Modulating Corneal and Scleral Biomechanics with Riboflavin Crosslinking

Prof. Michael Mrochen, PhD

Institute of Refractive and Ophthalmic Surgery, Zürich, Switzerland
Swiss Federal Institute of Technology
Introduction

UV-A / Riboflavin tissue interaction

Diffusion

Biomechanical effect

Safety aspects

Clinical outcomes

Future perspectives

Conclusion

... cross linking is used for dental fillings ...
Cross-Linking for stiffening ocular tissue structures

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Intrahelical and interhelical cross links:

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Denaturation temperature resistance against enzymatic degradation
Intermicrofibrillar cross links

Tissue shrinkage during fixation, Tensile strength
Strain at break, Ruptured pattern

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Riboflavin concentration in the stroma

R. Doyle Stulting, MD, PhD
Ijeoma M. Asota, MD
Barbara S. Fant, PharmD
Henry F. Edelhauser, PhD
Stress – strain measurements

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- A standardised sample of the material is placed in a machine that applies an axial force

- An extensometer is used to measure the extension
Stress – strain measurements: human cornea

- 5 untreated
- 5 cross-linked with clinical parameters

stress in $10^5$ Pa

strain in %

E = 5.9 MPa

increase factor = 4.5

E = 1.3 MPa

E. Spörl

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Anterior Flap

Posterior Flap

3 mW/cm²

Percentage of original irradiance

0 mu

200 mu

400 mu

100%

25%

6%

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Corneal cross linking

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Endothelial cell damage after riboflavin–ultraviolet-A treatment in the rabbit

Gregor Wollensak, MD, Eberhard Spoerl, PhD, Michaela Wilsch, PhD, Theo Seiler, MD, PhD

3 mW/cm² / 30 min

Endothelium
Skleral cross linking

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Corneal cross linking for keratoconus

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Corneal cross linking for keratoconus

Postoperative corneal topography

5 years after treatment
Corneal cross linking for iatrogenic keractasia

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**Typical clinical observations and results**

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**Inclusion criteria:**
- Progressive form of keratectasia
- Thickness of cornea stroma > 400 microns
- Epithelium must be removed for proper diffusion

**Typical clinical outcomes**
- Reduction of max. K-Value by 1.0 to 2.0 D
- Stability statistically proven over 24 months
- 1 to 2 line gain in BSCV (do not promised to the patient)
- Low to moderate haze up to 6 months post surgery

**Complications**
- Delayed corneal reepithalization
- Corneal endothelium cell damage (thin corneas)
- Sevier corneal haze (very seldom) – 6 cases
Possible future applications of corneal crosslinking?

- Prevention of iatrogenic ectasia?
- Improved predictability after laser surgery?
- Small refractive corrections?

Possible future clinical of skleral crosslinking?

- Staphyloma
- Myopia
- Glaucoma
The combination of Riboflavin and UV or blue light have been shown to increase the stiffness of ocular tissue structures.

Corneal cross linking procedure are already performe international (about 1000 a month)

FDA clinical trails for corneal cross linking have been started in January 2008.

Skleral crosslinking is still in the experimental phase.
Thank you very much for your attention!

4th International Congress of Corneal Cross Linking
Technical University of Dresden
December the 5th and 6th, 2008

www.ccl-congress.ch