Quantitative analysis of the mechanical properties of healthy and cancer lung tissue for the design of mechano-mimetic culture substrates

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Abstract

Mechanical properties of tissues are increasingly recognized as crucial in disease progression. Here we investigate the mechanical properties of normal and adenocarcinoma lung tissues from 18 patients using indentation-type atomic force microscopy. We show that these tissues exhibit a predominant linear elastic behavior. Microscale tissue stiffness and shape descriptors of stiffness texture are extracted from maps of the Young's modulus. Furthermore, a correlation between tissue composition and stiffness is performed. Combining these parameters with photolithography, stiffness-textured polyacrylamide hydrogels are engineered, resulting in culture substrates that mimic the tumor tissue's stiffness distribution. By culturing A549 cells on these hydrogels, the influence of substrate stiffness texture on cellular behavior is evaluated. The development of this versatile mechanomimetic platform reveals its potential applicability to other human tissues and is envisioned as an in vitro model to improve the predictability of drug screening.

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