Time Domain Optical Coherence Tomography Evaluation of the Human Skin

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The aim of this study is to evaluate the normal skin by using the optical coherence tomography in Time Domain Mode. In conclusion, the optical coherence tomography could act as a valuable technique to be used for a better evaluation of the skin.

Keywords: Dermatology, Optical Coherence Tomography, Non Invasive Investigation

Evaluation of the skin can be done by using different methods, such as Scanning Electron Microscopy, Transmission Electron Microscopy, Multimodal Imaging for Skin Structure, High Resolution Ultrasound, Magnetic Resonance Imaging, High Resolution In Vivo Multiphoton Tomography of the Skin, Optical Coherence Tomography, Confocal Microscopy of Skin In Vivo and Ex Vivo, Two Photon Microscopy and Confocal Laser Scanner Microscopy of In Vivo Skin, Polarized Light Imaging of the Skin, Application of Reflectance Confocal Microscopy, Sonography of the Skin and other methods [1].

Optical Coherence Tomography (OCT) is a noninvasive imaging method with a resolution situated in the range between those of high-frequency ultrasound and confocal microscopy. This method is dedicated for imaging superficial layers of the skin in vivo. In the cross-sectional images provided by the procedure, a determination of the thickness of the stratum corneum and epidermis is easily possible. Therefore OCT is a useful method suitable for monitoring various changes occurring in the inflammatory skin, as well as for evaluation of all aspects concerning skin layer thickness alterations triggered by numerous dermatological conditions [1].

Gamblicher et al. published a recent review relating the technical aspects and clinical application of OCT methods in dermatology [2]. The same author investigated acute skin alteration following exposure to ultraviolet radiation by using the optical coherence tomography method [3]. A commercial OCT scanner (SkinDex 300, ISIS optronics GmbH, Mannheim, Germany) was used in this study. A bandwidth D k=70 nm and a central wavelength of k =1.300 nm was utilized. The architecture of the system with eight parallel scanning channels allows fast scans. Within 2s, a number of 512 scans are acquired over a 1mm-length in lateral direction and an axial range of 0.9 mm. Echo signals are digitized with 14 bits amplitude resolution. An integrated CCD camera with a field-of-view of 4.5 mm² delivered optical images of the skin surface.

OCT depends upon light interferometry to select light from a distinct depth extent within the examined tissue [4]. The axial sectioning in the procedure is correlated with the bandwidth of the employed light source spectrum. Regular OCT systems use point illumination quickly scanned vertically through the examined tissue, and the resulted scans, obtained with a point detector, are sequentially repeated over a line or an area, in order to acquire either a vertical two dimensional slice or a three dimensional volume. OCT has been successfully employed for in vivo exploration and assessment of cutaneous surfaces [5,6]. OCT offers images with a resolution superior to that of both MRI and ultrasound (of an order of 10 μm) and in the same time has an analysis capacity for a depth extent of up to 1 mm, therefore proving itself to be a tool of paramount importance in evaluating the thickness of the cutaneous layers, as well as various architectural aspects of the skin tissue [5,7].

In dermatology, OCT has been tested and may be employed in several applications; given its potential to carry out both qualitative and quantitative assessment of skin layers, it proved to be useful in providing data concerning the depth extension of melanocytic skin tumors and in evaluating the nail plate in inflammatory conditions such as psoriasis; in these dermatological applications, OCT appears to be more useful and reliable than high-frequency ultrasound [8-12].

The aim of this study is to evaluate the normal skin by using the optical coherence tomography in Time Domain Mode.

Fig.1. 3D reconstruction of the normal finger.

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Results and discussions

Material and methods
12 samples of fingers have been evaluated by using the Time Domain Optical Coherence Tomography method. This evaluation implies a 1300 nm Time Domain Optical Coherence Tomography system.

Conclusions
After noninvasive investigation using optical coherence tomography 2D, 98 slices were obtained. A 3D reconstruction was obtained using these sections (fig.1.).

On this 3D reconstruction a navigation in and out of the investigated tissue is possible in order to evaluate the skin quality.

In conclusion, the optical coherence tomography could act as a valuable technique to be used for a better assessment of the skin.

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References

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