topography Corneal Angle:** 39.2 degrees
- **Desired Chord Diameter:** 14.5 mm
- **Calculated Sagittal Depth:** 3,880 microns

[New Calculation]

### SCL Sagittal Height

**Diameter:** 14.5 mm

<table>
<thead>
<tr>
<th>Base Curves</th>
<th>Lens Sag</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>4,501 um</td>
</tr>
<tr>
<td>8.3</td>
<td>4,158 um</td>
</tr>
<tr>
<td>8.6</td>
<td>3,882 um</td>
</tr>
<tr>
<td>8.9</td>
<td>3,652 um</td>
</tr>
</tbody>
</table>

- 8.0 to 8.3 = 343 um
- 8.3 to 8.6 = 276 um
- 8.6 to 8.9 = 230 um

### SCL Sagittal Height

**Base Curve:** 8.6 mm

<table>
<thead>
<tr>
<th>Diameters</th>
<th>Range in Sag's</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5 mm</td>
<td>3,191 um</td>
<td>1,099 microns</td>
</tr>
<tr>
<td>14.0 mm</td>
<td>3,518 um</td>
<td></td>
</tr>
<tr>
<td>14.5 mm</td>
<td>3,882 um</td>
<td></td>
</tr>
<tr>
<td>15.0 mm</td>
<td>4,290 um</td>
<td></td>
</tr>
</tbody>
</table>

### SCL Sagittal Height

**Base Curves:** 8.0, 8.3, 8.6 and 8.9 mm

**Diameter:** 14.5

- Range in Sag's = 4,501 to 3,652 um
- Difference = 849 microns

### Fitting the Large Cornea

- **Right Eye:** 12.89 mm
- **Left Eye:** 12.83 mm

### Custom Lens Design Calculators
Diameter 14.0 vs. 15.5

8.3 / 14.0
8.3 / 15.5

(8.3 / 14.0 mm)

(8.3 / 15.5 mm)

Toric Soft Lens Power Calculations

Vertex Spectacle Rx

To Determine:
Actual lens powers required (*sphere and cylinder*) at the corneal plane.
Lens parameter availability.
Sphere power
Cylinder power
Axis

- Spectacle Rx: - 4.00 -2.50 x 180
- Corneal Plane: - 4.00 -2.00 x 180
**Spectacle Rx:**
-8.75 -3.25 x 180
**Corneal Plane:**
-8.00 -2.50 x 180

**Spectacle Rx:**
+6.00 -3.00 x 180
**Corneal Plane:**
+6.50 -3.50 x 180

**Contact Lens Rx:**
8.4mm -5.25 -1.75 x 035 14.4mm

**Order CL**
**Power:** -5.25 -1.75 x 035

**Marker Position and Stability**

**Biofinity Toric**
**Rotational Characteristics**
- 94% rotated within 5 degrees of 0
- 98% within 10 degrees of 0
- 45% showed no rotation
- 37% rotated nasally
- 18% rotated temporally

**N = 125**
IU School of Optometry
**Empirical Lens Power**

- Scenario #1
  - Rotation Marker Positions at 6:00.
  - Cylinder Power of Lens is in alignment with the Cylinder Power of the Eye.

- Scenario #2
  - Rotation Marker Positions Either Side of 6:00
  - Cylinder Power of the Lens is not in alignment with the Cylinder Power of the Eye.

**Scenario #1 Lens**

Rotation Marker Positions Exactly at 6:00

- Patient sees 20/15
- Patient doesn't see 20/15 (20/30)

**Poor Visual Acuity**

- Vertexing errors
- Lens draping effects
- Cylinder masking
- Tear lens effects

**Sphero-Cylinder Over-refraction**

Contact Lens Rx:
-5.25 -1.75 x 035
20/30
Marker at 6:00

S.C.O.R.:
+0.75 -0.25 x 120
20/15

**Over-Keratometry**

Repeatable endpoint on SCORx is critical

If not suspect:
- Poor fit
- Everted lenses
- Switched lenses

**Enter Optical Data**

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Cylinder</th>
<th>Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectacle Rx</td>
<td>-5.50</td>
<td>-2.25</td>
</tr>
<tr>
<td>Contact Lens Rx</td>
<td>-5.25</td>
<td>-1.75</td>
</tr>
<tr>
<td>Over Rx</td>
<td>+0.75</td>
<td>-0.25</td>
</tr>
<tr>
<td>Final Rx</td>
<td>-4.75</td>
<td>-1.50</td>
</tr>
</tbody>
</table>
**Order CL**

**BC:** 8.40 mm **Power:** -4.75 -1.25 x 35  
**Diameter:** 14.4 mm

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**Example**

- **Spectacle Rx:** -1.00 -3.00 x 180  
- **Toric SCL:** -1.00 -2.75 x 180  
- **Rotation 10° SCOR:** +0.50 -1.00 x 045  
- **Rotation 20° SCOR:** +1.00 -2.00 x 035  
- **Rotation 30° SCOR:** +1.50 -3.00 x 020

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**Scenarios for the Lens Rotation Marker**

- A. The marker positions at 6:00  
- B. The marker positions either side of 6:00

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**Patient NV**

**Rx Vertexed to the Corneal Plane**

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Cylinder</th>
<th>Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>-8.25</td>
<td>-2.00</td>
<td>70</td>
</tr>
</tbody>
</table>

**Final Rx**

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Cylinder</th>
<th>Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>-7.50</td>
<td>-1.75</td>
<td>70</td>
</tr>
</tbody>
</table>

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**Important**

The amount of cylinder power in the SCOR increases as the lens misalignment increases.

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**??? How many degrees has this lens rotated???”**
**LARS Compensation**

- **Spectacle Cylinder Axis:** 70 Degrees
- **Degrees of Rotation:** 20 Degrees to the right... LARS
  
<table>
<thead>
<tr>
<th>Lenticular Cylinder</th>
<th>Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>-8.25</td>
<td>-2.00</td>
</tr>
<tr>
<td>-7.50</td>
<td>-1.75</td>
</tr>
</tbody>
</table>

- **LARS** Axis 50 Degrees
- **New CL:** -7.50 -1.75 x 50 20/25

**Poor Visual Acuity**

- Vertexing errors
- Lens draping effects
- Cylinder masking
- Tear lens effects
- Lens rotation

**B+L Calculator (LARS)**

**Optometric Toolbox (Input Rotation)**

**OrthoTools Toric Calculator (Input Rotation)**
**OphthalmicCalc (Calculates Rotation)**

**Results**
- B&L Calculator (LARS only)  
  -7.50 -1.75 x 050
- Optometric Toolbox (input rotation)  
  -7.75 -1.25 x 053
- OrthoTools (input rotation)  
  -7.75 -1.25 x 055
- ToriTrack (calculates rotation)  
  -7.75 -1.25 x 053
- OphthalmicCalc (calculates rotation)  
  -8.25 -2.00 x 58

**Patient CR Rx Vertex to the Corneal Plane**

**Poor Visual Acuity**
- Vertexing errors  Toric SCL On-Eye  
  -5.50 -2.75 x 180
- Lens draping effects  Over-Refraction  
  +0.75 -1.25 x 040
- Cylinder masking  Rotation, 15 Left
- Tear lens effects
- Lens rotation

**Results**
- B&L Calculator (LARS only)  
  -5.50 -2.75 x 010
- Optometric Toolbox (input rotation)  
  -5.50 -2.50 x 013
- OrthoTools (input rotation)  
  -5.50 -2.50 x 015
- ToriTrack (calculates rotation)  
  -5.25 -2.75 x 013
- OphthalmicCalc (calculates rotation)  
  -6.00 -3.25 x 011