

Tomography-Guided Customized CXL

Cassagne et al. should be congratulated for their work on customized corneal cross-linking (CXL) in the May 2017 issue.¹ This novel technique has the potential to replace the standard protocol, and that is why we need a clear and contradiction-free presentation of parameters and results. However, the study has some flaws that need to be discussed.

First, the maximally used radiant exposure was 15 J/cm², which clearly exceeds the official exposure limit of 1 J/cm² as published by the International Commission on Non-Ionizing Radiation Protection.² Even assuming an absorption of the ultraviolet light by riboflavin, which has been reported to be maximally 90%,^{3,4} the energy load for intraocular structures is still substantially too high.

Second, this is by far not the first report of customized CXL. Our group presented nearly identical results already at the CXL Expert Meeting 2014 and the ESCRS 2015 meeting, and published in the *American Journal of Ophthalmology* in March 2016.⁵ Other groups have published similar results regarding customized CXL.⁶

Third, the presentation of the technique of ultraviolet application is contradictive: on page 291, it reads “superimposed concentric circular zones,” but Figure 1 presents sectorial areas. Which customization was really used?

Finally, the title itself includes two misnomers: “topography-guided” and “collagen cross-linking.” Because the authors centered the treatment on the posterior elevation obtained by the Oculyzer, the technique presented would be better characterized as “tomography-guided.” Since 2013, we know that the CXL procedure established additional chemical bonds not only within the collagen molecules of the cornea but also well (and maybe even more important) in the interfibrillar space between proteoglycans forming bridges between the collagen fibers.⁷ When using the term “collagen cross-linking,” do the authors really refer only to the new chemical bonds within the collagen molecule or to the entire CXL process?

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Theo G. Seiler, MD
Beatrice E. Frueh, MD
Theo Seiler, MD, PhD

Bern and Zürich, Switzerland

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Reply

We agree that this exciting new technology has the potential to significantly alter the standard treatment approach for corneal cross-linking, and thank Seiler et al. for their comments on our article.¹

Although the International Commission on Non-Ionizing Radiation Protection guidelines do recommend a limit of 1 J/cm², the purpose of the guidelines is to establish exposure limits for laser radiation, and they explicitly do not apply to “deliberate exposure as an integral part of medical treatment.” The cross-linking device used in this study applies radiation with a non-laser light emitting diode (LED) for the purposes of medical treatment, so the International Commission on Non-Ionizing Radiation Protection guidelines do not apply in this case. Further, in our study, we saw no adverse impact on the intraocular surfaces, including the crystalline lens or retina.

We apologize for overlooking the fact that Seiler et al. were the first to publish on this new customized corneal cross-linking procedure in 2016. Nevertheless, we would like to highlight that at the time of submission our work was the first to deal with the biological aspect regarding demarcation line and confocal microcopy nerve and cell densities.

Regarding the description of the ultraviolet application technique, please allow us to clarify. In our study, we applied sectorial areas that were always part of circular treatment zones. The extent of these segments was determined based on the extent of the cone, ranging from partial segments to full circular treatment zones. The most important parameter is that these ar-

eas are concentric, centered onto the maximum posterior elevation determined by the WaveLight Oculyzer II (Alcon Laboratories, Inc., Fort Worth, TX) posterior float.

We thank Seiler et al. for the clarification regarding the nomenclature used in the title of our article. They are correct that the term corneal tomography more completely describes the inclusion of both the anterior and posterior surfaces of the cornea used to derive the treatment parameters. We chose the term topography-guided to follow convention with other studies presenting the use of the Oculyzer system to guide treatment decisions and to emphasize a primary goal of the procedure, which is to achieve a more normal anterior corneal topography.

Similarly, we agree with their comment that cross-linking concerns not only collagen fibers but also proteoglycans, but our intention was to apply the historical and commonly used abbreviation CXL, which corresponds to corneal collagen cross-linking. We agree that this technique of cross-linking does not dif-

fer from conventional cross-linking in regard to its impact on both the collagen fibers and the interfibrillar space.

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Myriam Cassagne, MD, MSc
Kévin Pierné, FRCOph
Stéphane D. Galiacy, PhD
Marie-Pierre Asfaux-Marfaing, RA
Pierre Fournié, MD, PhD
François Malecaze, MD, PhD
Toulouse, France

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