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MICROSTRUCTURAL MODELS OF LIGAMENT AND TENDON ELASTICITY AND VISCOELASTICITY

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Ligaments and tendons are vital connective structures in the musculoskeletal systems of vertebrates that consist of collagen fibres organised in a hierarchical structure. Their main subunit is the fascicle which is made of crimped fibrils. In this talk, I will discuss two models that describe the mechanical behaviour of ligaments and tendons and are based on the microstructure mentioned above.

The first model is a non-linear elastic model, which is expected to be valid in the low strain-rate limit. I will present a strain energy function for modelling ligaments and tendons based on the geometrical arrangement of their fibrils [1], and will compare the ability of the new model to reproduce experimental data with that of the commonly-used Holzapfel-Gasser-Ogden model [2]. I will then use the new model to explain the mechanical differences between positional and energy-storing tendons [3].

The second model is a viscoelastic model. By assuming that each fibril is now linearly *viscoelastic*, I will show that several complex, non-linear viscoelastic effects arise directly as a result of there being a *distribution* of fibril crimp lengths. The viscoelastic model accurately predicts the results of cyclic tensile tests, and can reproduce different data sets with a single set of constitutive parameters simply by changing the crimp distribution parameters.

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