Optical Coherence Tomography (OCT) is a non-invasive imaging technology with rapidly growing applications in diagnostic medicine, at present particularly in ophthalmology. In simplest terms, OCT works by emitting near-infrared light into a target, then capturing the light as it reflects off of biological tissues. Optical qualities of the reflected/recaptured light are used to construct a three-dimensional image of the micro-architecture of the target. The process has been likened to “optical ultrasound.”

These principles have now been developed into a new OCT system for dermal application: VivoSight (Michelson Diagnostics, UK). This FDA-cleared system is capable of imaging living tissue microstructure at <10µm resolution, in real time, to depths of 1mm or more. OCT may have potential applications in clinical dermatology.

Daniel Siegel, MD, Clinical Professor of Dermatology at the State University of New York at Downstate School of Medicine, has been investing possible applications for OCT in dermatology, including use in Mohs micrographic surgery. Below, he shares insights on the technology and addresses its potential.

What has been your clinical experience with OCT?
In a pilot study undertaken at his practice on Long Island, Dr. Siegel has been using OCT on Non-Melanoma Skin Cancer (NMSC) patients receiving Mohs micrographic surgery. The goal is to determine how accurately OCT is able to define margins, with the ultimate hope that the technique may have tissue-sparing and procedural benefits, allowing for surgeons to use smaller initial excisions while getting the margin right the first time, more of the time.

In each instance, Dr. Siegel reviews the case and makes a decision on surgical margins as usual. He draws the proposed initial excision area on the skin based upon his visual clinical examination of the site. Next, the apparent margins are viewed and checked with OCT, and a proposed modified excision area is mapped based on the subsurface features of the lesion and surrounding tissue. As this is a passive study, the area is then excised exactly as it would have been during conventional Mohs surgery. Excised material is processed and histologically evaluated, and additional excisions are made until margins are clear. This final margin, the current ‘gold standard’ for treatment of NMSC, is compared to that defined by use of OCT.

Given that a primary benefit of Mohs micrographic surgery is that it is tissue-sparing, the ability to further conserve tissue should be welcome, Dr. Siegel says. If the process proves effective, it may decrease the number of stages a patient must endure. “OCT appears to make pre-operative margin assessment better,” he observes. It may, “give you a shot at clearing the lateral margins in the first pass.” In addition, in areas outside the US, where Mohs surgery is a rarity rather than the norm, OCT may be able to significantly improve outcomes for patients treated by conventional surgical excision, where incomplete excision rates are often much higher.

How does OCT work?
It is important for clinicians to understand what OCT is and is not, Dr. Siegel says. The OCT system does not render a diagnosis. Rather, the automated image acquisition and display process provides a series of images that the clinician reviews to gather information that may support a diagnosis or treatment plan. The scanning handpiece creates a 5x5x2mm volume of 2-D

Optical Coherence Tomography in the Dermatology Clinic
A novel imaging device allows real-time viewing of the skin to 1mm depth.

By Paul Winnington, Editorial Director

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images analogous to b-mode ultrasound. Looking through the images, Dr. Siegel says, is like going slice by slice through a loaf of bread. A cross-section of the tissue micro-architecture is viewed in much the same way as a histology slide, presenting as a b-mode vertical section through the skin.

There are no risks of adverse events associated with the process, and there is no pain or discomfort, he adds. His patients have responded favorably to the device, and many seem to appreciate seeing the real-time images of their skin on screen.

Image acquisition is quick and easy for the clinician or a staff member to perform. It involves the placement of a handpiece, similar to many laser handpieces, on the desired treatment site. The handpiece can be easily moved across the skin. Images appear on a display screen in real time and are also recorded so that the user can review data. Image capture is quick, he says, and the current device, which stands on a mobile cart, would fit comfortably in many offices.

What are the benefits and limitations of OCT?

OCT received FDA 510(k) clearance for use in the two-dimensional, cross-sectional, real-time imaging of external tissues of the human body. It does not have an indication for “diagnosis,” Dr. Siegel notes. A current limitation of OCT as a dermatologic tool is a lack of validated clinical correlates, something Dr. Siegel and the manufacturers of the system are working to address. Because this method of imaging the skin is novel, Dr. Siegel says, evidence must be gathered to build a consensus regarding the appearance of various structures, cell types, and lesion types on OCT.

Dr. Siegel is confident that with accumulation of sufficient data, dermatologists will be able to use the technology as a clinical diagnostic aid. He has recently started a second, larger IRB approved study; in his clinic he is scanning the majority of suspicious lesions prior to biopsy so that he can correlate OCT findings with histologically confirmed diagnoses. This, he notes, will help to quickly establish concordance between the OCT-appearance of structures and their clinical and histological appearance. Furthermore, Michelson Diagnostics has recently raised funding to recruit further investigators to assist in this process.

There are some instances in which OCT does not provide optimal imaging, Dr. Siegel says. For example, he notes that areas of fibrosis or scarring can be challenging to image. Additionally, he observes, there are some instances in which the images obtained are grainy or unclear, however, the use of a medium such as ultrasound gel may help to reduce backscatter from the surface layers and generate better images.

With expanded use and more experience in the clinic, a clear understanding of indications, contraindications, and optimal strategies for imaging will evolve with a possible positive impact on NMSC care.