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Extracting permeability model parameters for skin tissue from injection experiments[1] PRANAV SHRESTHA, BORIS STOEBER, The University of British Columbia — Hollow microneedles are medical devices used to inject fluid, such as vaccines, into the skin. As the fluid flows into the skin, a soft porous medium, it deforms the porous matrix. The fluid flow and solid deformation are coupled – the flow-induced deformation changes the porosity and permeability of the tissue, which in turn affects fluid flow. In our experiments, we injected water into excised porcine skin, while recording fluid flow-rate and visualizing the tissue cross-section in real time using optical coherence tomography (OCT). We performed digital image correlation on the OCT images to generate strain maps for quantifying tissue deformation. We used a spherical model of tissue expansion and a two-parameter exponential relationship between permeability and volumetric strain in tissue. Applying Darcy's law to the measured fluid flow-rate and the strain maps over time yields the two parameters through an optimization algorithm. The fluid flow estimated from the optimized permeability model matched closely with the recorded flow-rate. The permeability-strain relationship can help improve the efficiency of fluid injections into the skin.

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