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Traction Stresses Exerted by Adherent Cells: From Angiogenesis to Metastasis

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Cells exert traction stresses against their substrate that mediate their ability to sense the mechanical properties of their microenvironment. These same forces mediate cell adhesion, migration and the formation of stable cell-cell contacts during tissue formation. In this talk, I will present our data on the traction stresses generated by endothelial cells and metastatic breast cancer cells focused on understanding the processes of angiogenesis and metastasis, respectively. In the context of capillary formation, our data indicate that the mechanics of the substrate play a critical role in establishing endothelial cell-cell contacts. On more compliant substrates, endothelial cell shape and traction stresses polarize and promote the formation of stable cell-cell contacts. On stiffer substrates, traction stresses are less polarized and cell connectivity is disrupted. These data indicate that the mechanical properties of the microenvironment may drive cell connectivity and the formation of stable cell-cell contacts through the reorientation of traction stresses. In our studies of metastatic cell migration, we have found that traction stresses increase with increasing metastatic potential. We investigated three lines of varying metastatic potential (MCF10A, MCF7 and MDAMB231). MDAMB231, which are the most invasive, exert the most significant forces as measured by Traction Force Microscopy. These data present the possibility that cellular traction stress generation aids in the ability of metastatic cells to migrate through the matrix-dense tumor microenvironment. Such measurements are integral to link the mechanical and chemical microenvironment with the resulting response of the cell in health and disease.