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Peristaltic Pumping in an Elliptical-Annulus Model of a Perivascular Space[1] J. BRENNEN CARR, JOHN H. THOMAS, JESSICA K. SHANG, Department of Mechanical Engineering, University of Rochester — Cerebrospinal fluid enters the brain parenchyma through a network of perivascular spaces (PVSs). The flow removes metabolic waste and its disruption is associated with stroke and neurodegenerative diseases. Recent in vivo experiments show that the flow is peristaltically pumped by traveling waves along the arterial wall. We simulate this perivascular pumping in three-dimensional models of the PVS using a finite element solver. The PVS is idealized as an annulus with a circular inner wall and an elliptical outer wall; a sine-wave displacement is propagated along the inner wall. We examine the effects of shape and eccentricity of the annulus and the amplitude and wavelength of the wave on velocity profiles and net flow rates. In contrast to the concentric circular annulus, in which the flow is axisymmetric, the velocity fields in an elliptical or eccentric annulus have an azimuthal velocity component. The net flow is in the direction of the propagated wave and is greater in elliptical and eccentric annuli than in a concentric circular annulus with the same cross-sectional area.

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