In Vivo Quantification of Melanin Mass Density in Human by Using Third Harmonic Generation Microscopy

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Abstract

Melanin is the primary determinant of human skin color and can be accessed noninvasively by optical means. The melanosome is a unique membrane-bound organelle where melanin biosynthesis takes place. Melanosomes can be divided into eumelanosomes and pheomelanosomes depending on the type of melanin synthesized: either eumelanin or pheomelanin. Eumelanin is the dominant component of human epidermal melanin, representing more than 90% of total epidermal melanin. Melanin deficiency has been connected with various genetic abnormalities and disease states. Melanin can also serve as an endogenous marker to assist the diagnosis of pigmented skin diseases, including melanoma. Melanoma is less common than other skin cancers, but causes the majority of deaths related to skin cancer. In this work, by calibrating the third-harmonic generation (THG) enhancement ratio versus eumelanin mass density in live melanocytes, we realized, for the first time, in vivo quantification imaging of melanin mass density in human by using the noninvasive THG microscopy, together with a high penetration capability and a submicron 3D spatial resolution. Calibration process was performed by using live melanoma cells.

In this study, the relation between the THG enhanced ratio and MMD was constructed to quantify the melanin in human skin by using HGM. This is the first time to obtain in vivo human imaging and quantitative information of melanin at the same time. HGM with high penetration depth, high resolution, noninvasive nature and melanin quantification ability therefore becomes a promising technique for application such as disease prognosis, therapeutically monitoring, follow-up and cosmetic product evaluation.

Reference