Schwind Amaris 1050
Smart Pulse
Technology

Paolo Vinciguerra, MD$^{1,2}$
Samuel Arba Mosquera$^3$ PhD

$^1$Dept of Ophthalmology, Istituto Clinico Humanitas
$^2$Columbus, Ohio State University
$^3$SCHWIND eye-tech-solutions
Is surface quality important in ANY laser ablation?

- Yes it influences:
  - Nomogram
  - Recovery time for CDVA
  - Level of CDVA
  - HOA
  - Riepithelization time
  - Flap quality interface/adherence
  - PAIN in surface ablation
How did we measure it in the past?
Digitalized Retro Illumination (Nidek EAS 1000)
Materials and methods

- 57 eyes treated by PRK using a Nidek EC 5000 excimer laser
- Mean preoperative spherical equivalent: -7.03±/-2.4 D (range -1.75D / -21D); mean cylinder 1.6+//-0.5 D (range 0 D / 4.25 D)
- Immediately after PRK Digitalized Retroillumination Images were taken and analyzed with respect to smoothness of surface and optical homogeneity (smoothness scale)

Vinciguerra P., Azzolini M., Radice P., Sborgia M., De Molfetta V.
A method for examining surface and interface irregularities after photorefractive keratectomy and laser in situ keratomileusis: Predictor of optical and functional outcomes
J Refractive Surgery 1997; 13: 5. S450, ISSN : 1081-597X

Vinciguerra P., Azzolini M., Airaghi P., Radice P., De Molfetta V.
Effect of decreasing surface and interface irregularities after photorefractive keratectomy and laser in situ keratomileusis on optical and functional outcomes
Smoothness scale

😊 0  No irregularities

😊 1  Mild

😊 2  Severe

Paolo Vinciguerra M.D.
Difference from the planned emmetropia at 12 months - PRK

Smoothness scale

* P always < 0.005 except here

Paolo Vinciguerra M.D.
Haze at 12 months-PRK

- H 0: 67%
- H 0,5: 22%
- H 1: 68%
- H 1,5: 19%
- H 2: 47%

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Q1: Is surface quality important in ANY laser ablation?

Yes

roughness/smoothness matters
How does roughness occur?

- Generally speaking, the local residual roughness approximates the depth of a single pulse.

- Usually short term outcomes in surface ablation are regarded as non-stable/not representative, and only after 1-3 Months are waited and Rx and VA can be determined.

- Smoothing techniques have been applied to improve short term outcomes.
How did we solve it in the past?

Post regular ablation: note the irregular map pattern

Post smoothing: note the regular map pattern

Intraoperative Placido rings during PTK laser smoothing
Final smoothing after PRK and LASIK

- 225 eyes were graded according to our smoothness scale:
  - 0: 78 eyes
  - 1: 91 eyes
  - 2: 56 eyes
- The 1 and 2 eyes were randomised in two groups:
  - 74 eyes submitted a smoothing of the surface by PTK immediately at the end of the laser procedure
  - 73 eyes were patched without additional treatment
Results
Percentages of eyes within +/- 0.5, 1 and 2 D from the planned emmetropia at 12 months

- Smoothing
- Not sm.

<table>
<thead>
<tr>
<th></th>
<th>+/- 0.5 D</th>
<th>+/- 1 D</th>
<th>+/- 2 D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoothing</td>
<td>74%</td>
<td>89%</td>
<td>92%</td>
</tr>
<tr>
<td>Not sm.</td>
<td>35%</td>
<td>51%</td>
<td>69%</td>
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</table>

Paolo Vinciguerra M.D.
Results

Mean corneal haze

St.. dev. always < 0.535
Results
Mean spectacle-corrected visual acuity

- Pre-op: Mean = 0.9
- 1 mo: Mean = 1
- 3 mos: Mean = 1.1
- 6 mos: Mean = 1.1
- 12 mos: Mean = 1.05
- 18 mos: Mean = 1.1

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Smoothing with masking fluid

Scheimpflug camera retro illuminated images: Corneal stromal irregularities induces diffraction:

End point after smoothing: note the amount of transmitted light
Q2: Can we fix roughness?

Yes

roughness/smoothness can be improved through e.g. soaked smoothing PTK
What is “Smart Pulse Technology”?  

- It is a pulse technology to enhance short term outcomes by reducing the residual roughness (improving smoothness of the residual bed) without compromising stability or long term outcomes (including aberrations).

- The development has been completed by SCHWIND eye-tech-solutions, with the feedback of Paolo Vinciguerra as well as the extremely valuable input by David Lin.
What is “Smart Pulse Technology”? 

- For Smart Pulse Technology the cornea does not look like this: flat square matrix of 114µm reticle size
What is “Smart Pulse Technology”? 

- Nor like this: flat hexagonal lattice of 99µm size
What is “Smart Pulse Technology”? 

- But like this: fullerene-like 3D structure of just 29µm size
Results: Residual roughness
Results: Local deviation
Comparison

\[ y = 1.3595e^{0.0766x} \]

\[ R^2 = 0.9879 \]
Results

- Roughness has been reduced by -60%, so residual roughness is just 40% from previous one (from 749nm down to 272nm local deviation)
- 749nm means ~1 pulse (nominal 721nm)
- 272nm means ~1/3 of a pulse
Q3: Can we AVOID roughness?

Yes

roughness/smoothness can be avoided using Smart Pulse Technology
Initial clinical experiences
Smart pulse vs Flying spot

- Laser Schwind Amaris 1050RS
- Same patient
- Two eyes treated the same day
- One eye Smart Pulse one Standard
- Same OZ size
- Same post op therapy
Initial clinical experiences
Smart pulse vs Flying spot

Pre op  Post abl  Smoothing

Smart pulse

Standard  Flying spot
Intraoperative VA (first 10+10 eyes) Smart pulse vs Flying spot

<table>
<thead>
<tr>
<th></th>
<th>Pre CDVA</th>
<th>Post Dry UDVA</th>
<th>Post Drops UDVA</th>
<th>Post Smoothing UDVA</th>
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</thead>
<tbody>
<tr>
<td>Standard</td>
<td>21</td>
<td>163</td>
<td>94</td>
<td>48</td>
</tr>
<tr>
<td>Smart Pulse Technology</td>
<td>21</td>
<td>82</td>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>Benefit Smart Pulse Technology</td>
<td>0,0</td>
<td>3,0</td>
<td>4,1</td>
<td>2,1</td>
</tr>
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</table>
Intraoperative VA (first 10+10 eyes)
Smart pulse vs Flying spot

<table>
<thead>
<tr>
<th></th>
<th>Effect Drops</th>
<th>Effect Smoothing</th>
<th>Effect Smoothing + Drops</th>
<th>Overall Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>3,0</td>
<td>3,9</td>
<td>6,9</td>
<td></td>
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<tr>
<td>Smart Pulse Technology</td>
<td>3,7</td>
<td>1,2</td>
<td>4,9</td>
<td></td>
</tr>
<tr>
<td>Benefit Smart Pulse Technology</td>
<td>0,7</td>
<td>2,7</td>
<td>2,0</td>
<td>2,4</td>
</tr>
</tbody>
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Smart pulse vs Flying spot

PTS perception

- Less Pain and discomfort in the eye treated with Smart Pulse

Re-epithelization time: shorter!

- Terapeutic contact lens removed 8,5 +/- 2.3 hours before
CDVA overtime
Smart pulse vs Flying spot

UDVA

CDVA

Flying
Smart
Sph and Cyl overtime
Smart pulse vs Flying spot

1 mos post

<table>
<thead>
<tr>
<th></th>
<th>Sph</th>
<th>Sph Smart</th>
<th>Cyl</th>
<th>Cyl Smart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diopters</td>
<td>0,17</td>
<td>0,08</td>
<td>-0,04</td>
<td>-0,08</td>
</tr>
</tbody>
</table>
HOA: Smart pulse vs Flying spot

- Smart pulse
  - Same patient; OOV pre op -7.75 (-0.75): 1 mos post

- Standard Flying spot
  - 0.306μm
  - 0.135μm
  - 0.202μm

- 0.505μm
- 0.236μm
- 0.169μm
Haze: 1 month post
Smart pulse vs Flying spot

Smart pulse

Standard Flying spot
Personal feedback
Smart pulse vs Flying spot

- The surface immediately after ablation look MUCH smoother than with standard
- All pts feed back give you confidence
- Better outcome
- No complication
- Easy to insert in your practice
Conclusion

- When you start is difficult to go back
- No comparison with other platform
- Can resurrect surface ablation
- Useful also in intrastromal practise
- Schwind is able to improve Amaris constantly
Take home message

- Smart Pulse Technology drastically improves surface smoothness immediately after ablation, resulting in:
  - Shorter recovery time of the VA
  - Higher levels of postop VA
  - Reduced levels of induced HOA
  - Better flap quality interface/adherence
  - Shorter Reepithelization time
  - Lower PAIN in surface ablation
Thank you very much for your kind attention

Thanks to Smart Pulse Technology, SCHWIND eye-tech-solutions