

Multiphoton Tomography of the Human Cornea

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Multiphoton tomography (MPT) is a novel label-free clinical imaging method for non-invasive tissue imaging with high spatial (300 nm) resolution and temporal (100 ps) resolution. In vivo optical histology can be realized due to the nonlinear excitation of endogenous fluorophores and second harmonic generation (SHG) of collagen. Furthermore, optical metabolic imaging (OMI) is performed by two-photon autofluorescence lifetime imaging (FLIM). So far, applications of the multiphoton tomographs DermaInspect and MPTflex were limited to dermatology. Novel applications include intraoperative brain tumor imaging as well as cornea imaging. The presentation highlights the latest developments in two-photon cornea imaging of donor eyes for transplantation as well as of patients undergoing cornea surgery. Furthermore, the cross-linking process based on UVA exposure and 0.1 % riboflavin was studied with a 16 channel PMT detector associated with time-correlated single photon counting for fluorescence lifetime imaging. An increase in the fluorescence intensity and modifications of the fluorescence lifetimes were observed in the human corneal samples following riboflavin and CXL.

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[1] A. Batista, HG. Breunig, A. Uchugonova, AM. Morgado, K. König. Two-photon spectral fluorescence lifetime and second harmonic generation imaging of the porcine eye with a 12 femtosecond laser microscope. JBO 21(3), 036002 (2016).

[2] S. Kantelhardt, D. Kalasauskas, K. König, E. Kim, M. Weinigel, A. Uchugonova, A. Giese. In vivo multiphoton tomography and FLIM of human brain tumor tissue. J Neurooncol online 30. Januar 2016. DOI 10.1007/s11060-016-2062-8

[3] K. König. Multiphotonen-Tomographie der humanen Kornea. Ophthalmologische Nachrichten Sept. 2014