Thermal effect and inflammation in laser refractive surgery

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Excimer laser refractive surgery produces heating of corneal surface.

Temperature elevation is one of the factor implicated in etiology of post op pain and haze

- Maldonado et al (cornea 2001) demonstrated a mean increase of temperature of 7.35°C during PRK on myopia between -2 and -10
- Betney et al (cornea 1997) demonstrated a mean temperature elevation from 29.15°C to 37.77°C
- Niizuma et al (J. Refract. Corneal surg.;1994) Kitazawa et al (J. Cataract Refract. surg. 1999) showed that the cooling of the cornea surface reduces pain, subepithelial haze and myopic regression
- Stein et al. (J. Refract. Surg. 1999) demonstrated cooling of the cornea significantly reduces haze in patients with myopia between -6 and -9.75
- Kitazawa et al (Surv. Ophthalmol., 1997) histological study showed that the cooling of the cornea surface reduces tissue damage related to subepithelial haze in live rabbit corneas treated with PRK
Purpose

- To evaluate temperature increase of corneal surface produced by diode refractive laser and by excimer laser
- To compare the inflammatory effects and the visual recovery

Methods

- Temperature of corneal surface were measured during laser treatments with thermocamera (thermaCAM s series)
- Inflammation was evaluated one day post op considering:
  - level of pain
  - conjunctival injection
  - eyelid oedema
  - corneal oedema
- Visual acuity was evaluated 10 and 30 days after surgery
- Haze was detected with slit lamp examination and graded
- Confocal microscope corneal examination was performed before surgery, 10 and 30 days after
Methods

- 62 eyes of 33 patients affected by myopia or/and myopic astigmatism (s. e. between -1 and -9 ) divided in 2 groups:


- 26 eyes treated with Zeiss Asclepion Meditec MEL 70 excimer laser

Results

Temperature measurement

Mean temperature increase:

0.8°C in eyes treated with solid state diode laser ( max: 1.3° C )

5.3°C in eyes treated with excimer laser ( max: 7° C )
## Results

### Inflammation

**Solid state diode laser**

- **conjunctival injection**
  - absent 39% (14 cases)
  - light 61% (22 cases)

- **eyelid oedema**
  - 11% (4 cases)

- **corneal oedema**
  - 0%

**Excimer laser**

- **conjunctival injection**
  - absent 8% (2 cases)
  - light 46% (12 cases)
  - severe 46% (12 cases)

- **eyelid oedema**
  - 61% (16 cases)

- **corneal oedema**
  - 3.8% (1 case)
Results

Pain

Solid state diode laser

- Absent
  39% (14 cases)

- Light
  33% (12 cases)

- Medium
  14% (5 cases)

- Severe
  14% (5 cases)

Excimer laser

- Absent
  7.7% (2 cases)

- Light
  30.8% (8 cases)

- Medium
  15.4% (4 cases)

- Severe
  46.1% (12 cases)

Clinical Results - BCVA

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<tr>
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<th>Pre-op.</th>
<th>10 Days</th>
<th>30 Days</th>
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<tbody>
<tr>
<td>Katana</td>
<td>0.96</td>
<td>0.94</td>
<td>1.02</td>
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<tr>
<td>MEL 70</td>
<td>0.96</td>
<td>0.94</td>
<td>1.02</td>
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</tbody>
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0.75  0.80  0.85  0.90  0.95  1.00  1.05
Visual acuity

Clinical Results - Spherical Equivalent

Pre-op. 10 Days 30 Days

Katana MEL 70

Results
Haze 30 days post op

Solid state diode laser Excimer laser

- Grade 0: clear cornea
  30 eyes (83%)

- Grade 0.5: trace for faint corneal haze
  seen by indirect tangential illumination
  6 eyes (17%)

- Grade 1: mild haze easily visible with
direct focal illumination
  0 eye (0%)

- 6 eyes (23%)
- 18 eyes (69%)
- 2 eyes (8%)
**Results**

**Confocal microscope**

- Images of the anterior stroma taken just after laser treatment show a very reduced “shock glare” in corneas treated with solid state diode laser.

- Keratocyte activation in anterior stroma is present in both groups of corneas after 10 and 30 days but is more severe in corneas treated with excimer laser.

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**Shock acoustic glare**

<table>
<thead>
<tr>
<th>Excimer laser</th>
<th>Solid state diode laser</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Excimer laser image" /></td>
<td><img src="image2.png" alt="Solid state diode laser image" /></td>
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Conclusion

A reduced thermal effect in PRK reduces post op. pain and inflammatory effects (evidence of less stromal damage on confocal microscopy).

A reduced thermal effect is associated with a better and faster visual recovery and a less appearance of haze in the first 30 days after surgery.