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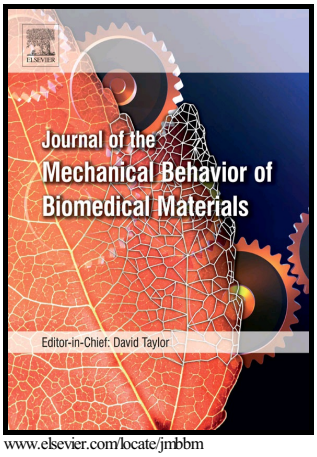

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Correlation between stress drop and applied strain as a biomarker for tumor detection

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Abstract

This is the first study to measure the viscoelastic behavior of tumor tissues using stepwise compression-relaxation testing, and investigate the measured ($\Delta\sigma$-ε) relation between stress drop ($\Delta\sigma$) and applied strain (ε) as a biomarker for tumor detection. Stepwise compression-relaxation testing was implemented via a 2D tactile sensor to measure stress drop at each applied strain of a sample. Pearson correlation analysis was conducted to quantify the measured $\Delta\sigma$-ε relation as slope of stress drop versus applied strain ($m=\Delta\sigma/\varepsilon$) and coefficient of determination (R^2). The measured results on soft materials revealed no dependency of coefficient of determination on the testing parameters and dependency of slope on them. Three groups of tissues: five mouse breast tumor (BT) tissues *ex vivo*, two mouse pancreatic tumor (PT) tissues *in vivo* and six normal tissues, were measured by using different testing parameters. Coefficient of determination was found to show significant difference among the center, edge and outside sites of all the BT tissues, and no difference between the BT outside sites and the normal tissues. Coefficient of determination also revealed significant difference between before and after treatment of the PT tissues, and no difference between the PT tissues after treatment and the normal tissues. Moreover, coefficient of determination of the PT tissues before treatment was found to be significantly different from that of the BT center sites, but slope failed to capture their difference. Dummy tumors made of silicon rubbers were found to behave differently from the native tumors. By removing the need of fitting the time-dependent data with a viscoelastic model, this study offered a time-efficient solution to quantifying the viscosity for tumor detection.

Graphical abstract