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 strenght of cornea of 300%
  - prevents PK

(Wollensak G, Am J Ophthalmol 2003)

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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 opacityis is a complex process.
- Available methods:
  - LOCS III, Age-Related Eye Disease Study
  - Clinical measurement: subjective

(McCarty CA, Dev Ophthalmol 2002)

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

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 mu at thinnest point
  - • History of herpetic keratitis
  - • Severe dry eye
  - • Concurrent corneal infections
  - • Corneal opacities
  - • Concomitant autoimmune disease

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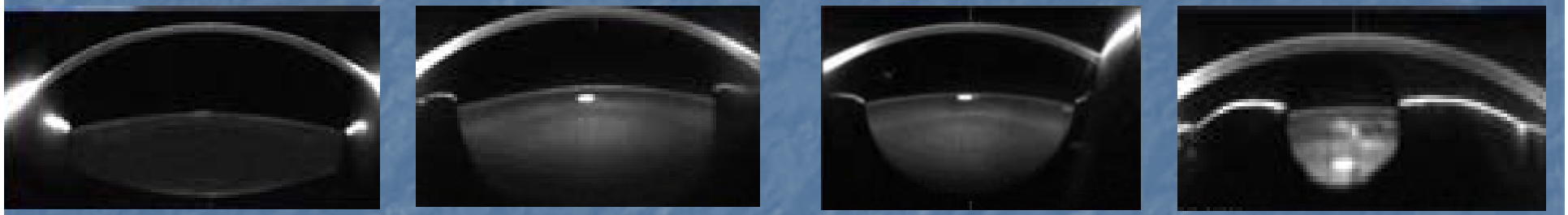
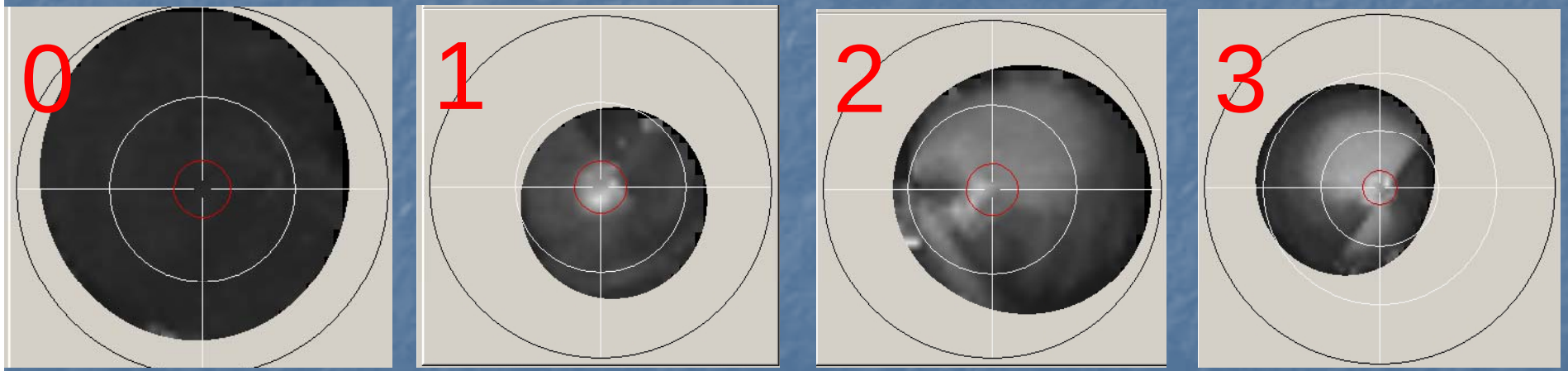
Pentacam Nucleus Staging

Staging Example



Pentacam Nucleus Staging:



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 ($p<.05$)

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

Time Interval	Preoperative	1 year	*p*	2 years	*p*	3 years	*p*
Mean opacity (%) (mean ± SD) (range: min to max)	9.05 ± 1.31 (7.30 – 12.70)	8.84 ± 1.00 (7.60 – 11.50)	ns	9.29 ± 1.25 (7.50 – 12.10)	ns	9.15 ± 1.02 (8.00 – 10.90)	ns
Crystalline lens opacity grading scale value	0 - 1	0 - 2	ns	0 - 1	ns	0 - 1	ns

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 trasparent 36 months after CXL:

the procedure did not induce any lens change measurable with Pentacam and the dedicated densitometry software

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