Advances in clinical skin imaging using multiphoton microscopy

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Multiphoton microscopy (MPM) has been used in the past few years in clinical studies at the Beckman Laser Institute Clinic (UC Irvine, CA) to assess the potential of this technology to diagnose and guide therapies for melanoma¹, basal cell carcinoma², and cutaneous diseases as well as understand skin photodamage and aging. We perform this research by using a clinical multiphoton tomograph (MPTflex, JenLab, Germany) based on two-photon excited fluorescence (TPEF) and second-harmonic generation (SHG). These contrast mechanisms produce images of endogenous biomolecules in the tissue, without using specific fluorescent labels. In MPM imaging of skin, the main sources of fluorescence are reduced nicotinamide adenine dinucleotide (NADH), flavin adenine dinucleotide (FAD), keratin, melanin, collagen, and elastin fibers, whereas SHG is used to visualize collagen fibers in the dermis. This presentation will include a summary of current advances in our clinical research studies on in vivo MPM imaging of various skin conditions and effects of treatment (Figure 1).

Fig. 1 Evaluating the potential of multiphoton microscopy for skin disease diagnosis, skin therapy guiding and for understanding skin aging and photodamage.

Data acquired in a total of 75 patients show the potential of MPM to distinguish melanoma from dysplastic and common nevi, to diagnose basal cell carcinoma, to guide therapies of pigmentary skin disorders such as vitiligo and melasma, and to advance the understanding of skin aging and laser treatments effects for skin rejuvenation.

Current limitations of the technology and potential approaches to overcome them will also be addressed.