Custom Soft Lenses for the Atypical Eye

Indications for Custom Soft Lenses
- Custom Toric Designs
- Keratoconus
- Post Trauma
- Post Refractive Surgery
- Aphakia
- High Refractive Error
- Glaucoma
- Macro/Micro Cornea

Custom Soft Lens Parameters
- Base Curve
  - Keratoconus
  - Reverse Geometry
- Power
- Diameter
- Thickness
- Optical Zone Diameter
- Material

Sagittal Depth of the Cornea and CL

Corneal Anatomical Features and Their Contribution to Sagittal Height

Corneal Radius & Sagittal Height
**Diameter & Sagittal Height**

Corneal Radius 43.00 D (7.85 mm)

**200 Consecutive Right Eyes**

Average HVID 11.8 mm

**DVID Distribution**

Pacific University Class

**CL Too Flat**

**CL Too Tight**

**Corneal Diameter and Apical Radius**

10.2 mm HVID

Apical Radius:
46.00 D 7.34 mm

13.0 mm HVID

Apical Radius:
41.00 D 8.23 mm
**Custom Parameters**

- **Base Curve**
- **Diameter**
- **Power**
- **Optical Zone**
- **Thickness**
- **Asphericity**
- **Reverse Geometry**

**Base Curve Radius**

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
- Med. Base Curve = 8.60 mm
  
  or

- Flat Base Curve = 8.60 mm

In the Future?

- **Corneal**: 12.8 mm, **Lens**: 12.5 mm
- Sagittal Depth: 3.15 mm

- **Cornea**: 10.5 mm
- Sagittal: 3.97 mm

Overall Lens Diameter 14.2 mm

- **Large 12.8 mm Cornea**
- **Small 10.5 mm Cornea**

46.00 D 7.34 mm

41.00 D 8.23 mm

10.2 mm

13.0 mm

Overall Lens Diameter 14.2 mm

14.2 mm

14.2 mm

Corneal Diameter 12.8 mm

Cornea Diameter 10.5 mm

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

Med. Base Curve = 8.60 mm

or

Flat Base Curve = 8.60 mm

or
**Custom Soft Contact Lens**

**Parameter Availability**

- Base Curve (any 0.1mm steps)
- Diameter (any 0.1mm steps)

#1 Corneal Diameter

- HVID 12.0 mm, Lens Dia. 14.0 mm

**Step #1 Measure HVID**

- HVID 12.0 mm

**Vertical Measurement Gauge**

- Large > 12.2 mm
- Normal 11.4 to 12.2
- Small < 11.4 mm

**Patient: EM Age: 30 F**

**History:**
- Bilateral microphthalmia with secondary high hyperopia
- Would like to try SCL due to longstanding GP intolerance

**Km:**
- OD 55.62 @ 101 / 54.50 @ 011
- OS 55.12 @ 080 / 54.12 @ 170

**MR:**
- OD +19.25 DS 20/100
- OS +20.00 DS 20/70

**Microphthalmos Right Eye**

- GP Lens
Microphthalmos

- Step # 1
  - HVID = 10.3 mm
- Step # 2
  - Mean K = 55.00 D
    - 55.62 @ 101
    - 54.50 @ 911

Calculate Effective “K”

- Step # 3
  - For every 0.2 mm smaller than 11.8 mm subtract 1.00 D from the Mean K
  - For every 0.2 mm larger than 11.8 mm add 1.00 D from the Mean K

  Corneal Diameter: 10.3 mm (1.5 < 11.8 mm)
  Mean "K": 55.00 D (6.14 mm)
  Effective "K": (-) 7.50 D from mean "K" 47.50 D (7.11 mm)

Calculate BC Radius

- #1 HVID: 10.3 mm
- #2 Mean "K": 55.00 D
- #3 Effective "K": 47.50 D
- #4 Lens Diam.: 12.5 mm
- #5 Diam. Factor: 0.10 mm
- Base Curve: 7.21 mm
- CL Base Curve: 7.2 mm
- Lens Diameter: 12.5 mm

Order Soft Contact Lens

<table>
<thead>
<tr>
<th>Eye</th>
<th>Sphere</th>
<th>Cylinder</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>7.2</td>
<td>+25.00</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>Left</td>
<td>7.2</td>
<td>+25.00</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>Right</td>
<td>6.8</td>
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<td>6.8</td>
<td>+25.00</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>Right</td>
<td>6.4</td>
<td>+25.00</td>
<td>12.5 mm</td>
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<tr>
<td>Left</td>
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<td>+25.00</td>
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<tr>
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</tbody>
</table>

Calculated Diagnostic Parameters

- Right Eye: 7.2 +25.00 12.5 mm
  - Excessively Flat with edge fluting

Order Soft Contact Lens

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<tr>
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<td>6.0</td>
<td>+25.00</td>
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<tr>
<td>Left</td>
<td>6.0</td>
<td>+25.00</td>
<td>12.5 mm</td>
</tr>
</tbody>
</table>
Diagnostic

- Right Eye: 6.8 +25.00 12.5 mm
  - Flat with poor centration

Diagnostic

- Right Eye: 6.4 +25.00 12.5 mm
  - Good Centration, Good comfort

Diagnostic

- Right Eye: 6.0 +25.00 12.5 mm
  - Steep with apical bubble

Dispensed

- hioxifilcon 54% Base Curve 6.4
- Power +25.00 / Diameter 12.5 mm
- Good Fit and Comfort OU

Arc Length Calculator

<table>
<thead>
<tr>
<th>BC</th>
<th>Diameter</th>
<th>Arc Length</th>
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</thead>
<tbody>
<tr>
<td>6.4</td>
<td>12.5</td>
<td>8.6 / 14.0</td>
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</table>

Arc Length Calculator

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<thead>
<tr>
<th>BC</th>
<th>Diameter</th>
<th>Arc Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4</td>
<td>12.5</td>
<td>8.3 / 15.5</td>
</tr>
</tbody>
</table>
Patient: LH  Age: 16 F

Final Rx
OD hioxifilcon 54 / 8.7 mm / -2.00-0.75x125 / 16.0 mm
OS hioxifilcon 54 / 8.3 mm / -3.75-1.00x180 / 15.1 mm

Sagittal height differences of frequent replacement silicone hydrogel contact lenses
Eef van der Woop, Cristian Mertz
Custom Parameters

- Base Curve
- Diameter
- Power
- Optical Zone
- Thickness
- Asphericity
- Reverse Geometry

Custom Toric SCL Lens Design

- When Vision is Not Right

Custom Toric Lens Design

- Base Curve: Any
- Power: Any
- Sphere, Cylinder or Axis
- Diameter: Any

Soft Toric Pearl

- Repeatable endpoint on SCORx is critical
  - Poor fit
  - Everted lenses
  - Switched lenses

Over Keratometry

- Clear Mires
- Slight Distorted
- Very Distorted
Assessing Rotation

LARS Limitations
- Vertexing errors
- Lens draping effects
- Cylinder masking
- Tear lens effects
- Cross-cylinder effects

Sphero-Cylinder Over-refraction

Contact Lens Rx:
-5.25 -1.75 x 030
20/30

S.C.O.R.:
+0.75 -0.50 x 150
20/20

Spec Rx:
-5.50 -2.25 x 030
20/30

Resultant = ????

ToriTrack
www.coopervision.com

EyeDock
Patient: CJ  Age: 39 M

History:
- Retinitis Pigmentosa with concurrent pathologic high myopia OU
- Has tried GP and SCL in the past
  • unsuccessful due to glare and halos

Km:
- OD 48.25 @ 128 / 46.50 @ 038
- OS 48.25 @ 072 / 46.12 @ 162

MR:
- OD -13.50 – 2.00 x 035     20/60+
- OS -12.00 – 3.50 x 155     20/50-

Varying Optical Zone
- Not successful with GP due to glare
  - ↑ OZ but notes glare with lens movement
- Re-fit in to Custom Toric SCL
  - Good vision and comfort but still notes glare
  - Specified larger OZ
    • Good vision and comfort without glare

Final Rx
- OD hioxifilcon 59% / 7.9 mm / -10.50-2.00 x 024 / 14.4 / OZ 10.0 mm
- OS hioxifilcon 59% / 7.9 mm / -9.50-2.75 x 024 / 14.4 / OZ 10.0 mm

The Effect of Sagittal Height
- 10.2 mm
- 13.0 mm

Custom Soft Contact Lenses
- FDA approval on January 4th 1979
- "The Flexlens soft contact lens is indicated for the correction of the any atypical ametrope with either normal or abnormal refractive errors"
HEMA Material Options

Types of Silicone Hydrogel Materials
- Molded S/H Vistakon, Alcon
  B+L, CooperVision
- FDA Approved Latheable S/H
 -contac (Definitive 74, 65, 50)
  -Menicon (Lagado LSH)

Lathable Silicone Hydrogel
- Manufacturing
  - Lathing
  - Wetting properties
- High Refractive Errors
  - Plus lenses vs. Minus lenses
- Corneal Irregularities
  - Custom parameters
  - Increase center thickness

Custom Parameters
- Base Curve
- Power
- Diameter
- Optical Zone
- Thickness
- Asphericity
- Reverse Geometry

Soft Contact Lenses for KCN
- Initial Base Curve Selection
  - Mean K + 1.00 mm
  - Example:
    - 54.00 D (6.25 mm) @ 165 / 55.50 D (6.08 mm) @ 077
    - Mean K = (6.25 mm + 6.08 mm) / 2 = 6.16 mm
    - Initial BC = Mean K + 1.00 mm = 7.16 mm
  - Initial Base Curve = 7.20 mm
- Select Fitting Curve
  - 8.3 mm, 8.6 mm or 9.5 mm
- Select Overall Diameter
  - 10.0 mm to 17.0 mm
Patient: KB  Age: 50 M

History: Keratoconus OU with history of GP intolerance
K’s: OD 61.62 @ 174 / 55.00 @ 084
     OS 51.75 @ 030 / 46.00 @ 120
MR:  OD +3.00-3.25 x 088
     VA 20/60
     OS +4.50-4.25 x 105
     VA 20/70

Mean K:
- OD 58.37 D (5.79 mm)
- OS 48.85 D (6.91 mm)

Base Curve:
- OD 5.79 mm + 1.00 = 6.8 mm
- OS 6.91 mm + 1.00 = 7.9 mm

Custom SCL’s for KC

OD: 6.8 mm / -1.50-3.25 x 072 / 14.8 /
    8.9 mm fitting curve
OS: 7.9 mm / -0.25-2.75 x 104 / 14.8 /
    8.9 mm fitting curve

Center Thickness

No Contact Lens

Over Contact Lens
Keratoglobus

- An extremely rare, bilateral, condition
- Characterized by limbus to limbus corneal thinning often resulting in extreme protrusion of the entire cornea
- The corneal changes begin early in life with diagnosis typically at ages 12 to 16
- The condition reaches maximum severity in the 20 to 30’s and tends to remain stationary throughout one’s life

**K’s Right Eye**

- VA: 20/40
- Corneal Astigmatism: 7.87 D.
- Corneal Eccentricity: 0.40 @ 174

**K’s Left Eye**

- VA: 54.62 @ 012 / 60.87 @ 102
- Corneal Astigmatism: 6.25 D.
- Corneal Eccentricity: 0.44 @ 012

**Normal**, Keratoconus, PMD, Keratoglobus
Anterior Segment OCT

Right Eye

Left Eye

Soft Contact Lenses for KCN

- **Thickness**
  - Center: ≥ 0.30 mm or greater
  - Periphery: thinner outside optical zone

- **Lens Material**
  - Water Content 55% or greater HEMA
  - Silicone Hydrogel

- **Fitting Tips**
  - One eye at a time
  - Refit most needy eye first
  - Sphere power only for first lens
  - Monitor topographical changes
  - Caution with hydrogen peroxide systems

Custom Parameters

- **Base Curve**
- **Power**
- **Diameter**
- **Thickness**
- **Optical Zone**
- **Asphericity**
- **Reverse Geometry**

Reverse Geometry Design

- **Refractive Surgery**
  - RK
  - PRK
  - LASIK

- **Penetrating Keratoplasty**
  - Sunken Grafts

- **Oblate corneal shape**
  - Post trauma
  - Post infection

Reverse Geometry SCL Fitting Set

<table>
<thead>
<tr>
<th>Base / Fit Curve</th>
<th>Power</th>
<th>Diameter</th>
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<tbody>
<tr>
<td>9.1 / 8.6</td>
<td>Plano</td>
<td>14.5</td>
</tr>
<tr>
<td>9.4 / 8.6</td>
<td>+2.00</td>
<td>14.5</td>
</tr>
<tr>
<td>9.7 / 8.6</td>
<td>+4.00</td>
<td>14.5</td>
</tr>
<tr>
<td>10.0 / 8.6</td>
<td>+6.00</td>
<td>14.5</td>
</tr>
</tbody>
</table>

* 7.8 mm posterior optical zone
Soft Reverse Geometry Lens
Base Curve Selection

Add 0.4 mm to Flattest Central “K”

K’s: 37.25 / 38.75 @ 100
Flat K: 37.25 D = 9.05 mm
(9.05 + 0.40 = 9.45 mm)
Base Curve: 9.40 / 8.60
Diameter: 14.5 mm

Soft Reverse Geometry Lens
Fit Evaluation

Central Zone
- No folds or bubbles
- Keratometry over CL - crisp mires

Para-Central Zone
- No edge lift or buckle
- Good movement

Soft Reverse Geometry Lens
Determining Power

- Retinoscopy
  - Should resemble standard soft lens in the central zone
- Refraction
  - Sphero-cylinder over-refraction
  - Stable endpoint
- Spherical and Toric power

Tip

Considerations:
- Soft lens related complications
  - Deposit
  - Solution
  - Hypoxia
- Lens Replacement Schedule
  - Conventional
  - Planned replacement

Custom Soft Lenses

- Builds your practice
- Increases your referrals
- Not a commodity
- Locks the patient into your practice
- Annuity to your practice

Custom Soft Lenses for the Atypical Eye
Multifocal Soft Contact Lenses

Indications
- Presbyopia & Astigmatism
- Suboptimal Vision in Stock Multifocal Lenses
- Fit Issues in Stock Multifocal Lenses (decentration, large or small corneas, steep or flat corneas)
- Large or Small Pupil
- Intolerance to GP Contact Lenses

Simultaneous Vision Designs

The Challenge
- Reduced tear production
- Loss of contrast sensitivity
- Reduced transparency of lens and cornea
- Decreased pupil size
- Line of sight
- Visual expectations
- Communication

Soft Multifocal Lens Designs

Custom Soft Contact Lenses

Custom Soft Contact Lenses

Concentric Multifocals

- Available in center/near or center/distance

Simultaneous Image CL’s

Multifocals

- Centration is critical
- Alter base curve or diameter
- Consider lens design
- Consider custom multifocal

Custom Soft Multifocal

- Summary
  - Soft Multifocal
    - Customize beyond off shelf
    - Specialty optic beyond presbyopia
    - Able to control zone sizes
    - Off label use
Sagittal Depth and SCL Fitting
(An In Depth Look)

Toric SCL Sagittal Height
Diameter: 14.5 mm
Base Curves: Lens Sag:
8.00 4,501 um
8.30 4,158 um
8.60 3,882 um
8.90 3,652 um
8.00 to 8.30 = 343 um
8.30 to 8.60 = 276 um
8.60 to 8.90 = 230 um

SCL Sagittal Height
Base Curves: 8.6 mm
Diameter:
13.5 mm 14.0 mm 14.5 mm 15.0 mm
3,191 um 3,518 um 3,882 um 4,290 um

Base Curve Change  Diameter Change
Diameter 14.5 mm  Base Curve 8.6 mm
8.00 to 8.30 = 343 um 13.5 to 14.0 = 327 um
8.30 to 8.60 = 276 um 14.0 to 14.5 = 364 um
8.60 to 8.90 = 230 um 14.5 to 15.0 = 408 um

Sagittal height differences of frequent replacement silicone hydrogel contact lenses
Eef van der Worp, Cristian Mertz

SCL Sagittal Height
Base Curves: 8.00 mm to 8.90 mm
Diameter: 14.5
Range in Sag’s = 4,501 to 3,652 um
Difference = 849 microns

SCL Sagittal Height
Base Curve: 8.60 mm
Diameters: 13.5, 14.0, 14.5 and 15.0 mm
Range in Sag’s = 3,191 to 4,290 um
Difference = 1,099 microns
DK – Average Diameter Cornea

DK – HVID = 12.1
Sag at 14.6 = 3,650 um

DK...BC 8.00 / 14.6 Sag 4,450
Comfort Score 6

DK...BC 8.17 / 14.6 Sag 4,250
Comfort Score 7

DK...BC 8.37 / 14.6 Sag 4,050
Comfort Score 7
What You Need to Know About:
The Design and Fitting of SCL’s

Sagittal Depth of a Soft Lens

Base Curve Radius (BOZR) + Lens Diameter = Sagittal Height or (Sag) in microns
What are the sagittal heights of our currently available soft contact lenses??

Dr Ben Coldrick
Head of Technical Development
Optimec Limited
Malvern, Worcestershire
United Kingdom

Sagittal Height (SAG)
Is calculated as the distance (in microns) from the base line of the lens to the posterior apex at the geometric center of the lens.

Sag Measurement with the is830

Base Curve (BC) or Back Optic Zone Radius (BOZR)
The BC or BOZR are calculated based on a circle fit to all of the points on the posterior surface within the Optic Zone.

Base Curve Optic Radius (BCOR)
The Base Curve Optic Radius is calculated using the Chord Sag and a Chord Diameter of 10.0mm.

ISO 18369-3:2006, section 4.1.4.5:

\[
r = \frac{y}{2} + \frac{2}{8} \times r
\]

where:
- \( r \) = BC or BCOR
- \( y \) = The Chord Sag
- \( s \) = Chord Sag
**Sag Charts 2019 Daily Disposable**  
**Spherical Lens Designs**

<table>
<thead>
<tr>
<th>Brand</th>
<th>1 Day</th>
<th>1 Day Moist</th>
<th>Difference</th>
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<tbody>
<tr>
<td>Alcon</td>
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<td>9.0 - 3.00 14.3</td>
<td>262 microns</td>
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<tr>
<td>B + L</td>
<td>8.6 - 3.00 14.1</td>
<td>9.0 - 3.00 14.2</td>
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<tr>
<td>Cooper Vision</td>
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<td>9.0 - 3.00 14.2</td>
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<tr>
<td>J&amp;J</td>
<td>8.5 - 3.00 14.3</td>
<td>9.0 - 3.00 14.2</td>
<td></td>
</tr>
</tbody>
</table>

**How Do We Use This Data ???**

**Posterior Sagittal Depth of Daily Disposable Spherical Soft Lenses**
Additional lens properties (beyond sagittal depth) that can influence the physical fit of a specific SCL.

- Material modulus (hardness / stiffness)
- Material elasticity
- Anterior lens design
- Lens thickness
- Hydration/wettability
- Specific gravity
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