Comparison of Retinal Image Quality between SBK and PRK

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Study Design

- Purpose: To compare optical quality and intraocular scatter between SBK and PRK using double-pass (DP) technology.

- Analysis performed using the Optical Quality Analysis System (OQAS) (Visiometrics SL, Tarrasa, Spain).

- Author has no commercial affiliation with Visiometrics.
• 25 patients (50 eyes)
  – One eye treated with SBK (25 eyes)
  – Fellow eye treated with PRK (25 eyes)
  – Subjects randomized according to dominant eye
  – All SBK flaps made using the 60 Hz IntraLase FS Laser
  – All eyes treated with wavefront guided Alcon LADAR6000
  – Average Age: 31 ± 5 years
  – Mean MRSE:
    • SBK eyes: -4.18 ± 1.03 D
    • PRK eyes: -4.30 ± 1.04 D
  – Measurements at pre-op, 1, 3, and 6 months
Introduction

What is SBK?

Sub-Bowman's Keratomileusis (SBK)

- Corneal flap just below the level of Bowman’s membrane created by Intralase FS laser
- Optimal flap: 8.5 mm diameter, 100 microns or less, centered on visual axis
- Has advantage of both Lasik and surface ablation
- Decreased post-op dryness, decreased loss of sensitivity, and decreased higher order aberrations
Part of larger SBK vs. PRK comparative study:

1. Visual acuity, refractive Outcome
2. Corneal sensitivity
3. Dry eye signs/symptoms
4. Endothelial cell count
5. Keratocyte cell density – ARVO 2007
6. Corneal biomechanical properties – ASCRS 2007
7. Intraocular pressure comparison:
   a. Goldmann Applanation Tonometer (GAT)
   b. Ocular Response Analyzer (ORA)
   c. Pascal Dynamic Tonometer (PDT)
8. Wavefront analysis
9. Patient questionnaire
10. OQAS analysis
Optical Quality Analysis System (OQAS)

- Objective measurement of visual quality
- Uses double-pass (DP) technology to measure light reflection from retina including light scatter (LS) and higher order aberrations (HOA)
Introduction

How does OQAS work?

Double-Pass Technology

1. A motorized optometer lenses corrects for patient’s defocus
2. First pass, the system sends a diode laser light (780 nm) into the eye
3. Produces an image of a circular spot on the retina
4. Second pass, the reflection of the spot is measure by a light camera
5. Directly measures the point spread function (PSF) of the optical system
6. Using Fourier analysis, the PSF data is translated to a modulation transfer function (MTF) value
7. Measurement at 4mm undilated pupils
The main advantage of this instrument compared with aberrometers is that it directly obtains the actual retinal images including lower, higher order aberrations and *intraocular scattering*.

Current aberrometers mathematically calculate MTF values

OQAS measures MTF directly
MTF Value

- MTF is the square root of the modulus of the Fourier transformation of the average double-pass image
- Correlates to the loss of contrast in the retinal image for each spatial frequency
- Average value is 30.0
- The higher the MTF value the higher the quality of image
• OQAS numerical measurement of contrast sensitivity
• Average value is 1.0
• Higher the contrast value the higher the quality of image
Results
Uncorrected Vision – 1 month

N = 25
Results

Uncorrected Vision – 1 month

<table>
<thead>
<tr>
<th>Vision Grade</th>
<th>SBK</th>
<th>PRK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/16 or better</td>
<td>64%</td>
<td></td>
</tr>
<tr>
<td>20/20 or better</td>
<td></td>
<td>80%</td>
</tr>
<tr>
<td>20/25 or better</td>
<td>88%</td>
<td>76%</td>
</tr>
<tr>
<td>20/40 or better</td>
<td>100%</td>
<td>92%</td>
</tr>
</tbody>
</table>

N = 25
Results

Uncorrected Vision – 3 months

N = 25
## Results

### MRSE and Cylinder

<table>
<thead>
<tr>
<th></th>
<th>Pre-OP</th>
<th>1 month</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MRSE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBK</td>
<td>-4.18</td>
<td>-0.17</td>
<td>-0.12</td>
</tr>
<tr>
<td>PRK</td>
<td>-4.30</td>
<td>-0.08</td>
<td>-0.15</td>
</tr>
<tr>
<td><strong>Cylinder</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBK</td>
<td>-0.70</td>
<td>-0.27</td>
<td>-0.18</td>
</tr>
<tr>
<td>PRK</td>
<td>-0.61</td>
<td>-0.38</td>
<td>-0.40</td>
</tr>
</tbody>
</table>
Which Eye Has Better Vision?
Through 3 Months

![Bar chart showing the percentage of times one eye has better vision than the other through 3 months.]

- **1 Month**
  - SBK Better Vision: 70%
  - PRK Better Vision: 10%
  - Both Same: 20%

- **3 Months**
  - SBK Better Vision: 60%
  - PRK Better Vision: 20%
  - Both Same: 20%

*N=25*
**OQAS**

**Average MTF**

![Bar graph showing MTF over time for different conditions](image)

- **Pre-Op**: 30.09
- **1 Month**: 29.39
- **3 Month**: SBK
- **6 Month**: PRK

**N=25**
OQAS
Average MTF

Pre-Op | 1 Month | 3 Month | 6 Month
-------|---------|---------|---------
SBK:   | 30.09   | 29.39   | 31.85   |
PRK:   | 25.61   | 29.49   | 29.93   |

N=25
OQAS
Contrast Value

Contrast Value

Pre-Op  1 Month  3 Month  6 Month

N=25
OQAS
Contrast Value

N=25
OQAS
Contrast Value

N=25
OQAS
Contrast Value

N=25
# OQAS Results

## Change in MTF Value

<table>
<thead>
<tr>
<th></th>
<th>Pre-Op</th>
<th>1 Month</th>
<th>3 Month</th>
<th>6 Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBK</td>
<td>--</td>
<td>+6%</td>
<td>+3%</td>
<td>-1%</td>
</tr>
<tr>
<td>PRK</td>
<td>--</td>
<td>-13%</td>
<td>0%</td>
<td>-5%</td>
</tr>
</tbody>
</table>

## Change in Contrast Value

<table>
<thead>
<tr>
<th></th>
<th>Pre-Op</th>
<th>1 Month</th>
<th>3 Month</th>
<th>6 Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBK</td>
<td>--</td>
<td>+8%</td>
<td>+2%</td>
<td>-1%</td>
</tr>
<tr>
<td>PRK</td>
<td>--</td>
<td>-13%</td>
<td>-1%</td>
<td>-7%</td>
</tr>
</tbody>
</table>
## OQAS

### Sample Point Spread

<table>
<thead>
<tr>
<th></th>
<th>Pre-Op</th>
<th>1 month</th>
<th>3 month</th>
<th>6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SBK</strong></td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>MTF</strong></td>
<td>39.43</td>
<td>42.11</td>
<td>41.67</td>
<td>42.56</td>
</tr>
<tr>
<td><strong>PRK</strong></td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>MTF</strong></td>
<td>38.79</td>
<td>24.51</td>
<td>35.89</td>
<td>36.24</td>
</tr>
</tbody>
</table>
Retinal Image Quality
Normal Eye

- 33 year old male
- BSCVA 20/15

- MTF = 43.58
- Contrast Value = 1.48
Retinal Image Quality
Cortical Cataract

- 62 year old male
- BSCVA 20/20-2

- MTF = 14.50
- Contrast Value = 0.48
Retinal Image Quality
Nuclear Sclerosis

- 66 year old male
- BSCVA 20/25

- MTF = 8.92
- Contrast Value = 0.3
Conclusion

• Double pass technique can be used to assess the overall image quality not possible with snellen visual acuity charts
• At 1 month, the retinal image quality decreased significantly in PRK eyes compared to SBK eyes
• Retinal image quality was higher in all post-op visits for SBK eyes compared to PRK eyes
• There was a slight decrease in retinal image quality from 3 month to 6 month in all eyes
• Further study needed on importance of scatter on overall quality of vision