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Quantitative assessment of wound-healing process as a response to laser-induced micro-injuries

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ABSTRACT

Currently, most investigations of wound healing rely on invasive biopsy followed by histology and immunohistochemistry staining. There is a great need to develop non-invasive techniques for in vivo diagnostic, clinical and scientific evaluation. Here, we performed a comprehensive investigation on the dynamic wound healing process as a response to laser-induced microinjuries using non-invasive imaging techniques such as reflectance laser-scanningconfocal microscopy and video microscopy. Eight healthy subjects ranging from Fitzpatrick skin type II-VI with age from 27 to 57 years were recruited. The volar forearm of each subject was treated with a laser device that generates an array of microbeams with an infrared wavelength. The microscopic changes of epidermal cells and collagen during the wound healing process were assessed non-invasively using confocal microscopy. We also developed a quantitative method to evaluate the dynamic wound healing process at the microscopic level in three areas of interest: (1) treated micro-wounding zone, (2) surrounding collateral damage zone and (3) normal area. The depth-dependent intensity profile derived from reflectance confocal microscope images clearly distinguishes the three areas of interest and quantitatively measures the cellular structure-associated changes. A progressive change in depth-dependent intensity profiles in subjects with different ages parallels the clinical observation of wound healing rate. The quantitative analysis developed in this study may find broad applications in assessing the skin response to treatment at a microscopic level.