Results of Wavefront-Guided ablation for Myopia and Astigmatism Correction in Primary Eyes

Maria Regina Chalita, MD
Cleveland Clinic Foundation
Federal University of Sao Paulo - Brazil
Co-authors

• Meng Xu, M.S.

• Ronald R. Krueger, M.D.
 Purpose

• Evaluate the outcomes of wavefront-guided LASIK treatments for the correction of myopia and myopic astigmatism with the Alcon CustomCornea™ platform.
Methods

• 184 patients (237 eyes) underwent primary wavefront-guided LASIK treatment

• UCVA, BCVA, manifest refraction and wavefront analysis were assessed at 1 week, 3 months and 6 months post surgery

• Humidity, age and flap thickness were analyzed and correlated to the outcome (Multivariable Logistic Regression)
Methods

- **Absolute Magnitude** Outcomes were classified as:
  1. **Reduced**: value less than preoperative
  2. **Induced**: value greater than preoperative

- **Directional Magnitude** Outcomes were classified as:
  1. **Success**: lesser magnitude of same sign or less than \_ the magnitude of the opposite sign
  2. **Induced**: greater magnitude of the same sign
  3. **Overcorrection**: greater than half the value of the opposite sign
  4. **Induced and Overcorrection**: greater than full value of the opposite sign
### Refraction from Wavefront
- **Sphere**: -4.61 Diopters
- **Cylinder**: 0.96 Diopters
- **Axis**: 9 Degrees
- **Match**: 0.02%
- **Diameter**: 6.56 mm

### Aberrations
- **Defocus**: 8.29 RMS (microns)
- **Astigmatism**: 0.46
- **Coma**: 1.30
- **Spherical Aberration**: 0.62
- **Other**: 0.32

Directional Value (magnitude & sign)  Absolute Value (magnitude only)
**Success:** Reduction of magnitude without change of sign or less than half the magnitude of the opposite sign

**Induced:** Greater magnitude and the same sign

**OverCorrection:** Greater than half the magnitude of the opposite sign

**Induced & OverCorrection:** Greater magnitude and opposite sign
Results

• 184 patients: 81 F (44%): 103 M (56%)

• Age: Mean: 39.2 years (18-62)

• Follow-up: 237 eyes (1 week)
  129 eyes (3 months)
  48 eyes (6 months)
UCVA: Custom LASIK

- **1 Week:**
  - \( \geq 20/20 \) in 68.35% (N= 237)
  - 20/15 in 29.11%

- **3 Months:**
  - \( \geq 20/20 \) in 75.97% (N= 129)
  - 20/15 in 38.76%

- **6 Months:**
  - \( \geq 20/20 \) in 72.91% (N= 48)
  - 20/15 in 29.16%
BCVA after Custom LASIK

BCVA:

• 1 Week:
  ≥20/20 in 91.49% (N= 237)
  20/15 in 35.82%

• 3 Months:
  ≥20/20 in 96.90% (N= 129)
  20/15 in 50.99%

• 6 Months:
  ≥20/20 in 100% (N= 48)
  20/15 in 37.50%
Loss of BCVA after Custom LASIK

<table>
<thead>
<tr>
<th>Postoperative Visit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Week (N= 237)</td>
<td></td>
</tr>
<tr>
<td>20.28%</td>
<td>59.49%</td>
</tr>
<tr>
<td>13.95%</td>
<td>28.68%</td>
</tr>
<tr>
<td>0.77%</td>
<td>39.58%</td>
</tr>
<tr>
<td>0.00%</td>
<td>6.25%</td>
</tr>
<tr>
<td>3 Months (N= 129)</td>
<td></td>
</tr>
<tr>
<td>13.95%</td>
<td>56.59%</td>
</tr>
<tr>
<td>28.68%</td>
<td>31.25%</td>
</tr>
<tr>
<td>0.00%</td>
<td>29.16%</td>
</tr>
<tr>
<td>6 Months (N= 48)</td>
<td></td>
</tr>
<tr>
<td>20.28%</td>
<td>29.16%</td>
</tr>
<tr>
<td>13.95%</td>
<td>16.25%</td>
</tr>
<tr>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Legend:
- Loss >2 Lines
- Loss 2 Lines
- Loss 1 Line
- Same
- Gain 1 Line
- Gain 2 Lines
Total Aberrations and HOA

100% Reduction

1 week (N=237)
3 month (N=120)
6 month (N=48)

~30% Reduction

1 week (N=237)
3 month (N=120)
6 month (N=48)

Total Aberrations
High Order Aberrations
Defocus and Astigmatism

100% Reduction

80+% Reduction

Defocus

Astigmatism
Coma (Total)

~50% Reduction at 6 months

<table>
<thead>
<tr>
<th>Aberrations</th>
<th>RMS (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defocus</td>
<td>8.29</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>0.46</td>
</tr>
<tr>
<td>Coma</td>
<td>1.30</td>
</tr>
<tr>
<td>Spherical Aberration</td>
<td>0.62</td>
</tr>
<tr>
<td>Other</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Percent

1 week (N=237) | 58.1 |
3 month (N=120) | 57.5 |
6 month (N=48)  | 48.8 |
Other Terms

Aberrations  | RMS (microns)
------------|-------------
Defocus      | 8.29        
Astigmatism  | 0.46        
Coma         | 1.30        
Spherical Aberration | 0.62   
Other        | 0.32        

~50% Reduction at 6 months

Percent

<table>
<thead>
<tr>
<th>Week</th>
<th>N=230</th>
<th>N=120</th>
<th>N=48</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 week</td>
<td>71.7</td>
<td>28.3</td>
<td></td>
</tr>
<tr>
<td>3 month</td>
<td>85.0</td>
<td>35.0</td>
<td></td>
</tr>
<tr>
<td>5 month</td>
<td>47.9</td>
<td>52.1</td>
<td></td>
</tr>
</tbody>
</table>

Success  | Induced
Directional Value (magnitude & sign)
**Success:** Reduction of magnitude without change of sign or less than half the magnitude of the opposite sign.

**Induced:** Greater magnitude and the same sign.

**OverCorrection:** Greater than half the magnitude of the opposite sign.

**Induced & OverCorrection:** Greater magnitude and opposite sign.
Zernike Aberrations Components

Each component has Quality of Vision value in Custom LASIK

Zernike Point Spread Functions

Obl Astig, Defocus, Card Astig, Trifoil 6, Coma 7, Coma 8, Trifoil 9, Quadrafoil 10, 2nd Astig 11, Sph Ab 12, 2nd Astig 13, Quadrafoil 14
Wavefront Refraction

Wavefront Sphere
Nearly 100% success
Wavefront Cylinder
~40-50% success

J0 (Cardinal Astigmatism)

J45 (Oblique Astigmatism)
Coma 7 and 8

33-35% Success

37-50% Success
Trefoil 6 and 9

43-50% Success

31-45% Success

Trefoil 6

Trefoil 9
Spherical Aberration 12

10-15% Success, ~75% Induced

~12% Overcorrected and Induced are mostly negative Spherical Aberration becoming Positive
2nd Astigmatism 11 and 13

27-34% Success

29-38% Success

Astigmatism 11

Astigmatism 13
Quadrafoil 10 and 14

39-45% Success

41-45% Success

Quadrafoil 10

Quadrafoil 14
Results

- Flap thickness was **negatively associated** with overcorrections for M at 1 week (p=0.001), defocus at 1 week (p=0.020) and 6 months (p=0.046), and coma 7 at 1 week (p=0.019)

- Flap thickness was **positively associated** with overcorrection for SA at 1 week (p=0.008), quadrafoil 10 at 3 months (p=0.042) and trefoil 9 at 6 months (p=0.028)

- Humidity was **negatively associated** with overcorrections for defocus at 1 week (p<0.001), quadrafoil 14 at 1 week (p=0.023), M at 3 months (p=0.027), defocus at 3 months (p=0.009), and M at 6 months (p=0.049)
Results

• Age was negatively associated with overcorrections for secondary astigmatism 13 at 1 week (p=0.028) and coma 7 at 3 months (p=0.031)

• Age was positively associated with overcorrections for trefoil 6 at 3 months (p=0.008)
Conclusion

• Wavefront-guided LASIK for the correction of myopia with the Alcon CustomCornea™ platform showed good visual outcome.

• Total aberrations were reduced significantly after the procedure.

• High order aberrations are still being induced, but in a much less amount than when compared to conventional treatments.
Conclusion

- Lower humidity was associated with overcorrection of the spherical component.
- Thinner flaps were associated with overcorrection of defocus at 1 week and 6 months.
- Humidity, flap thickness and age were significantly correlated to overcorrection of some higher order parameters evaluated in the study.
Thank You for Your Attention!!!