Change of Corneal Asphericity

Custom Q

Dr Paul H. Hughes
Different Methods of Customization

- Based on Wavefront
  - A-CAT
- Based on Corneal Topography
  - T-CAT
- Based on Corneal Tomography
  - Oculink
- Based on minimising spherical aberration
  - F-CAT
Visual Quality

- GOOD Visual Acuity?
- GOOD Night Vision?
- GOOD Visual Quality?
- ...IF IT’S NOT BROKEN, DON’T FIX IT!

- WFO - 85 % of cases
Custom Q

- Q-Factor is a measure of corneal asphericity.
- In normal population mean Q is - 0.25 (*Prolate*)
  - Central part of cornea has a stronger curvature than periphery.
- Ablation profile is designed to improve eye’s optical quality by optimising asphericity of the cornea.
Corneal Asphericity

- Spherical Cornea $Q = 0$
- Oblate Cornea $Q > 0$
  (Frog)
- Prolate Cornea $Q < 0$
  (Eagle)

Courtesy Prof. Seiler
Spherical Shape

$Q = 0$, several focal points
Corneal Asphericity

Prolate Cornea

One focal point
After Standard Myopic Ablation

Induced spherical aberration
$\Delta Q$ following Myopic WFG ablation

![Graph showing the relationship between Refractive correction sph. equ / D and Change in Q-value (Q20)].

Courtesy Prof. Seiler

Custom Q Dublin 2010
Custom Q Ablation Pattern

- Ablation pattern for $\Delta Q$ –0.60 for 6.5mm oz
- Prolate cornea is produced by:
  - Hyperopic-like correction in mid-periphery
  - PTK – like ablation in centre to avoid consecutive hyperopia
Oblate to Prolate

No sph/cyl correction Pre-OP:
$Q_{1/2} = 0.00$ (spheric)

Target $Q = -0.30$
From Prolate / sphere => to oblate

No sph/cyl correction Pre-OP:
$Q_{1/2} = 0.00$ (spheric)

Target Q = +0.30

Spheric $Q$-Value adjusted Oblate
“Myopic Effect”:
Myopic Sphere plus -Q

Sphere: \(-1.00D\) (OZ 6.50mm)

Change of Q-Value:
\(\Delta Q \sim 0.30\)

Attention!!!
different scale between both maps
“Myopic Effect”: Hyperopic Sphere plus -Q

Spherical part only: +1.00D

Change of Q-Value only:

ΔQ –0.30

15.71µm

5.90µm

Attention!!!

different scale between both maps
Q-Factor Effect to ablation profile

The central profile equals to a lamellar ablation (yielding a prolate cornea) while the mid periphery faces amended refractive power.

Rule of thumb: the refraction achieved using Custom-Q, corresponds to the refractive power of a corresponding ablation depth using a WFO ablation profile.

Example: -1D Sphere + (-0.3) ΔQ
Prof. Seiler has shown:

**OD: Q-Otimized**

-5.0 / -0.5 x 175° = 20/20  
UVA 20/16 +1  
Q = -0.1

**OS: WFG**

-5.0 / -0.5 x 5° = 20/20  
UVA 20/16  
Q = +0.40
Case 1

• 33 yo Female
• Refraction: -3.75 / -0.5 x 10 6/7.5
• Scotopic Pupils: 6.5mm OU
• Occupation: Lawyer
Allegretto Wave Eye Q
Custom Q module

- Eccentricity at angle of incidence of 20° measured by Allegro Topolyzer or Oculyzer
  - Flat and Steep Ecc Values
### Lens Fitting Software

#### Contact lens fitting:
- **Manufacturer:** Bausch + Lomb
- **Lens:** Quantum 1
- **r0(mm):** 7.60
- **Ecc:** 0.60
- **Toric r0:** 7.60
- **Ø(mm):** 9.00

#### Suggestions:
- B+Lomb Quantum 1: 7.60, 0.60, 9.00
- B+Lomb Quantum 2: 7.60, 0.60, 9.00
- Jen.lensA-B-K-O-T: 7.65, 0.45, 9.30
- Jen.lensAsphärflex: 7.60, 0.60, 9.30

#### Eccentricity of major meridians

<table>
<thead>
<tr>
<th></th>
<th>Curv. centr.</th>
<th>Degrees peripheral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecc. Nas</td>
<td>7.52</td>
<td>0.14 0.52 0.68 0.83 0.89</td>
</tr>
<tr>
<td>Ecc. Temp</td>
<td>7.62</td>
<td>0.48 0.38 0.30 0.39 0.51</td>
</tr>
<tr>
<td>Ecc. Inf</td>
<td>7.45</td>
<td>0.63 0.60 0.58 0.59 0.60</td>
</tr>
<tr>
<td>Ecc. Sup</td>
<td>7.37</td>
<td>0.40 0.46 0.51 0.48 0.50</td>
</tr>
<tr>
<td>Mean val.</td>
<td>7.49</td>
<td>0.41 0.49 0.51 0.57 0.62</td>
</tr>
</tbody>
</table>

#### Keratometric data
- **Rh:** 7.57 mm
- **Rv:** 7.41 mm
- **Rm:** 7.49 mm
- **Astigm.:** -0.95 D
- **Axis:** 17.9°
- **Ø cor:** 11.1 mm
- **Ecc.:** 0.62
- **Fix.dif.:** 0.26 mm

#### Display:
- Eccentricity
- Sagittal cur.
- Top-Test
- Fluo image

#### Position:
- **R/L(mm):** +0.00
- **U/D(mm):** +0.00
- **Incl.°:** -18

---

**Note:** The software interface shown is for educational purposes and may not reflect the exact functionalities of the actual software.
Allegretto Wave Eye Q
Custom Q module

- Eccentricity at angle of incidence of 20° measured by Allegro Topolyzer
  - Flat and Steep Ecc Values
- Fine adjustment of OZ, TZ (0.1mm) and refraction (0.01D)
- Lap-top converts Ecc to Q-value $\varepsilon = -(Q^2)$
  $\varepsilon_1 = \text{Average of flat values (blue) at 20°}$
  $\varepsilon_2 = \text{Average of steep values (red) at 20°}$
Custom Q Dublin 2010

**Examination Data**

**Pupil**
- Diameter: 6.00 mm

**Pachymetry**
- Central thickness: 605 μm

**Clinical Refraction**
- Sph: -3.57 D
- Cyl: -0.50 D
- Axis: 10°
- VD: 12.0 mm

**Fine adjustment of Refraction**

**Keratometry**
- K1: 44.60 D
- K2: 45.50 D
- @: 18°
- ε1: 0.49
- ε2: 0.55
- Q1: -0.24
- Q2: -0.30

**Surgeon Notes**

- Surgeon: Dr. P. H. Hughes
Allegretto Wave Eye Q
Custom Q module

• Eccentricity at angle of incidence of 20° measured by Allegro Topolyzer
  – Flat and Steep Ecc Values
• Lap-top converts Ecc to Q-value
• Fine adjustment of OZ, TZ (0.1mm) and refraction (0.01D)
• Target Asphericity up to –0.6
Treatment type: F-CAT
Nomogram: S 301

Clinical:
- Sph: -3.57 D
- Cyl: -0.50 D
- Axis: 10°
- VD: 12.0 mm

Target:
- Sph: 0.00 D
- Cyl: 0.00 D
- Axis: 10°
- Q: -0.37

Correction:
- Sph: -3.57 D
- Cyl: -0.50 D
- Axis: 10°

Correction: Myopic Astigmatism

Optical zone: 6.50 mm
Transition zone: 1.25 mm
Flap thickness: 130 μm
Corneal thickness: 605 μm
Stroma: 412 μm

Warning:
Fine Adjustment of OZ & TZ

Pattern preview: 2D Grid
3D
ani
Post-Op

UCVA 6/4.5 plano

Keratometric data: major meridians perpendicular (d=3mm)

Rh: 41.9D 112.0° 292.0°
Rv: 42.9D
Ast.: -1.0D
AxS.: 22.0°
Ecc.: -0.55
Øcor: 11.1
AA: 68%
**Eccentricity of major meridians**

<table>
<thead>
<tr>
<th>Curv. centr.</th>
<th>Degrees peripheral</th>
<th>10°</th>
<th>15°</th>
<th>20°</th>
<th>25°</th>
<th>30°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecc. Nas</td>
<td>8.09</td>
<td>0.56</td>
<td>0.62</td>
<td>0.65</td>
<td>-0.22</td>
<td>-0.48</td>
</tr>
<tr>
<td>Ecc. Temp</td>
<td>8.01</td>
<td>0.37</td>
<td>-0.26</td>
<td>-0.47</td>
<td>-0.57</td>
<td>-0.52</td>
</tr>
<tr>
<td>Ecc. Inf</td>
<td>7.87</td>
<td>0.61</td>
<td>0.48</td>
<td>0.35</td>
<td>-0.32</td>
<td>-0.47</td>
</tr>
<tr>
<td>Ecc. Sup</td>
<td>7.87</td>
<td>-0.34</td>
<td>-0.65</td>
<td>-0.81</td>
<td>-0.80</td>
<td>-0.71</td>
</tr>
<tr>
<td>Mean val.</td>
<td>7.96</td>
<td>0.30</td>
<td>0.04</td>
<td>-0.07</td>
<td>-0.48</td>
<td>-0.55</td>
</tr>
</tbody>
</table>

**Keratometric data**

- Rh: 8.05 mm
- Rv: 7.87 mm
- Rm: 7.96 mm
- Astigm.: -0.96 D
- Axis: 22.0°
- Ø cor: 11.1 mm
- Ecc.: -0.55
- Fix. dif.: 0.06 mm

**Contact lens fitting**

- Manufactur.: Müller-Welt
- Lens: CN
- r0(mm): 8.05
- Ecc: 0.00
- Toric r0: 8.05
- Ø(mm): 9.10
- Suggestions: Mü-Welt CN, Mü-Welt CNM, Mü-Welt CNM-ATO, Mü-Welt KC
- r0: 8.05
- Ecc: 0.00
- Ø: 9.10

**Display:**
- Eccentricity
- Sagittal cur.
- Top-Test
- Fluo image

**Position:**
- R/L[mm]: +0.00
- U/D[mm]: +0.00
- Incl.(°): -22
Case 2

- 29 yo Male
- Refraction: -1.75  6/6
- Scotopic Pupils:  7.0mm
- Occupation:  Shift Worker
Post-Op

0.25/-0.50 x 110   20/15

Keratometric data: major meridians perpendicular (d=3mm)

Rh: 41.1D  212.2°  32.2°
Rv: 41.0D
Ast.: +0.1D
Axs.: 122.2°
Ecc.: -0.24  122.2°  302.2°
Øcor: 11.9  6  4  2  0  2  4  6  AA:73%
WFO -1.75DS plano 20/20

Keratometric data: major meridians perpendicular (d=3mm)

Rh: 41.0D
Rv: 41.5D
Ast.: -0.5D
Axs.: 177.7°
Ecc.: -0.65
Øcor: 12.3
WaveFront Refraction:  ---
Clinical Refraction:  -1.71D -0.00D @ ...°

Refraction:  0.0%  Coma:  61.7%  Higher Order:  38.3%
WaveFront Refraction:  ---
Clinical Refraction:  -0.25D +0.00D @ ...°

Refraction:  0.0%  Coma:  40.8%  Higher Order:  59.2%

AL / ACC:  +1.00 / -0.25
WaveFront (1)  WaveFront Diameter:  7.0
Case 3

- 21 yo Male
- Refraction: -5.0 / -0.25 x 45  6/6
- Scotopic Pupils: 6.7mm
- Occupation: Student
F-CAT -5.00/-0.25 x 45
6.75 Oz
Current Treatment Regime

• Custom-Q up to -5.00D with no significant HOA and astigmatism < 1.50D
• Eccentricity values from Allegro Topolyzer OR Allegro Oculyzer
• Target Q increased by -0.15
• Increase OZ according to scotopic pupil size
• Compare ablation depth F-CAT vs WFO
Summary

• Higher Predictability
• Larger optic zones
• Improved quality of vision
• Q less affected than with WFO
Thank you