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The physics of Eukaryotic cell crawling through elastic media
ELNAZ ALIPOUR BAUM-SNOW, CHARLES WOLGEMUTH, University of CT Health Center — Understanding the motion of cells through deformable media, such as the extra-cellular matrix (ECM), is important for understanding many biological processes, such as cancer metastasis, wound healing, and organismal development. Crawling eukaryotic cells exert dipole-distributed traction stresses on the external environment. These stress distributions pull backwards at the front of the cell and forward at the rear of the cell. Recent experiments have shown the magnitude of the deformations induced in a collagen matrix by migrating cancer cells. We propose a model to understand cell movements through the ECM, by considering a dipole-crawler moving through an isotropic, linear elastic medium. This model captures the major features of the deformations that are induced by motile cancer cells in collagen. In addition, the model suggests that the deformations that are induced in the matrix can provide a mechanism by which distal cells can interact with one another through matrix-mediated interactions. We, therefore, study the forces, torques, and trajectories of two cells migrating through the ECM. Our analysis suggests a mechanism that may be relevant for the collective migration of cells during cancer metastasis and other processes where numerous cells move through the ECM.

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