abstract

The interactions between biochemical and mechanical signals during cell adhesion, migration, spreading and other processes influence cellular behavior. Three-dimensional measurement techniques are needed to investigate the effect of mechanical properties of the substrate on cellular behavior. This talk discusses a new three-dimensional full-field measurement technique that has been developed for measuring large deformations in soft materials. The technique utilizes a digital volume correlation (DVC) algorithm to track motions of sub-volumes within 3-D images obtained by using laser fluorescence confocal microscopy. The technique was validated through measurement of non-uniform deformation fields near hard and soft spherical inclusions under far-field uniaxial compression. The technique is well-suited for investigating 3-D mechanical interactions between cell and extra cellular matrix, and for obtaining local constitutive properties of soft biomaterials. Results from the migration of single fibroblast cells on polyacrylamide gels and their implications for cell motility models are discussed. The implications of the traction distributions of epithelial cell clusters have on the inhibition of proliferation due to cell contact and scattering of cells in a cluster are also discussed. These results provide insights on force fields generated by cells and the role of the mechanical properties of the substrate on cellular interactions and mechanotransduction. Analytical solutions and finite element simulations are used to elucidate the mechanics of cellular forces exerted on extracellular matrix.

Biosketch

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