

Comparison of structural anisotropic soft tissue models for simulating Achilles tendon tensile behaviour

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Published in: Journal of the Mechanical Behavior of Biomedical Materials, 2016

Material models are mathematical descriptions of how materials behave during loading, for example under pressure or stretch. Living tissues in the body can be treated as materials and their mechanical behaviour described with material models. Numerous material models have been developed for soft tissues. Soft tissues are a generalised classification of tissues that connect, support and surround other structures and organs in the body, such as tendons, ligaments, cartilage, muscles, and blood vessels. They are characterised by a hydrated tissue material that consists of water, collagen and ground substance.

In this study, we compared three different material models for soft tissues and their capacity to represent Achilles tendons (heel tendons). Two of the models had previously been developed for heart tissue and cartilage, whereas one was specifically modified to describe Achilles tendons. The results showed that all models could capture tendon behaviour during stretching. But only the model specifically modified for Achilles tendons could simulate the water being pressed out of the tissue when it is stretched. This behaviour is in better agreement with experimental observations of tendons.