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ABSTRACT

Use of Scanning Acoustic Microscopy to Examine and Evaluate Physical Characteristics of Mucosal Tissues

By

Frank Winterroth

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Elastic properties of mucosal tissues (namely within the oral cavity and the uterine lining) are poorly understood. Deformation, flow, and remodeling are fundamental to a variety of higher cell functions including cell contraction, adhesion, spreading, wound healing, and division, and have been implicated as well in mechanotransduction, regulation of protein and DNA synthesis, and programmed cell death. Our understanding of the physical elastic measurements are unclear, both for natural and synthetically engineered soft tissues. The characteristics of tissue engineered oral mucosal tissues have resulted in successful transplantation. These oral mucosal tissues have also been incorporated into vaginoplasty. The versatility of the oral mucosal tissues shows the potential to incorporate as a surrogate for other soft tissues to repair/replace damaged or missing tissues and organs. Of critical importance is whether engineered tissues, specifically a commercially available acellular cadaveric dermal tissue (AlloDerm®) and an *ex vivo* produced oral mucosal equivalent (EVPOME) match the mechanical properties of native tissues. If the oral tissues' structural and physical functions are similar, it is possible that they are

compatible for surgical implantation to replace/repair damaged or missing uterine and vaginal tissues. Scanning acoustic microscopy (SAM) has been shown to effectively image the surface characteristics and mechanical properties of tissues at the micrometer range. We used SAM to study morphologies and elastic properties of both natural and engineered tissues; the latter being the AlloDerm® and EVPOME. These studies include using SAM to measure and characterize whether AlloDerm's® and/or EVPOME's physical properties are similar to natural oral mucosal tissues; this is a significant step to determine whether such tissues are transplantable to other areas of the body. Further studies to characterize regulated changes in the EVPOME involved using both SAM and standard histology images to analyze the EVPOME after it underwent an elevated thermal stress test. Finally, using a compression mechanism in conjunction with SAM - a known method to test for elasticity in tissues – this study aims to determine the elastic properties of soft tissues: oral mucosa and skin. In addition, the same tests were performed on AlloDerm® and EVPOME to compare their elastic properties.