A fibre-reinforced poroviscoelastic model accurately describes the biomechanical behaviour of the rat Achilles tendon.

By: Khayyeri, Gustafsson, Heuijerjans, Matikainen, Julkunen, Eliasson, Aspenberg, Isaksson

Published in: PLoSONE, 2015

Achilles tendons connect the calf-muscle to the heal bone and are responsible for transferring mechanical loads and enabling energy-efficient locomotion. Repetitive loading can be detrimental to Achilles tendon health, as it can induce changes in tissue composition that leads to inflammation and pain. But the underlying cause of Achilles tendon injuries is not well understood, primarily due to the limited knowledge about the basic biomechanics of healthy tendons.

This research presents a material model for Achilles tendons to study tendon biomechanics. Material models are mathematical descriptions of how a material behaves under loading. To tailor a model for a specific material, the parameters constants must be fitted to experimental data of that material. Tendons can be described as a material consisting of mainly water, collagen and ground matrix. Thus, three different material models (one for each component) can be used to represent the entire Achilles tendon. Data from experiments on rat Achilles tendons were used to find the model parameters. This study results in a model that can capture the deformations and forces in rat Achilles tendons when the tissue is subjected to repeated tension. It is the first model of Achilles tendons that explicitly describes the main tissue components (water, collagen and ground matrix). This new model helps us to explore the contribution of each tissue component to load-transfer and their importance for maintaining Achilles tendon health.