Sopakayang, Ratchada; **De Vita, Raffaella**; **Kwansa, Albert**; **Freeman, Joseph W.**
Elastic and viscoelastic properties of a type I collagen fiber. (English) Zbl 1307.92040
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Summary: A new mathematical model is presented to describe the elastic and viscoelastic properties of a single collagen fiber. The model is formulated by accounting for the mechanical contribution of the collagen fiber's main constituents: the microfibrils, the interfibrillar matrix and crosslinks. The collagen fiber is modeled as a linear elastic spring, which represents the mechanical contribution of the microfibrils, and an arrangement in parallel of elastic springs and viscous dashpots, which represent the mechanical contributions of the crosslinks and interfibrillar matrix, respectively. The linear elastic spring and the arrangement in parallel of elastic springs and viscous dashpots are then connected in series. The crosslinks are assumed to gradually break under strain and, consequently, the interfibrillar is assumed to change its viscous properties. Incremental stress relaxation tests are conducted on dry collagen fibers reconstituted from rat tail tendons to determine their elastic and viscoelastic properties. The elastic and total stress-strain curves and the stress relaxation at different levels of strain collected by performing these tests are then used to estimate the parameters of the model and evaluate its predictive capabilities.

MSC:

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