Challenges in Dermatological Research: Analysing Skin Structures using *in-vivo* Confocal Laser Scanning Microscopy

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Confocal laser scanning microscopy (CLSM) for in-vivo visualisation of skin structure is a rapidly growing technique in dermatological research as well as clinical diagnosis and treatment (overview [2], Melanoma [3], skin aging [4]). It provides rapid visualisation of the inner structure of the skin in its native state, i.e. without the need for biopsies. Therefore, CLSM is well suited for cosmetical research where the usage of invasive methods is obviously restricted.

CLSM can be used to visualise all skin layers from strateum cornum (SC) to reticular dermis on cellular level (resolution: x-y:0.5-1.0μm, z: 4μm). The different microstructures of the skin induce natural variations in refractivity which is mapped to grayscale in the images (Fig. 1). The resulting image data is very noisy, which makes automatic analysis very difficult and manual analysis is a time-consuming and error-prone task.

Even the simple and most widely used measurement — thickness of the SC — is (to our knowledge) not automatically assessable. At most, a software presents the image data to a trained technician who selects the top and bottom slice where corneocytes (majority of cells in the SC, large, polygonal shaped) and no keratinocytes (majority of cells in the strateum granolosum showing "honeycomb"-structure) are visible and the software "calculates" the thickness (Fig. 2). The SC-thickness is an important parameter for general "skin health" since SC is the out-most layer of the skin and the major barrier of the body against physical,

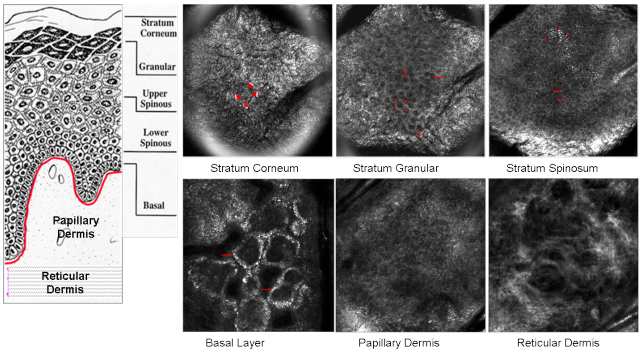

Figure 1: Skin layers and corresponding CLSM.

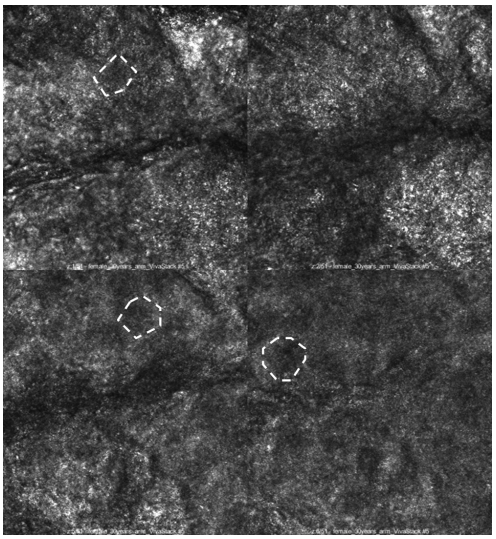

Figure 2: For measurement of thickness of SC the user selects the first slice with visible corneocytes (top) and the bottom slice where the first keratinocytes are visible (bottom)

chemical or biological hazards in the outer environment [1].

Further parameters interesting for cosmetical research which can be manually evaluated from CLSM image data are:

- dermal papillae structure
- epidermal thickness
- pigmentation, Melanin Granula
- collagen structure
- morphological changes in strateum cornum

In our opinion, most of these parameters could be automatically evaluated by employing image analysis algorithms. The automatic analysis could (hopefully) help to increase sensitivity of these parameters and allow better product evaluation in cosmetical and clinical studies.

References

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