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Characterization of the passive mechanics at three different structural levels of the muscle

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Skeletal muscle is a multiscale tissue whose mechanical properties are usually characterized at only one level. The links between the mechanical responses of myofibrils, fibers, fascicles and the entire muscle are poorly understood and largely under-investigated. Thus, the purpose of this study was to experimentally measure the passive properties of muscle at different scales (macroscopic: muscle, microscopic: fiber, submicron: myofibril). Soleus and extensor digitorum longus (EDL) of mice (slow and fast muscles) were extracted and examined at these three scales. Passive mechanical (ramp, relaxation) tests were applied at each scale to compare the passive properties (Young's modulus, static and dynamic stresses) within a given scale and across scales. This study provides a better understanding of the passive mechanical links between various scales, and might help in multi-scale modeling approaches of skeletal muscles.