Corneal Changes Following LASIK and Enhancement with Microkeratome and Femtosecond Laser Flaps

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Commercial Disclosures

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• Daniel Pierre, MSIV (none)
Purpose
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• To determine the thickness of both LASIK flaps and residual stromal bed at the time of primary LASIK and LASIK enhancement

• To compare differences in these two parameters according to ablation type

• To determine longitudinal changes in these two parameters between Microkeratome and femtosecond laser procedures
Methods
98 patients
n=196 eyes

Microkeratome
n=79 eyes

Femtosecond
N=117 eyes

Primary LASIK treatment

Myopia n=59
Hyperopia=20

Myopia n=91
Hyperopia=26
Methods

**Primary procedures:**
- Microkeratome (Moria M2, 110 um head)
- Femtosecond (IntraLase 15 and 30 kHz, 110 um flap)

**Laser Platform:**
- Alcon LadarWave 4000

- Preoperative and intraoperative Ultrasound Pachymetry 50 HZ (Sonogage) probe
Measurements
Measurements

**Primary Procedures**

- Central Corneal Thickness
- Pre-ablation Stromal Thickness
- Post-ablation Stromal Thickness
Measurements

Enhancement Procedures

- Central Corneal Thickness
- Pre-enhancement Stromal Thickness
- Post-ablation Stromal Thickness
Calculations
Primary Procedures
Central Corneal Thickness (CCT)
Primary Flap Thickness (PFT)

PFT = CCT - PAST

Preablation Stromal Thickness (PAST)
Calculated Primary Post-Ablation Depth (CPPAD)

Theoretical Laser Ablation Depth (TLAD)

\[ CPPAD = PAST - TLAD \]
Measured Ablation Depth (MAD)

\[ \text{MAD} = \text{PAST} - \text{POST} \]

Post-Ablation Stromal Thickness (POST)
Enhancement Central Corneal Thickness (ECCT)
Enhancement Flap Thickness (EFT)

\[ \text{EFT} = \text{ECCT} - \text{PEST} \]

Pre-enhancement Stromal Thickness (PEST)
Calculated Enhancement Post-Ablation Depth (CEPAD)

\[ \text{CEPAD} = \text{PEST} - \text{TLAD} \]
Measured Enhancement Ablation Depth (MEAD)

MEAD = PEST - POST

Post-Ablation Stromal Thickness (POST)
Statistical Analysis

- Paired t-test was used to assess differences in thickness between:
  - Primary & Enhancement flaps
  - Calculated & pre-enhancement stromal thickness
  - Calculated & Measured ablation depth

- A p value < 0.05 was considered statistically significant
Results
Microkeratome
# Microkeratome Flap Thickness

<table>
<thead>
<tr>
<th></th>
<th>PFT</th>
<th>EFP</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>114.9</td>
<td>141.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>120</td>
<td>119.8</td>
<td>0.94</td>
</tr>
</tbody>
</table>
## Microkeratome
### Residual Stromal Bed Thickness

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>CPPAD</th>
<th>PEST</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>364.1</td>
<td>346.6</td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>366</td>
<td>411.5</td>
<td></td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Femtosecond
### Femtosecond: Flap Thickness

<table>
<thead>
<tr>
<th>Mean</th>
<th>PFT</th>
<th>EFT</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>134.9</td>
<td>141</td>
<td>0.003</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>126</td>
<td>118.6</td>
<td>0.07</td>
</tr>
</tbody>
</table>
### Femtosecond: Residual Stromal Bed Thickness

<table>
<thead>
<tr>
<th>Mean</th>
<th>CPPAD</th>
<th>PEST</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td>351.2</td>
<td>331.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td>376.32</td>
<td>421.2</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Femtosecond Primary Treatment: Difference in Ablation Depth

<table>
<thead>
<tr>
<th></th>
<th>TLAD</th>
<th>MAD</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td>85</td>
<td>102</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td>54</td>
<td>19</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Femtosecond Enhancement Difference in Ablation Depth

<table>
<thead>
<tr>
<th>Mean</th>
<th>ETLAD</th>
<th>MEAD</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia</td>
<td>15</td>
<td>10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>21</td>
<td>7</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Primary LASIK vs. Enhancements
## Flap Thickness Difference
Primary LASIK vs. Enhancement

<table>
<thead>
<tr>
<th></th>
<th>Microkeratome</th>
<th>p value</th>
<th>Femtosecond</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td>+ 26.3</td>
<td>&lt;0.001</td>
<td>+ 6.1</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td>- 0.25</td>
<td>0.94</td>
<td>- 7.42</td>
<td>0.07</td>
</tr>
</tbody>
</table>

\[ \Delta \text{FT} = \text{EFT} - \text{PFT} \]
### Stromal Thickness Difference
Primary LASIK vs. Enhancement

<table>
<thead>
<tr>
<th></th>
<th>Microkeratome</th>
<th>p value</th>
<th>Femtosecond</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myopia</strong></td>
<td>- 17.97</td>
<td>&lt;0.001</td>
<td>- 19.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Hyperopia</strong></td>
<td>+ 45.6</td>
<td>&lt;0.001</td>
<td>+ 44.8</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

\[ \Delta ST = PEST - CPPAD \]
Conclusions
Microkeratome vs. Femtosecond

*Myopic Ablations*

- PFT thinner due to underestimation of pre-ablation stromal bed
- Calculated post ablation depth > pre-enhancement stromal bed
  
  ➢ Substraction methods are very sensitive to tissue hydration
Microkeratome vs. Femtosecond

Myopic Ablations

• PFT femtosecond flaps > microkeratome flaps
  ➢ Possible fluid displacement during flap creation
• Difference Femtosecond & microkeratome EFT not significant
Microkeratome vs. Femtosecond

Hyperopic Ablations

• No statistically significant differences between PFT and EFT
• Pre-enhancement stromal bed > calculated post ablation depth

- Lamellar tension reduction from more peripheral ablation may lead to increased baseline tissue hydration
Thank you