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Finite element modeling of finite deformable, biphasic biological tissues with transversely isotropic statistically distributed fibers: toward a practical solution. (English) Zbl 1338.74015

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Summary: The distribution of collagen fibers across articular cartilage layers is statistical in nature. Based on the concepts proposed in previous models, we developed a methodology to include the statistically distributed fibers across the cartilage thickness in the commercial FE software COMSOL which avoids extensive routine programming. The model includes many properties that are observed in real cartilage: finite hyperelastic deformation, depth-dependent collagen fiber concentration, depth- and deformation-dependent permeability, and statistically distributed collagen fiber orientation distribution across the cartilage thickness. Numerical tests were performed using confined and unconfined compressions. The model predictions on the depth-dependent strain distributions across the cartilage layer are consistent with the experimental data in the literature.

MSC:

Cited in **1** Document

74B20	Nonlinear elasticity
74D10	Nonlinear constitutive equations for materials with memory
74F10	Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
74Q15	Effective constitutive equations in solid mechanics
74S05	Finite element methods applied to problems in solid mechanics

Keywords:

articular cartilage; collagen fibers; finite element model; biphasic model; finite deformation

Software:

COMSOL

Full Text: DOI

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