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Use of Vibrational Optical Coherence Tomography to Evaluate Skin Lesions

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Vibrational optical coherence tomography (VOCT) is a new technique that combines the 3D imaging power of optical coherence tomography with sonic vibration to characterize the physical properties of tissues. This technique has been developed to perform “virtual biopsies” and make physical measurements on tissues non-invasively and non-destructively. It has been reported in the literature that cutaneous wound healing and the potential to metastasize are associated with changes in tissue stiffness. In this talk we present data illustrating how images and measurement of the resonant frequency of different skin lesions can help plan surgical interventions and assist the analysis of healing.

We have imaged and studied several types of skin lesions using VOCT to evaluate the 3D morphology, stiffness and margins of these structures. While images obtained with VOCT predominantly show the epidermis and collagenous dermal structures, the measurement of the tissue stiffness provides a mechanical picture of the components present. While cellular components present in skin have resonant frequencies in the range of 30 to 40 Hz, normal collagen and elastic tissue have resonant frequencies in the range of 90 to 100 Hz. In comparison, fibrotic collagen is shown to have higher resonant frequencies above 200 Hz.

The components of skin and skin lesions can be characterized non-invasively and non-destructively using VOCT. Using this technique, images of tissues and lesions can be overlaid with a map of the tissue stiffness. A calibration curve for skin component properties can be used to evaluate tissue pathology. The ratio of the resonant frequency and the tissue thickness obtained from VOCT can be used to grade the type of tissue response seen. Further studies are underway to establish the relationship between tissue stiffness and lesion morphology for cellular and fibrotic lesions based on the characteristic ratios of resonant frequency and tissue thickness.

Biography:

Dr. Frederick H Silver is a Professor of Pathology and Laboratory Medicine at RWJMS, Rutgers University. He did his Ph.D. in Polymer Science and Engineering at M.I.T. with Dr. Ioannis Yannas, followed by a postdoctoral fellowship in Developmental Medicine at Mass General Hospital with Dr. Robert L. Trelstad, a connective tissue pathologist. He has published over 200 research papers and book chapters and is co-inventor on over 20 patents. His research interests include wound healing, mechanobiology, implant pathology and artificial implantable materials.