Implications of ultrasound frequency in optoacoustic mesoscopy of the skin.

Abstract:
Raster-scan optoacoustic mesoscopy (RSOM) comes with high potential for in vivo diagnostic imaging in dermatology, since it allows for high resolution imaging of the natural chromophores melanin, and hemoglobin at depths of several millimeters. We have applied ultra-wideband RSOM, in the 10-160 MHz frequency band, to image healthy human skin at distinct locations. We analyzed the anatomical information contained at different frequency ranges of the optoacoustic (photoacoustic) signals in relation to resolving features of different skin layers in vivo. We further compared results obtained from glabrous and hairy skin and identify that frequencies above 60 MHz are necessary for revealing the epidermal thickness, a prerequisite for determining the invasion depth of melanoma in future studies. By imaging a benign nevus we show that the applied RSOM system provides strong contrast of melanin-rich structures. We further identify the spectral bands responsible for imaging the fine structures in the stratum corneum, assessing dermal papillae, and resolving microvascular structures in the horizontal plexus.