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On the validity of evaluation of human tendinous tissues elasticity in vivo by ultrasonography

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The tendinous tissues possess elasticity, and are elongated when the load is applied and then shorten to the original length after the load is removed, thereby creating a so-called load-deformation relationship. This knowledge is based on animal studies (e.g., Alexander and Bennet-Clark, 1977) and in human studies that followed, tendon deformation has been conventionally measured as longitudinal length change (elongation) by B-mode ultrasonography. In these studies, applied loads are controlled by setting target torque levels (graded contraction of muscles that connect to the tendinous tissues, e.g., Kubo et al., 1999) or by changing joint angles (passive lengthening of the muscle-tendon unit, Kawakami et al., 2008). But this approach inherently possesses limitations such as 1) uncertainty in tendon stress that is estimated from joint torque in a straightforward way (without considering the force distributions over synergistic or antagonistic muscles), 2) neglecting contributions of other soft tissues that may act as series elastic components. Our studies have accumulated findings to raise a need for serious attention to the above limitations (Kawakami, 2012). Recent progress in technology has made possible quantitative assessment of tissue elasticity by ultrasonography. This technique (compression elastography) is based on external tissue compression with subsequent computation of the strain profile along the transducer axis (Ophir et al., 1991). We propose a series of studies to challenge the above limitations by combining B-mode ultrasonography and elastography. Presently we are carrying out preliminary studies to decide testable experimental conditions and target tissues, and some data will be presented at the symposium.