

Poroviscohyperelastic Analysis of Single Chondrocyte: A Finite Element Study

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There are several continuum mechanical models that have been developed for the single cell as well as other biological tissues such as viscoelastic, biphasic and porohyperelastic (PHE) models. The poroviscohyperelastic (PVHE) model is developed based on the PHE model in this study to explore the mechanical properties of a single chondrocyte. Chondrocytes are cytoskeleton (CSK)-rich eukaryotic cells which are the mature cells in cartilage tissues and perform number of functions within the cartilage. Both creep and relaxation responses of a single chondrocyte are investigated by using FEM models of micropipette aspiration and AFM experiments, respectively. There are three material models which are viscoelastic, PHE and PVHE models are considered in this research. The PVHE showed that it can capture these behaviours of chondrocytes, accurately compared to other models.

Keywords: Biomechanics, Chondrocytes, Finite Element Method, Poroviscohyperelastic, AFM, micropipette aspiration.