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A phenomenological mixture model for growth of tissue engineered cartilage in cell-seeded scaffolds

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A phenomenological mixture model for growth of tissue engineered cartilage in cell-seeded scaffolds

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We extend a prior phenomenological (ODE) mixture model that captured interactions between extracellular matrix (ECM) biosynthesis and linking in a cell-scaffold seeded, but neglected cell proliferation. The extended model is comprised of a system of ordinary differential equations for average apparent densities of the unlinked ECM, linked ECM, scaffold, and biological cells along with initial conditions that describe scaffold material properties. The dynamic model for cell proliferation accounts for both the cells' ability to adhere to the solid phase and the ease with which they can spread through the open pores of the evolving mixture. A parametric analysis is carried out for the resulting initial value problem to analyze the effects of initial scaffold properties and biological interaction mechanisms on key functional outcomes in the engineered construct.