【国際セッション5】

Muscle fascicle stretch velocity in relation to stretch reflex activation at different contraction levels in human triceps surae

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Stretch distribution between muscle and tendinous tissues depends on their relative stiffnesses. At low forces, most of the stretch occurs in the more compliant muscle fibres. However, muscle and tendinous tissues both become stiffer with increasing force, with a greater relative increase in the muscle fibres¹. As muscle spindles only 'see' the movement of the muscle fibres in which they are situated, their view of a stretch depends on its distribution between muscle fibres and tendon¹. The aim of this study was to examine changes in stretch distribution to muscle fascicles with changes in contraction intensity in the human triceps surae. This information was related to EMG reflex responses. Thirteen healthy subjects aged 21-30 participated. Subjects sat in an ankle ergometer with the ankle (90°), knee (180°) and hip (120°) angles fixed. Dorsiflexion stretches of 8° were applied at a velocity of 250°/s to the ankle at different contraction levels: 0, 20, 40, 60, 80 and 100% of MVC. Surface EMG was recorded in the medial gastrocnemius (MG), soleus (SOL) and tibialis anterior (TA) muscles. Fascicle lengths of MG and SOL were determined using ultrasound. In both muscles, reflex amplitudes peaked between 40-60% and declined thereafter. Between 0 and 100%, pre-stretch fascicle length decreased by 1.80cm and 0.86cm in MG and SOL, respectively. Fascicle stretch amplitude decreased by 57% and 53% and fascicle stretch velocity decreased by 61 and 56% in MG and SOL, respectively. Stretch distribution was modulated with variations in contraction level, and the velocity at which muscle fascicles stretched dramatically decreased at high forces. As stretch velocity is a more potent stimulus to muscle spindles than stretch amplitude², and assuming constant sensitivity of the muscle spindles to stretch velocity, this decline would decrease afferent activity, contributing to the decreased reflex response. Short latency reflexes play an important role in force³ and stiffness production⁴, so the decrease in reflex stiffness we have observed previously at high contraction levels⁵ can at least partly be explained by this observation.

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