Non - Invasive characterization of allograft dermis, skin and scar using vibrational OCT

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Physicians have been palpating dermal lesions for over 100 years to assist in the diagnosis of disease. Recently, several papers report that cancerous lesions are stiffer (harder) than normal tissues. These events have led to over 40 years of research attempting to develop mechanical tests that can non-invasively and non-destructively evaluate the mechanical properties of skin in health and disease. My lab has measured the mechanical properties of a number of extracellular matrices including skin, decellularized dermis and chemically modified dermis for over 30 years. The mechanical behavior of skin is complicated by several factors including: (1) time dependence of the behavior (viscoelasticity); non-linearity of the stress-strain behavior; (3) ability to test tissue fragments without mechanical slippage during testing; (4) directional dependence of the properties along and perpendicular to Langer's Lines; (5) assumption that Poisson's ratio is independent of strain; and (6) age dependence of the stiffness of skin. All these variables make measurement and interpretation of the stiffness (modulus) and its dependence on deformation (strain) of skin very complex. Recently, we reported the use of optical cohesion tomography (OCT) in combination with vibrational analysis to measure the stiffness of normal skin and scar tissue as well as that of decellularized and chemically modified dermis (Shah et al., 2016, 2016a, 2017). In this technique skin is vibrated using a speaker that employs a low intensity sound wave generated by a cell phone app to find the resonant frequency of skin. This is done by measuring the frequency by OCT at which maximum deformation of the sample occurs. The frequency at which maximum deformation occurs is related the stiffness of a material and tissue properties such as the density.

Speaker Biography

Frederick H. Silver is a Professor of Laboratory Medicine and Pathology at Robert Wood Johnson Medical School, Rutgers University in Piscataway, NJ. 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. Over the last 40 years, he has taught biomedical engineers and physicians at Mass General Hospital, Boston University, Rutgers University and University of Minnesota. His research interests include connective tissue disorders, collagen self-assembly, tissue mechanical properties, pathobiology of implants, mechanobiology and non-invasive assessment of disease processes. He has published over 170 research papers and book chapters and is co-inventor on over 20 patents.

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