Application of a soft tissue modulus evaluation assay to breast tumor tissue

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In many diseases, development and progression result in changes in the stiffness of the tissue. Methods of assessing tissue elastic modulus have been developed which take advantage of this correlation to non-invasively evaluate disease state. However, a comprehensive understanding of the discriminatory power of clinical scale mechanical property measurements relative to disease state remains to be a challenge. To this avail, we developed a method of soft tissue modulus evaluation named the Model-Gel-Tissue (MGT) assay that combines a gel-submersion process, mechanical testing, and computational modeling. The validity of this technique was established by comparison to the traditionally accepted techniques in mechanical indentation. With its fidelity tested, the MGT assay was employed to evaluate the modulus of three different breast cancer tissue types: an aggressive tumor line, a non-aggressive, infiltrative, drug-responsive tumor line, and its drug-resistant counterpart. In the case of the aggressive tumor line, quantitative histology was also performed and demonstrated a correlation between tissue modulus and collagen content. With respect to the drug responsive/non-responsive tumor lines, preliminary results indicate that the responsive line is twofold stiffer than the drug resistant tumor. From these results, the MGT assay looks to be a promising evaluation technique for probing the value of mechanically-based biomarkers at clinically relevant length-scales.

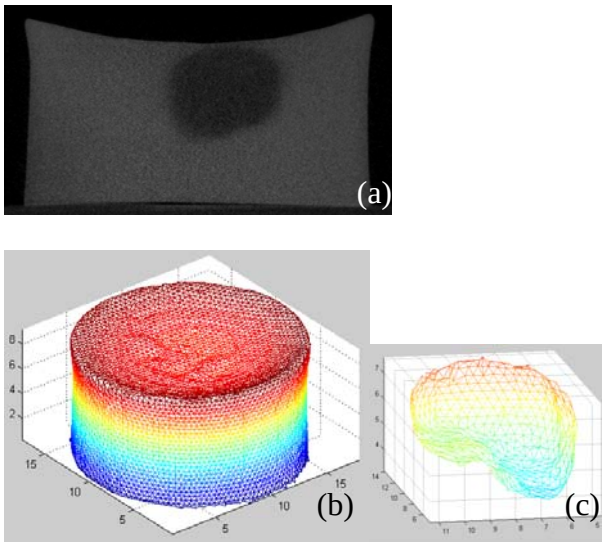

Figure 1. A representative CT slice (a) and the FEM models of the gel (b) and tissue (c).

Figure 2. Example of a gel-tissue sample in the mechanical testing setup.