Comparing Spherical Aberration after Conventional and Wavefront-Optimized LASIK for the Treatment of Hyperopia

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Disclosure

- Dr. Waring and Dr. Stahl have no financial interest in the material presented.
- Dr. Stahl is a clinical investigator for AcuFocus.
- Dr. Durrie is a clinical investigator for:
  - Alcon
  - Allergan
  - Wavefront Science
  - NeuroVision
  - High Performance Optics
  - OcuSense
  - QuestVision
  - Visiometrics
  - Tracey Technologies
  - Bausch and Lomb
  - IntraLase
  - Refractec
  - AcuFocus
  - WaveTec
Study Design

- Randomized, prospective, single center study
- Dominant eyes of 50 hyperopic patients
  - 25 eyes Alcon Ladar 4000
    - conventional
  - 25 eyes WaveLight Allegretto 200 Hz
    - “wavefront-optimized”
- Plano target
- No nomogram adjustment used for either laser
- IntraLase femtosecond laser used to create all flaps
- 6 Month follow up
  - Uncorrected visual acuity
  - Residual spherical equivalent and cylinder
  - Induced spherical aberration
    - Alcon LADARWave wavefront aberrometer
## Patient Demographics

<table>
<thead>
<tr>
<th></th>
<th>Alcon</th>
<th>WaveLight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age</td>
<td>53 years</td>
<td></td>
</tr>
<tr>
<td>Mean Spherical Equivalent</td>
<td>+1.55 ±0.98D</td>
<td>+1.33 ±0.76D</td>
</tr>
<tr>
<td>Range</td>
<td>+0.50D to +4.50D</td>
<td>+0.50D to +4.00D</td>
</tr>
</tbody>
</table>
## Treatment Zones

<table>
<thead>
<tr>
<th>Treatment Zones</th>
<th>Alcon</th>
<th>WaveLight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Zone</td>
<td>6.0mm</td>
<td>6.5mm</td>
</tr>
<tr>
<td>Total Ablation Zone</td>
<td>9.0mm</td>
<td>9.0mm</td>
</tr>
</tbody>
</table>
Uncorrected vision – 1 week

UCDVA at 1 Week

- 20/16 or better: 8% (Alcon), 27% (WaveLight)
- 20/20 or better: 32% (Alcon), 77% (WaveLight)
- 20/25 or better: 64% (Alcon), 92% (WaveLight)
- 20/40 or better: 84% (Alcon), 100% (WaveLight)

p = 0.002

Legend:
- Yellow = Alcon
- Red = WaveLight
Postoperative UCDVA

UCDVA at 6 Months

Percentage of Patients

- 20/16 or better
  - Alcon: 32%
  - WaveLight: 52%

- 20/20 or better
  - Alcon: 72%
  - WaveLight: 84%

- 20/25 or better
  - Alcon: 92%
  - WaveLight: 92%

- 20/40 or better
  - Alcon: 96%
  - WaveLight: 100%

p = 0.33

Legend:
- Yellow: Alcon
- Red: WaveLight
Predictability at 6 Months

- 52% ±0.25
- 72% ±0.50
- 96% ±0.75
- 100% ±1.00

Percentage of Patients

Diopeters from Plano

p = 0.65

Alcon
WaveLight
Postoperative Wavefronts

Alcon

WaveLight
Standard Deviation of Induced Spherical Aberration

![Bar chart showing preoperative and postoperative standard deviation of spherical aberration.](chart_image)
Postoperative Spherical Aberration

Residual Spherical Aberration

Post-Op Spherical Aberration (microns)

Preop Spherical Equivalent (diopters)

- Alcon
- WaveLight
Differences in Laser Algorithms

• **Alcon Ladarvision4000**
  – Conventional treatment
  – Not wavefront guided

• **WaveLight Allegretto**
  – “Wave-front optimized”
  – Not wavefront guided
  – Radial ablation efficiency
Understanding “Wavefront-Optimization”

- Conventional Treatments
  - Central and peripheral cornea treated with the same amount of energy
  - Does not compensate for natural slope in the cornea
  - Increased angle of incidence and reflection cause a reduction in effective peripheral ablation (central circular beam becomes ovaloid peripherally)
  - Tangential energy loss at the edges results in a more oblate shape
  - Induce spherical aberration

- “Wavefront-Optimization”
  - Not wavefront guided
  - Uses an algorithm derived from population based preoperative and postoperative wavefront data to determine ablation contours
  - Additional pulses applied in the periphery to pre-compensate the slope in the cornea
  - Preserves asphericity, and results in a more prolate ablation
  - Less induced spherical aberration
# FDA Hyperopic Treatment Outcomes

## UCVA 20/20 or better

<table>
<thead>
<tr>
<th>Laser</th>
<th>N</th>
<th>1 month</th>
<th>3 month</th>
<th>6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nidek EC-5000</td>
<td>290-291</td>
<td>59.9%</td>
<td>55.9%</td>
<td>60%</td>
</tr>
<tr>
<td>Visx Star S2 and S3</td>
<td>108-115</td>
<td>50.4%</td>
<td>54.0%</td>
<td>56.5%</td>
</tr>
<tr>
<td>Bausch &amp; Lomb Technolas 217a</td>
<td>131-159</td>
<td>50.8%</td>
<td>60.0%</td>
<td>61.4%</td>
</tr>
<tr>
<td>WaveLight Allegretto Wave</td>
<td>212-232</td>
<td>61.6%</td>
<td>68.9%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Alcon LADARVision 4000</td>
<td>59</td>
<td>59.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durrie et al. WaveLight</td>
<td>25</td>
<td>80%</td>
<td>92%</td>
<td>84%</td>
</tr>
<tr>
<td>Durrie et al. Alcon</td>
<td>25</td>
<td>58%</td>
<td>76%</td>
<td>72%</td>
</tr>
</tbody>
</table>
Conclusions

• Preliminary results excellent with both lasers
• “Wavefront-optimized” resulted in less induced negative spherical aberration
• No loss of BSCVA
• Need to evaluate the topography and contrast sensitivity
THANK YOU