Corneal Wavefront Guided Ablations with the Schwind Esiris Excimer Laser

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LASIK

- Successful surgical technique
- Many patients happy with results
- But some may have problems...
Aberrations induced by Refractive Surgery
Aberrations induced by Refractive Surgery
Purpose

Evaluate the efficacy of customized ablation on symptomatic lasik patients:

- Based on corneal wavefront data (CSO Topographer)
- Linked to a scanning spot excimer laser (Schwind Esiris)
Rationality

- In Post Lasik symptomatic patients, most of the aberrations are located in the cornea.
- Elevation topography maps can be used to obtain accurate data from the front surface of the cornea.
- Aberrometers might not get accurate data from this highly aberrated eyes.
What is our target corneal wavefront?
CSO Topographer
(Florence, Italy)

Methods

- Developed Arc-Step algorithm
- Advanced Pupil Detection
- Reference to Line of Sight
- Corneal Aberration Map
- Linked to Excimer Laser
Methods

Schwind ESIRIS
(Kleinostheim, Germany)

- Scanning spot excimer laser
- 0.8 mm Gaussian beam
- 200 Hz frec. rate
- 300 Hz IR eye-tracker
Methods

Patients

- 12 eyes of 9 patients with previous Myopic Lasik Surgery
- Retreatment was planned because of disturbing optical problems
- 24 eyes of 12 people without previous surgery were used as control group to analyze the induced corneal aberrations
**Methods**

**Procedure**

- **Corneal Wavefront**
  - 6 – 6.5 mm pupil
  - Tilt excluded
  - 2nd order Manif. Rx
  - 3rd to 6th order included

- **ORK-W**
  - LINK soft
  - Shot file
  - Transition zone

- **ESIRIS**
  - Std Technique
SURGICAL TECHNIQUE

- The crosshairs are aligned with the limbal marks.
- If the eye moves from the reference axis, the treatment is stopped and realigned.
Methods

Data Analysis

- 5 topographies were obtained from each patient (only one selected)
- Statistical methods
  - Non-parametric tests
    - 2 Paired samples: Wilcoxon
    - 2 Indep. samples: Mann-Whitney
  - SPSS 8.0
12 EYES OF 9 PATIENTS WITH PREVIOUS LASIK SURGERY (3 months follow-up)

- **AGE** average 32 years (from 24 to 38)
- **SEX**
  - female 41.7% or 5 eyes
  - male 58.3% or 7 eyes
- **EYE**
  - left 41.7% or 5 eyes
  - right 58.3% or 7 eyes
Preop and postop Refractive Error

- Preop
- Sph Equiv: -1.57
- Sphere: -0.36
- Cylinder: -1.11

- Postop
- Sph Equiv: -0.32
- Sphere: -0.91
- Cylinder: -0.1
Results

Stability

1. STABILITY: Achieved Change in Refr. over Time

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2. SAFETY: Change in BSCVA - Percentage

Results

Safety

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1 (12) 3 (11)
Results

Predictability

y = -0.01x^2 + 1.01x - 0.26

Attempted delta SR equiv. [D]

Achieved [D]

overcorrected

undercorrected

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Efficacy

4. EFFICACY: UCVA - Percent

- 20/15 or better: 27%
- 20/20: 36%
- 20/25: 8%
- 20/30: 18%
- 20/40: 17%
- 20/50: 17%
- 20/60 or worse: 18%

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pre op (12)
3 m (11)
Refractive Outcome

5. Refractive outcome - % within Attempted

-1.01 to -2: 25%
-0.51 to -1: 75%
-0.51 to +0.5: 73%
+0.51 to +1: 75%
+1.01 to +2: 73%

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Results

Tilt (1st order)

RMS microns

Preop | Postop | Control

1.07 | 0.63 | 0.51

p = 0.12

42% Reduction

80% Reduction

Tilt was not included in the shotfile
### Results

**High Order aberrations (6mm Pupil)**

<table>
<thead>
<tr>
<th></th>
<th>RMS Mean ± 2 SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12 preop</strong></td>
<td>1.0</td>
</tr>
<tr>
<td><strong>12 postop</strong></td>
<td>0.8</td>
</tr>
<tr>
<td><strong>12 control</strong></td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Coma**

<table>
<thead>
<tr>
<th></th>
<th>RMS Mean ± 2 SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coma control</strong></td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Coma post</strong></td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Coma Preop</strong></td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Z(4,0)**

- **68.0% Reduction**
- **p=N.S.**

**Spherical**

<table>
<thead>
<tr>
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<th>RMS Mean ± 2 SE</th>
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</thead>
<tbody>
<tr>
<td><strong>Spherical control</strong></td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Spherical post</strong></td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Spherical Pre</strong></td>
<td>0.6</td>
</tr>
</tbody>
</table>

**33.5% Reduction**

**62.0% Reduction**

**18.9% Reduction**

**35.1% Reduction**
Case # 2

- 34 yo male
- Myopic Lasik 1 year ago
- Right eye
  - Glare
  - Bad visual acuity
- UCVA OD 20/60
- BCVA OD 20/32 (+0.50sph -3x90° Cyl)
Shot File from ORK-W

Topography
UCVA preop: 20/60  
UCVA postop: 20/25
Corneal Wavefront  Pupil size 6 mm

RMS preop: 1.46µm  
RMS postop: 0.75µm
Contrast Sensitivity Function

Preop

Postop
Conclusions

- Customized Ablations based on CSO topofiles and ORK-W software proved to be effective reducing preoperative corneal High Order Aberrations.

- Corrections were more effective for coma than for spherical aberration.
Conclusions

● Esiris is a laser very well suited for customized ablations based on corneal wavefront

● Adjustments in the nomogram are necessary to improve clinical results

● More clinical research is required to validate this new technology