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Abstract
Soft tissues such as brain, liver, kidney, etc. are very vulnerable to trauma during car crash and other impact consequences, but mechanical properties of these soft tissues, which do not bear force, have not been investigated as completely as mechanical properties of load-bearing soft tissues such as ligament, tendon, articular cartilage, etc. The growing requirements of automotive safety regulation need examination of the mechanical properties of these soft tissues. The accurate constitutive models of these soft tissues are the perquisites for injury simulation and designing methods for injury prevention. Furthermore, recent developments in surgical robotic technology as well as advances in virtual reality techniques necessitate closer investigation of the mechanical properties of these tissues. The development of these technology and techniques, for these soft tissues, is highly dependent on the knowledge of mechanical properties of these tissues and the availability of proper constitutive models of these tissues.
In this study, the mechanical properties of pig kidney cortex under uniaxial tensile loads were characterized. The experimental data were obtained at three different loading displacement rates (0.08, 0.2 and 0.4 mm/sec), and they were fitted into three different viscoelastic constitutive models. It can be seen that 3-parameter fractional derivative model and 5-parameter Wiechert model can better fit the experimental results than 3-parameter linear viscoelastic model does. Furthermore, 3-parameter fractional derivative model is more suitable to fit the long term experimental data than 5-parameter Wiechert model. The constitutive models were used to calculate the viscoelastic work dissipation of pig kidney cortex specimen during single notched tensile tests via 1-D linear viscoelastic estimation and 2-D/3-D finite element simulations.
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