Surface Ablation Refractive Surgery

Abdel Rahman ElSebaey, MD, PhD.

Menoufia University

History

• Correction of optical defects of human eye started 1200 AD.
• Spherical error corrected by spectacle on 13th century.
• Astigmatism correction started on the 19th century.
• HOAs started last decade of the 20th century.
Key Milestones

- **Excimer Laser** 1970
- **PRK** 1970s
- **LASIK** 1990
- **First LASEK** 1996
- **Epi-LASIK** 2002

FDA Approval

- **PRK** 1995
- **LASIK** 1999
Surface Ablation Techniques

Overview

Four Main Techniques

- Conventional PRK
- PRK with MMC
- LASEK
- Epi-LASIK
In 1970 PRK was the first procedure of this new era.

First PRK was done with broad beam laser and small optical zone.

This was associated with:
- Tendency for regression
- Generated HOA

These factors drove the industry to develop LASIK with the introduction of precise microkeratomes.

Flap related complications and the risk of ectasia drove the surgeons to re-examine the surface techniques with the development of ASA.
Advanced surface ablation

- PRK with MMC
- LASEK
- Epi-LASIK
Different Techniques - Main Themes

Different Techniques - Main Themes

PRK  
LASEEK  
LASIK
Epithelial Removal

- Removal with a blade or a brush
- Removal with the use of alcohol (LASEK)
- Epithelial Flap with Epi-keratome (Epi-LASIK)
- Epithelial removal with the laser (Trans-PRK)
PRK

- Remove the corneal epithelium manually (Brush).

- Excimer laser (193 nm) is used to precisely sculpt the stroma according to the specific refractive error to be treated.

- Covering the cornea with a bandage contact lens to facilitate healing of the epithelium.

Brush Versus LASER
LASEK

- Alcohol dilute solution (20%) is used on the eye in a holding cup (8.5mm diameter) for approximately 30 seconds in order to loosen the epithelium.

- After the loosened epithelium is slid to the side, the stromal surface is treated with the excimer laser.

- The epithelium is replaced or can be directly removed.
Epithelium is separated as a sheet and replaced on the ablated stroma.

A special device (**Epikeratome**) can be used in an automated procedure.

No use of alcohol (Healthy Epithelium).

Dealing with drawbacks of PRK (postoperative pain, late visual recovery, haze) and avoiding risks of LASIK.
Epikeratome
Trans PRK

- Epithelium is removed with laser with the refractive error in single step

- criticism:
  - In thin epithelium -> over correction.
  - In thick epithelium -> under correction.
  - Excessive laser -> produce more heat on the stroma.

- However clinical studies showed no effect of these criticizing points.
CONCLUSIONS:
Our results indicate that with time, surface ablation tended to be performed more often than LASIK for the correction of myopia in our cohort. Increased awareness of risk factors and preoperative risk assessment tools, such as the ERFSS, have shifted the current practice of refractive surgery from LASIK towards surface ablation despite the former's advantages, especially in cases in which the risk for ectasia is more than minimal (risk score 2 and higher).
Advantages of surface ablation

Safe
• No Flap & No Flap Complications
• Safe on Posterior Segment

Safe
• Less thinning with more residual stromal bed.
• Less Risk for Ectasia.

Easy
• For all Grades of Myopia up to – 8.0 (-10) D.

When To DO?
### Advantages of surface ablation

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thin Cornea (Up to 470 um)</td>
<td>Dry Eye Syndrome</td>
<td>Flat or Steep Corneas</td>
<td>Basement Membrane Dystrophy</td>
</tr>
</tbody>
</table>

### Advantages of surface ablation

<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Wide Pupils</td>
<td>Chronic Blepharitis</td>
<td>Recurrent Corneal Erosions</td>
<td>Narrow palpebral fissure or sunset eye</td>
<td>After LASIK or Phakic IOL Surprises</td>
</tr>
</tbody>
</table>
Disadvantages

- Delayed Visual Recovery (up to few weeks).
- Postoperative Pain for 72 hours.
- Prolonged Medications e.g. steroids (3 months).
- Corneal Haze (May Persist).
- Corneal Scarring (Rare but dramatic).
Post Operative Haze

Get Over the "Haze"
Avoiding the haze: Preoperative

- Avoid doing ASA in patients with history of excessive healing as skin keloids.

Avoiding the haze: Intraoperative

- Mitomycin C 0.02% for up to 1.5 min depending on the attempted correction (delay in epithelial healing at 2 min)
- Washing the bed with cold BSS
Avoid early removal of contact lens before epithelial healing.
- Long term topical steroid therapy.
- Avoid sunrays exposure up to 3 months.

Avoiding the haze: Postoperative

Get Over the “Aberrations”
**Wave-Front Guided (WFG) & Wave-front optimized (WFO) PRK**

Marked Reduction in Postoperative **High Order Aberrations**.

Comparable Results to **Custom-LASIK**.

Recommended for **Military Personnel**.

**PRK * Special PRK?**
Special PRK

Wavefront Guided versus Wavefront Optimized PRK

Wavefront-Guided versus Non-Wavefront-Guided Photorefractive Keratectomy for Myopia: Meta-Analysis of Randomized Controlled Trials

Hidenaga Kobashi¹, Kazutaka Kamiya¹, Keika Hoshi², Akihito Igarashi¹, Kimiya Shimizu¹
1 Department of Ophthalmology, University of Kitasato School of Medicine, Kanagawa, Japan, 2 Department of Preventive Medicine, University of Kitasato School of Medicine, Kanagawa, Japan

Meta Analysis WFG versus WFO PRK

2014

Five Clinical Trials

298 eyes

No Superiority for one to the Other Technique
Conventional versus Custom PRK

Conventional versus custom ablation in photorefractive keratectomy: Randomized clinical trial

Farid Karimian, MD, Sepehr Feizi, MD, Mohammad Reza Jafarinasab, MD

<table>
<thead>
<tr>
<th></th>
<th>Conventional PRK</th>
<th>Custom PRK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20 or Better</td>
<td>68%</td>
<td>68%</td>
</tr>
<tr>
<td>Mean RMS of HOA</td>
<td>0.54</td>
<td>0.6</td>
</tr>
<tr>
<td>Spherical aberrations</td>
<td>0.08</td>
<td>0.1</td>
</tr>
</tbody>
</table>

46
Topography-Guided versus WFO PRK

**Topography-guided vs Wavefront-optimized Surface Ablation for Myopia Using the WaveLight Platform: A Contralateral Eye Study**

Khalil Ghasemi Falavarjani, MD; Masih Hashemi, MD; Mehdi Modarres, MD; Mostafa Soltan Sanjari, MD; Niloufar Darvish, BSc; Arzhang Gordiz, MD

<table>
<thead>
<tr>
<th>Topo-guided PRK</th>
<th>WFO PRK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20 or Better</td>
<td>Mean Spherical Error</td>
</tr>
<tr>
<td>90%</td>
<td>-0.1</td>
</tr>
<tr>
<td>-0.4</td>
<td>Mean Astigmatism</td>
</tr>
<tr>
<td>-0.05</td>
<td>-0.3</td>
</tr>
</tbody>
</table>
Trans PRK vs Alcohol assisted PRK

Single-Step Transepithelial PRK vs Alcohol-Assisted PRK in Myopia and Compound Myopic Astigmatism Correction

Bartlomiej J. Kaluzny, MD, PhD, Iwona Cieslinska, MD, Samuel A. Mosquera, PhD, and Shwetabh Verma, MSc

Conclusion

Single-step transepithelial PRK and conventional PRK provide very similar results 3 months postoperatively. These procedures are predictable, effective, and safe for correction of myopia and compound myopic astigmatism.

Standard, WFG and Topo-guided PRK are Similarly Effective

PRK * LASEK * Epi-LASIK?
Meta Analysis PRK versus LASEK

2008

Seven Clinical Trials of PRK versus LASEK

604 eyes for 302 patients

Comparison of laser epithelial keratomileusis and photorefractive keratectomy for the correction of myopia: a meta-analysis
M Cai, XM Chen, and P Lu.
Review published: 2008

PRK

1 Year Follow Up

LASEK

0.5 D of Target

20/20 or Better

73%

54%

71%

64%

Within 0.5 D of Target

20/20 or Better
Epi-LASIK versus LASEK

2008

Comparison of Visual Results Between Laser-Assisted Subepithelial Keratectomy and Epipolis Laser In Situ Keratomileusis to Correct Myopia and Myopic Astigmatism

_MIGUEL A. TEUS, LAURA DE BENITO-LLOPIS, AND MONTSERRAT GARCÍA-GONZÁLEZ_

Epi-LASIK 1-3 Months Follow Up

- 79% 20/20 or Better
- 89% Within 0.5 D of Target

LASEK

- 66% 20/20 or Better
- 77% Within 0.5 D of Target
PRK versus LASIK!

Surface Ablation Versus LASIK

Laser in situ keratomileusis versus surface ablation: Visual outcomes and complications

Faisal Ghadhfan, MD, FRCS, Ali Al-Rajhi, MD, FRCS, FRCOphth, Michael D. Wagoner, MD
Surface Ablation Versus LASIK

Low to Moderate Myopia: 1 Year Follow Up

Laser in situ keratomileusis versus surface ablation: Visual outcomes and complications
Faisal Ghandhy, MD, FRCS, Ali Al-Rajhi, MD, FRCS, FRCOphth, Michael D. Wagoner, MD

Comparison LASIK * LASEK * PRK * Trans-PRK

- LASIK
- LASEK
- PRK
- Trans-PRK

20/20
- LASIK: 55%
- LASEK: 48%
- PRK: 74%
- Trans-PRK: 65%

20/40
- LASIK: 98%
- LASEK: 94%
- PRK: 92%
- Trans-PRK: 100%

Within 0.5 D
- LASIK: 91%
- LASEK: 84%
- PRK: 92%
- Trans-PRK: 95%
Surface Ablation Versus LASIK

High Myopia: 1 Year Follow Up

Laser in situ keratomileusis versus surface ablation: Visual outcomes and complications
Faisal Ghadhan, MD, FRCS, Ali Al-Rajhi, MD, FRCS, FRCOphth, Michael D. Wagoner, MD

Comparison LASIK * LASEK * PRK * Trans-PRK

<table>
<thead>
<tr>
<th></th>
<th>LASIK</th>
<th>LASEK</th>
<th>PRK</th>
<th>Trans-PRK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/20</td>
<td>28</td>
<td>30</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>20/40</td>
<td>85</td>
<td>84</td>
<td>80</td>
<td>95</td>
</tr>
<tr>
<td>Within 0.5 D</td>
<td>72</td>
<td>76</td>
<td>70</td>
<td>95</td>
</tr>
</tbody>
</table>

3/16/2018
To Summarize
Surface Ablation

Surface Ablation Techniques are Effective and Safe Refractive Procedures, with Promising Future Enhancements.

To Summarize
Surface Ablation

Surface Ablation Techniques Could Achieve Comparable Results for LASIK.
Single step transPRK is a promising technique with comparable results to alcohol assisted PRK.

Traditional PRK can be enhanced by WFG, WFO and topoguided laser ablation.
To Summarize
Surface Ablation

Surface ablation can be used in low, moderate and high myopia

To Summarize
Surface Ablation

In Borderline Situations, Go Safe For Surface Ablation.
Thank you