

Influence of beam profile on changes of corneal topography and tomography after CXL in progressive keratoconus



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Chairman: Lutz E. Pillunat, MD, PhD



Introduction

- Effect of corneal CXL is provable by detection of demarcation line^{1,2}
- OCT confirmed that demarcation line depth is in central cornea deeper than in periphery by performing conventional CXL³
- Cross-linked volume is not sufficient enough²

¹Seiler T, Hafezi F. Corneal cross-linking-induced stromal demarcation line. *Cornea*. 2006;25(9):1057-1059.

²Mazzotta C, Traversi C, Baiocchi S, et al. Corneal Healing After Riboflavin Ultraviolet-A Collagen Cross-Linking Determined by Confocal Laser Scanning Microscopy In Vivo: Early and Late Modifications, *American Journal of Ophthalmology*, 2008;146(4): 527-533.

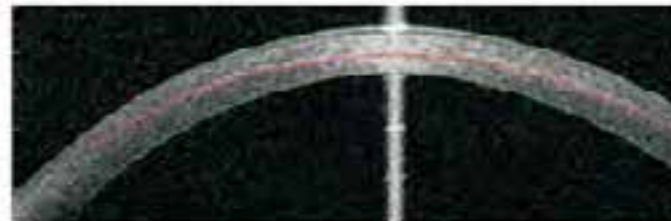
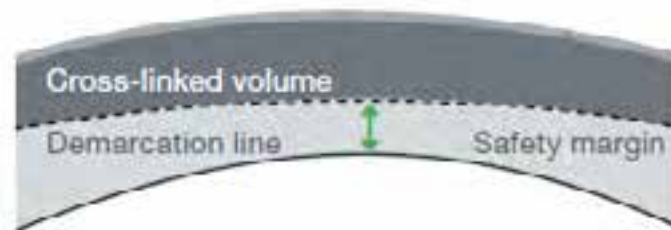
³Koller T, Schumacher S, Fankhauser F, et al. Riboflavin/ultraviolet a crosslinking of the paracentral cornea. *Cornea*. 2013;32(2): 165-168.



Introduction

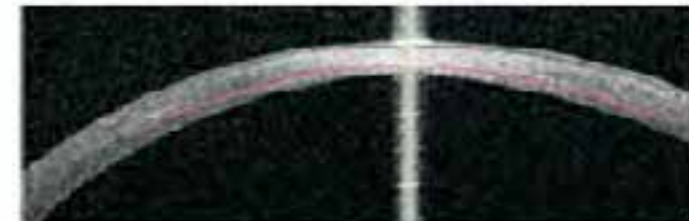
Standard beam profile

UV-Illumination
Standard beam profile



UV-X™ 2000

UV-Illumination
Optimized beam profile



Comparison of both illumination sources with provably deeper cross-links on OCT (source: UV-X 2000 Brochure, IROC Innocross AG [offline])



Purpose

- Comparison of topographic and tomographic changes by performing high intensity CXL with optimized beam profile and standard profile



Patients and methods

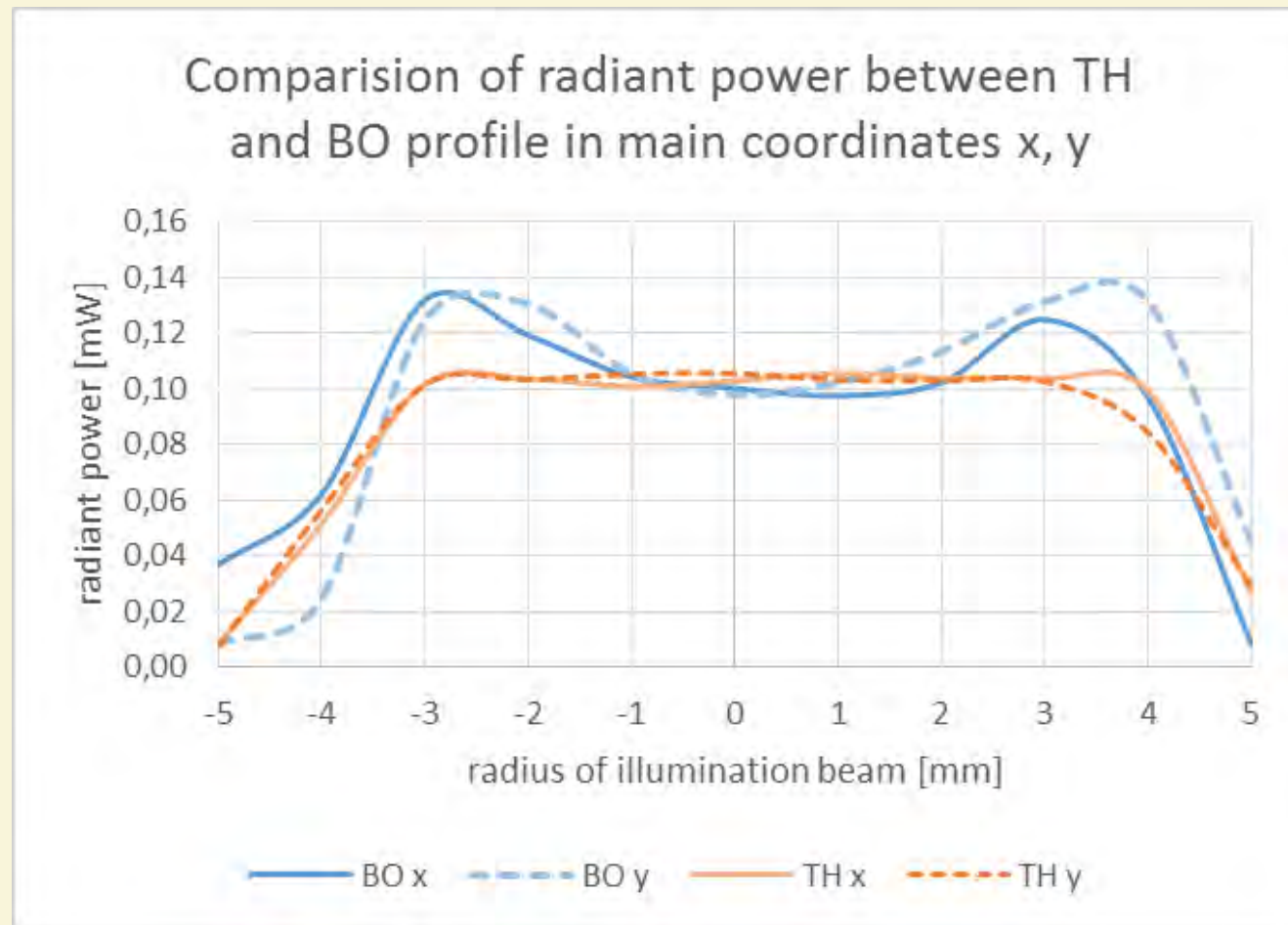
- Retrospective, nonrandomized
- Progressive keratoconus¹
- CXL was performed by Dresden protocol² with modifications in energy (9mW/cm²) and irradiation time (10 min)
- Standard (“top-hat”) profile (TH)
- Optimized beam profile (BO) with UV-X 2000
- Topographic and tomographic parameters were recorded by Pentacam

¹Gomes JAP, Tan D, Rapuano CJ, et al. Global consensus on keratoconus and ectatic diseases. *Cornea*. 2015;34(4):359-369.

²Raiskup-Wolf F, Hoyer A, Spoerl E, Pillunat LE. Collagen crosslinking with riboflavin and ultraviolet-A light in keratoconus: long-term results. *J Cataract Refract Surg*. 2008;34(5):796-801.



Patients and methods



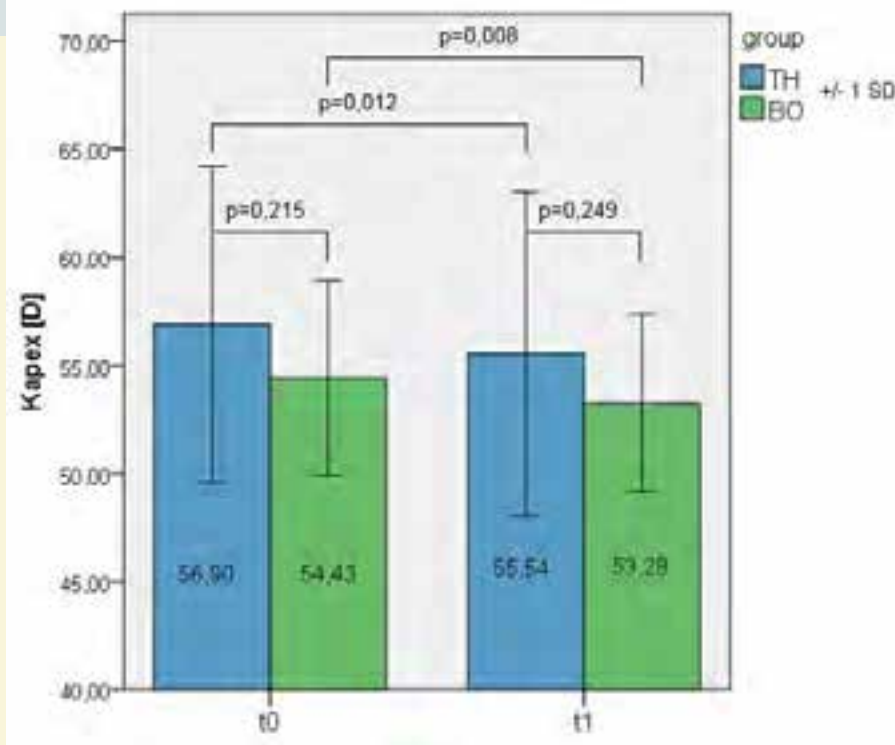
Laboratory measurements of radiant power for both profiles, peripheral radiant power of BO at 3 mm has a factor of 1,3 in comparison to the central of both devices, "Laser-Mate Q" with a range of 1 mW, pinhole 0,05 mm (Dresden, 2014)



Results - Keratometry

- K_{\min} / K_{\max} decreased (TH) significantly by $-0,39 \pm 0,65$ D
- Group 1: n=14, age = $26,4 \pm 0,9$ y, follow-up = $15,0 \pm 4,8$ m

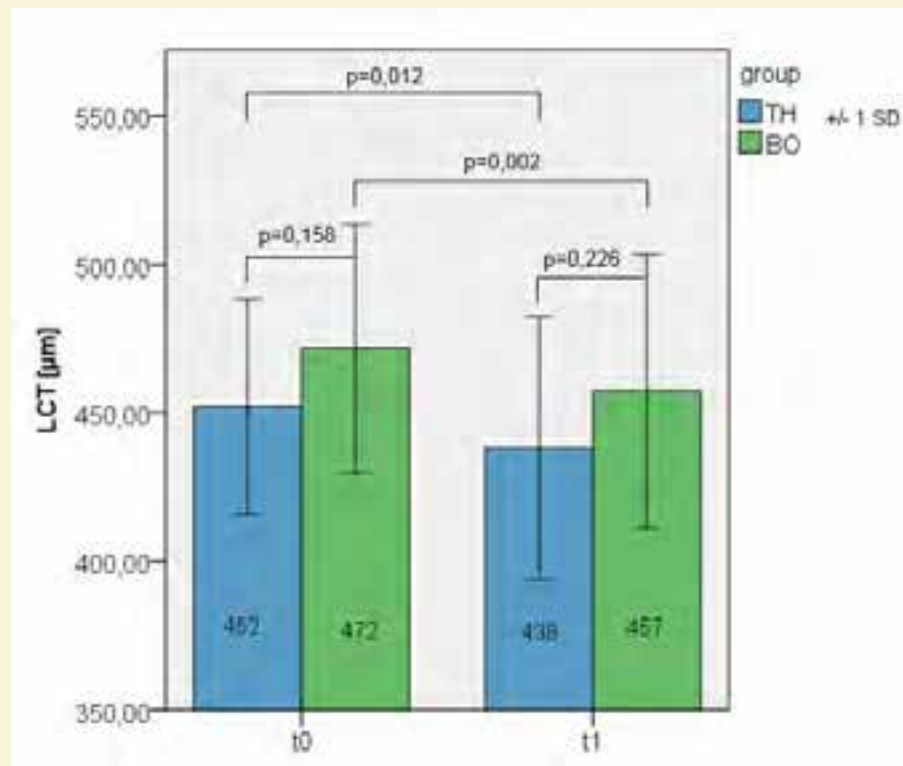
- K_{\min} / K_{\max} decreased (BO) significantly by $-0,39 \pm 0,80$ D
- Group 2 (BO): n=22, age = $28,4 \pm 1,0$ y, follow-up = $18,4 \pm 6,7$ m



Comparative analysis of Kapex, pre-(t0) and postoperative (t1) measurements, top-hat-profile (blue) and optimized beam-profile (green).



Results - LCT



Comparative analysis of lowest corneal thickness, pre-(t0) and postoperative (t1) measurements, top hat-profile (blue) and optimized beam-profile (green)



Results – Keratoconus Indices

Variables	group	P value
ISV (Index of Surface Variance)	TH	0,021
	BO	0,306
IVA (Index of Vertical Asymmetry)	TH	0,029
	BO	0,494
KI (Keratoconus Index)	TH	0,253
	BO	0,723
CKI (Center Keratoconus Index)	TH	0,336
	BO	0,021
IHA (Index of Height Asymmetry)	TH	0,594
	BO	0,017
IHD (Index of Height Decentration)	TH	0,035
	BO	0,127



Conclusion

- Significant flattening of flat, steep and maximum keratometry in both profile settings
- No differences were observed between top-hat and optimized beam profile
- All measured Keratoconus-Indices were reduced, but not all of them showed significance



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Paar	Parameter	Mittelwert±SD [μm]	T-Wert	$p^1=$	$p^2=$
TH	DiffELapF	-0,3±2,6	-3,839	0,002	0,573
	DiffELapB	3,6±3,5			0,429
	DiffELlctF	-2,9±4,1	-3,333	0,005	0,250
	DiffELlctB	4,8±9,2			0,459
	DiffELmaxF	-1,3±3,6	-2,400	0,032	0,164
	DiffELmaxB	5,2±8,2			0,534
BO	DiffELapF	-0,8±2,8	-2,949	0,008	
	DiffELapB	2,2±5,8			
	DiffELlctF	-1,3±3,9	-2,325	0,030	
	DiffELlctB	2,7±7,5			
	DiffELmaxF	0,6±4,1	-1,828	0,082	
	DiffELmaxB	3,7±6,4			