Excimer laser ablation in cross-linked corneas

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Areas of application

1. Improve VA in disease ✔️
2. Enlarge patient spectrum in elective surgery ✗
Simultaneous or sequential?

- “Athens protocol”

Kanellopoulos et al., JCRS, 2008
1. Areas of application

2. Simultaneous or sequential?

**Pros**

- One single procedure
- Less pain
- Faster recovery

**Cons**

- Unpredictable results due to flattening effect over time

**Simultaneous**

**Pro**

- More precise results?

**Cons**

- Only possibility for patients that had been treated by CXL in the past

**Sequential**

**Pro**

- CXL = strengthening the anterior stroma. Ablation of cross-linked stroma might weaken the cornea

**Cons**

- Lack of nomogram: How much tissue does a single laser shot ablate in a cross-linked tissue?
Excimer laser ablation rate in cross-linked corneas

1. Areas of application

2. Simultaneous or sequential?

3. Excimer laser ablation rate

SCHWIND CXL-365 vario system
**Excimer laser ablation rate in cross-linked corneas**

- Fresh porcine eyes (n=50 per condition)
- Ablation with SCHWIND AMARIS 750S
  - 1-50 µm, 51-100 µm, 101-150 µm, 151-200 µm
- 3 groups: Untreated, CXL, riboflavin only
- Diameter of 4 mm
- Pachymetry with OCP (optical coherence pachymetry) and modified software
1. Areas of application

2. Simultaneous or sequential?

3. Excimer laser ablation rate

**Excimer laser ablation rate in cross-linked corneas**

![Graph showing non-cumulative ablation depth (µm) against nominal total ablation depth (µm) for different groups: CXL, Control, Ribo.](image)
Excimer laser ablation rate in cross-linked corneas

TABLE 1

**Average individual stromal ablation depth**

<table>
<thead>
<tr>
<th>Nominal ablation depth (µm)</th>
<th>Achieved ablation depth (µm) *</th>
<th>Difference</th>
<th>P‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CXL (µm)</td>
<td>Control (µm)</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>57.5 ± 1.6</td>
<td>60.9 ± 0.8</td>
<td>-5.6%</td>
</tr>
<tr>
<td>100</td>
<td>43.0 ± 0.8</td>
<td>53.8 ± 0.7</td>
<td>-20.1%</td>
</tr>
<tr>
<td>150</td>
<td>43.8 ± 0.7</td>
<td>52.9 ± 0.9</td>
<td>-17.3%</td>
</tr>
<tr>
<td>200</td>
<td>44.3 ± 0.7</td>
<td>51.5 ± 0.9</td>
<td>-14.0%</td>
</tr>
</tbody>
</table>

* Data are expressed as mean in 30 eyes (no CXL control and CXL-treated) and 12 eyes (Riboflavin control) ± standard error
† Differences between CXL-treated and control groups (percent). Control eyes were set at 100%
‡ Student’s t-test
1. Areas of application

2. Simultaneous or sequential?

3. Excimer laser ablation rate

- 12 % less ablation
- Consistent over entire depth
- Creation of nomograms for new excimer generations

*Richoz and Hafezi, JRS, 2014*

- 9 % less ablation

*Chen and Seiler, PLOSOne, 2012*
New nomogram applied clinically

Preop

Male, 37 years
- CXL 2008
- Stable
- 425 µm
- CL intolerant

CDVA 20/200
New nomogram applied clinically

Postop

Male, 37 years
- CXL 2008
- Stable
- 350 µm
- CL intolerant

CDVA 20/40
LASIK Xtra

1. Areas of application
2. Simultaneous or sequential?
3. Excimer laser ablation rate
4. New nomogram
5. LASIK Xtra / KeraFlex
LASIK Xtra

No!

1. Areas of application
2. Simultaneous or sequential?
3. Excimer laser ablation rate
4. New nomogram
5. LASIK Xtra / KeraFlex

- 60 second CXL after every refractive procedure
- No scientific data, sample size
- Why perform? What about the flattening effect of CXL?
KeraFlex

No!

- Combines Microwave application and CXL
- Does not work: Kmax readings return to old values after treatment
- Method was withdrawn from industry

Before | 3 months after | 12 months after
Conclusion

1. Ablation rate of a laser pulse is consistently lower in a CXL cornea (-12%)

2. Combined procedures can be performed with more precision. Will be implemented in future software versions of the AMARIS

3. CXL for refractive candidates: not recommended