Biophysics of Cancer Cells During Invasion: A Study Based on Cell Confinement and Atomic Force Microscopy

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Cell mechanics is one of the most important properties of a cell, strongly related to many physiological and pathological cellular processes. In the case of cancer, cancerous cells have been found to be softer and more deformable than healthy ones. The hypothesis that cancer cells might be softer to be able to squeeze in small pores and migrate along micro-channels from primary to secondary locations has been frequently proposed. However, deep insight in the way cancer cells adapt their mechanical properties during invasion is still missing in the field of biophysics of cancer. With this study, we investigated cancer cell migration and mechanics in the transition between unconfined and confined spaces. Employing soft lithography technique and deep UV-based micro patterning, we promoted cancer cell confinement in a 3D and 2D fashion, respectively. Atomic force microscopy (AFM) was used to study mechanical properties of osteosarcoma cells under topographical and biochemical cues. Confocal and structured illumination microscopy (SIM) helped us to elucidate the role of cytoskeleton structure, cell morphology, nuclear deformation and adhesion sites in determining cell mechanics. Finally the role of YAP (yes-associated protein) in cellular mechanotransduction was investigated on both types of cellular confinement.
Overall, with the present work we bring additional insights in the field of biophysics and mechanobiology of cancer, showing that cancer cells adapt their mechanics during invasive processes, and that this is accompanied by a dramatic reorganization of stress fibers and YAP localization.