Two-photon cornea imaging

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The methods used for corneal evaluation in the daily clinical practice are typically slit-lamp microscopy, confocal microscopy, and anterior segment optical coherence tomography. Based on these imaging modalities, important information of the human cornea can be obtained. Moreover, they have greatly contributed to our increased understanding of this tissue anatomy and physiology in health and disease conditions. Nevertheless, the information provided by these imaging modalities is based on the morphological analysis of the tissue. The cells metabolism and the structural organization of the stroma are disregarded.

In this study, two-photon imaging (TPI) examination of the cornea is presented. Based on TPI, the cornea can be characterized based on its morphology, as well as on the its metabolism, by fluorescence lifetime imaging (FLIM), and on the structural organization of the stroma, by second-harmonic generation (SHG) imaging. The potential of TPI is explored in clinical applications such as the examination of corneal buttons[1,2], diagnosis of corneal diseases[3], and follow-up after corneal collagen crosslinking.

We demonstrate that the combination of functional and morphological analysis of the cornea can lead to an improved diagnosis, patient follow-up, and better evaluation of human corneal buttons prior to transplantation.

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