Evaluation of Crystalline Lens Opacity Induced by Corneal Cross-Linking with Scheimpflug Imaging

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Corneal Cross-Linking

- Corneal Cross-linking (CXL):
  - stabilizes progressive keratoconus
  - inhibits some physiopathological mechanism of corneal ectasia
  - increases biomechanical strength of cornea of 300%
  - prevents PK

UV Rays and Lens Opacification

UV rays: a well-known etiological agent of cataract

The ocular structure most exposed to UV rays during cross-linking, after the corneal endothelium, is the crystalline lens

Ectasia patients are often very young:
• progressive keratoconus
• ectasia following refractive surgery

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Cristalline Lens Opacity

• Objective evaluation of crystalline lens opacity is a complex process.
• Available methods:
  • LOCS III, Age-Related Eye Disease Study
  • Clinical measurement: subjective

(McCarty CA, Dev Ophthalmol 2002)
Lens Opacity Evaluation with Scheimpflug

- Oculus Pentacam HR Software (Oculus Optikgeräte, Wetzlar, Germany):
  - provides information from the anterior corneal surface to the posterior capsule of the lens
  - full scan may thus reconstruct the lens
- Pentacam software evaluates:
  - Central section of the lens (cylindrical shape)
    - Diameter: 1.2 mm
    - Length: 1.2 mm
    - Curvature (anterior / posterior): 12 mm
  - 3D optical density
  - Densitometry Software:
    - compares density with an advanced nomogram
    - quantifies density and area of lens opacification
    - assigns a lens density grade

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Lens Transparency After Cross-Linking: Evaluation with Scheimpflug (Pentacam)

**Materials and Methods**

- 24 eyes of 24 patients with progressive keratoconus, documented
- CXL performed between April and June 2006
- mean patient age: $34.9 \pm 6.5$ yrs (range: 26 to 50)
- CXL: well-established and described technique
- Preoperatively and 1, 2, 3 years postoperatively

*Vinciguerra P, Ophthalmology 2009*

*Vinciguerra P, Arch Ophthalmol 2009*

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Materials and Methods

• Evaluation:
  • complete ophthalmological examination
  • endothelial cell counts
  • corneal topography
  • aberrometry
  • central pachimetry and/or topo/tomography with Scheimpflug system (Pentacam)
  • Scheimpflug system used for the objective evaluation of lens transparency
  • lens opacities graded with a system ranging from 0 to 3

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Lens Transparency After Cross-Linking: Evaluation with Scheimpflug (Pentacam)

Materials and Methods

- Inclusion criteria
  - Progressive keratoconus (differential topo-tomographies)
  - Age above 18
- Exclusion criteria:
  - Corneal thickness < 400 μm at thinnest point
  - History of herpetic keratitis
  - Severe dry eye
  - Concurrent corneal infections
  - Corneal opacities
  - Concomitant autoimmune disease

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A software integrates sectional images, providing 3D images of opacity. The Pentacam-based lens opacity evaluation system grades lens opacity ranging from 0 to 3.
Lens Transparency After Cross-Linking: Evaluation with Scheimpflug (Pentacam)

Results

Mean UCVA and BSCVA:
- preoperative: 180/20 and 20/40
- 3 years after CXL: 20/50 and 20/25 (p<0.05)
- SE: reduction of 0.96 D

Mean simulated keratometry: reduced (p<.05)

Endotelial Cell Counts: unchanged (p=.13).

Lens transparency, measured with the Scheimpflug system, three years after CXL remained unchanged, always transparent.

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Preoperative</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean opacity (%)</td>
<td>9.05 ± 1.31 (7.30 – 12.70)</td>
<td>8.84 ± 1.00 (7.60 – 11.50)</td>
<td>9.29 ± 1.25 (7.30 – 12.10)</td>
<td>9.15 ± 1.02 (8.00 – 10.90)</td>
</tr>
<tr>
<td>(mean ± SD) (range: min to max)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crystalline lens opacity grading scale value</td>
<td>0 - 1</td>
<td>0 - 2</td>
<td>0 - 1</td>
<td>0 - 1</td>
</tr>
</tbody>
</table>
Lens Transparency After Cross-Linking: Evaluation with Scheimpflug (Pentacam)

Conclusions

- Pentacam dedicated software can measure lens density in an accurate, **objective** and reproducible way.
- Young mean age of the study cohort: completely **transparent lens**.
- Lens persistently transparent 36 months after CXL: the procedure **did not induce any lens change** measurable with Pentacam and the dedicated densitometry software.

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