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Medical Diagnosis Using Miniaturised Confocal Microscopes

Alan R. Hibbs, BIOCON, 7 Walhalla Drive, Ringwood East VIC 3135 Australia.

Confocal microscopy offers a number of important advantages for imaging live tissue samples. These include the ability to image below the tissue surface, to collect images at varying depths, to image relatively deeply into the tissue and to remove out of focus noise. These advantages have been exploited by Optiscan Pty Ltd (Melbourne, Australia), for the development of miniaturised confocal microscopes for aiding medical diagnosis of important tissue abnormalities.

Optiscan was one of the earliest developers of the confocal microscope for the biological research community. Their original research grade confocal microscope (the F900e) was developed using single mode fibre delivery and pickup of the fluorescent signal [1]. The use of fibre optics allowed the scan head to be small and robust, with most of the optics and electronics being remote from the scan head. In the mid 1990's Optiscan embarked on the development of a number of confocal microscopes for clinical examination using their own fibre optic technology.

The Stratum (Figure 1) hand held confocal scan head is designed for imaging skin lesions in vivo. The probe consists of a small hand held device that contains the scanning mirrors, and the front objective lens. All other optical and electronic components are attached using a single mode fibre optic connection. The Stratum is capable of imaging below the surface of the skin, down even as far as the vascular layer. The Stratum is being developed as an imaging device for medical examination of important dermatological problems, including skin cancer diagnosis.

The flexible confocal endomicroscope (Figure 2) is a highly miniaturised scan head that fits within an available channel in a conventional endoscope. This microscope is designed for the examination of cell abnormalities, particularly those leading to cancer in less accessible locations within the gastrointestinal tract. The ability to fully utilise the conventional functions of the endoscope allow both the macroscopic localisation of possible areas of cell abnormality, and the ability to locally deliver relevant dyes for diagnostic purposes.s

The development of miniaturised confocal medical imaging devices will substantially aid in the diagnosis of tissue lesions without the necessity for tissue biopsy. An important part of the development of these instruments is to also provide a reliable and relatively easy to use interface for use by clinicians that are experts in their own area of medical diagnosis, but are not confocal or imaging experts. This technology also provides the future possibility of remote diagnosis using internet connection and image transfer to a central specialist clinic.

Optiscan Imaging Limited:
PO Box 1066, Mt. Waverley MDC, VIC 3149, Australia (www.optiscan.com.au)

Alan R. Hibbs is not directly associated with Optiscan, but has worked as a consultant for Martin Harris, the Director of fundamental research at Optiscan.

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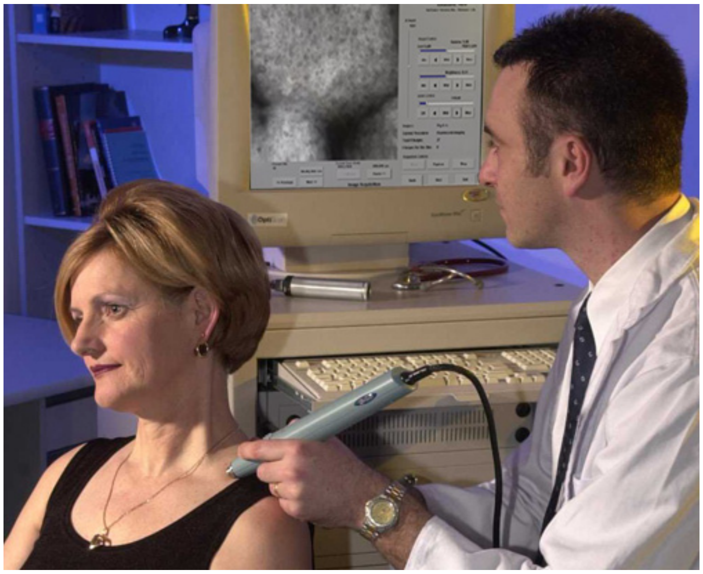

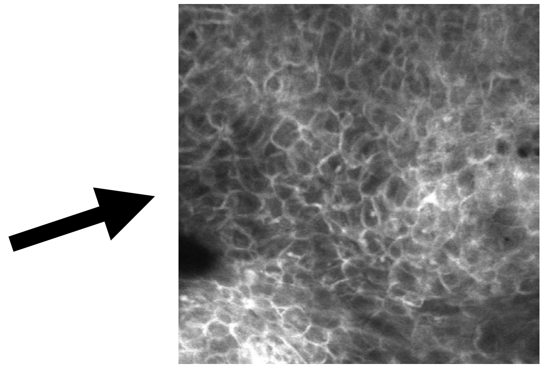

Figure 1: "Stratum" hand held confocal microscope imaging probe.
The Stratum hand held probe for in vivo confocal imaging of human skin has been developed for medical examination of skin lesions. The microscope provides non-invasive, below surface, imaging of human skin, allowing one to image the sub-cellular structure of skin in real time. The right hand panel shows confocal imaging of human stratum spinosum and basal skin cells in vivo, obtained using the Stratum confocal microscope probe. FOV = 250 um.

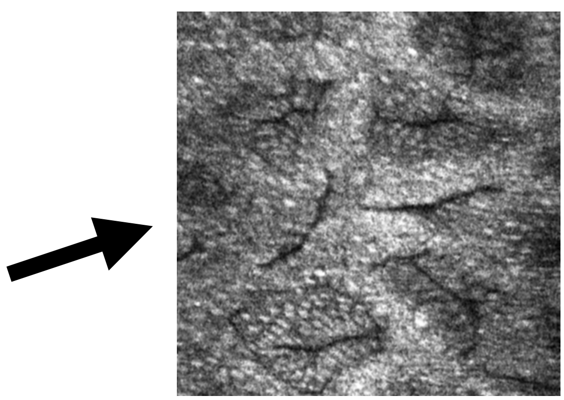

Figure 2: Live Micro Imaging (LMI) using a confocal endomicroscope.
Further miniaturisation of the Optiscan fibre optic based confocal scan head has allowed the production of a confocal microscope that can be inserted into an existing channel within a conventional endoscope. This instrument allows the collection of high resolution microscopic images of, for example, human colon in vivo, while at the same time allowing the macroscopic and dye delivery capabilities of the conventional endoscope to be available. The right panel shows human colonic crypts stained with acriflavine and imaged using a miniaturised confocal endomicroscope.

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