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Probing the directional structure and intracellular microrheology of vascular endothelial cells MANUEL GOMEZ-GONZALEZ, KATHRYN OSTERDAY, JULIE LI, GERARD NORWICH, JUAN LASHERAS, SHU CHIEN, JUAN CARLOS DEL ALAMO, University of California, San Diego — The magnitude of the rheological properties of cytoplasm is important because it sets the level of intracellular deformation in response to stress. The directionality is equally important because it allows the cell to modulate the stress-strain relation differently along different directions. We aim to elucidate the relation between the structural organization of the cytoplasm and the directionality of its rheological properties by 1) measuring the local orientation of fluorescently labeled intracellular filaments and 2) determining the local directions of the maximum and minimum intracellular viscosity. For this purpose, we improved current microrheology measurements by studying the drag force experienced by a microsphere in an anisotropic viscoelastic network permeated by a liquid. In the limit of strong frictional coupling between network and liquid, the flow around the sphere is modeled with a generalized Stokes equation using several viscosity parameters. We solve this equation analytically to provide new closed-form microrheology formulae relating the resistance measured experimentally to the anisotropic properties of the network. Tracking the random motion of endogenous particles in 2D and using these novel microrheology formulae we measured directional intracellular viscosities.

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