In vivo Confocal Microscopy: A New Paradigm in Dermatology

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A time-honored constant in experimental dermatology and dermatopathology is to view what no one has been able to see before. For decades, this challenge is offered to observers in the laboratory. Refinements have been gained in conventional and fluorescent microscopy as well as in transmission and scanning electron microscopy. The use of labelled probes and antibodies have yielded a link between morphology and biological functions. The imaging of cells within tissues is, however, limited by prerequisite fixation, processing, and sectioning procedures which may introduce unwanted and perhaps unknown artifacts. One improvement in the visibility of fine structures in unstained biological structures was introduced by phase contrast microscopy. The material to be examined had to be thin and transparent, and the resolution limit was impaired in these microscopes.

A quarter of a century ago, confocal microscopy was introduced as a new technology aimed at revealing a three-dimensional fine structure near a relatively flat overall specimen surface. It was therefore possible to visualize cells from uncut and unstained tissue blocks [1, 2]. As viewed by many scientists, the

development of the first confocal microscope and the circumstances surrounding this achievement have represented a most remarkable feat in the annals of scientific and technological discovery [3]. At present, the superiority of confocal imaging over conventional light microscopy is well recognized in some experimental conditions. These include the situations when there is a need of focusing beneath the surface layers of semiopaque tissues. Brain, eyes, teeth, bones and other organs have been examined successfully by this method. More recently, confocal microscopy was adapted for noninvasive imaging of living organ systems [3, 4]. Images are generated in real time to minimize problems of blurring due to motion, and to permit the study of dynamic events. Overall, 'in vivo' tandem scanning confocal microscopy provides details of living cells comparable to that of fixed and stained tissue. A more unique feature of 'in vivo' confocal noninvasive imaging is the ability to study cellular structures and functions sequentially over time in the same tissue. The goals are somewhat similar to those of ultrasound imaging in the B and C modes, and of nuclear magnetic resonance.

There are only very few studies of the skin by 'in vivo' confocal microscopy [5]. The work by Cor-cuff and Lévêque [6] presented in this issue of Dermatology is innovative and is a landmark in the evolution of technologies which will be available in clinical settings of the future. They show that the refractive index differences in living skin are large enough to enable the image to be read without any other means of improving the contrast. The photographic documents they provide should be understood as horizontal optical sections in the epidermis and compared to more conventional aspects given by optical and scanning electron microscopy (fig.1).

Confocal microscopy becomes a new paradigm in dermatology. However, obviously a great deal of work remains to be done in developing this technology, which should complement dermoscopy and prove to be valuable in diagnosing some diseases altering the epidermis and the dermo-epidermal junction. The main benefit should probably reside in collecting data concerning the kinetics of physiopathological and pharmacological events.

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Fig. 1. Aspect of keratinocytes in horizontal sections of the epidermis. a Optical microscopy, b, c Scanning electron microscopy.

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