SYSTEMATIC CO-ACTIVATION PATTERN DURING FATIGUING CONTRACTION OF SHANK MUSCLES
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Voluntary action of individual muscle groups is influenced by changes of excitability within the CNS. As one of the results from local neuromuscular fatigue, irradiation pattern develops and a large number of the neighboring as well as more distant muscle groups activate. The purpose of our study was to investigate such co-activation patterns in case of fatiguing the dorsal and plantar flexors fatiguing using a sustained isometric contraction. Additionally, we tempted to discover the importance of mechanical conditions for the development of these co-activation patterns.

Fifteen students (6 female, 9 male, age 24+3 years) volunteered for the study. Each subject was seated into the specially designed brace (trunk upright, hips 90°, knees 90°, ankles 90°). Detection electrodes were glued over m. tibialis anterior, m. soleus, m. biceps femoris l.h., and m. rectus femoris on both sides. These EMG signals were synchronized with the force signal detecting plantar/dorsal flexion for each foot. On three separated visits they were asked to perform sustained (120 s) isometric contractions (goal force of 75 and 100% MVC respectively) in the following manners (i) right leg dorsal flexion, (ii) both legs dorsal flexion, (iii) right leg plantar flexion, and (iv) both legs dorsal flexion. The first type of measurement was also used to test intra- and intersession repeatability. Additionally, modifications of knee and ankle fixations were applied to the same motor task in order to check for mechanical reasons for proximal co-activations during fatigue.

The 75% MVC one leg dorsal flexion resulted in a systematic pattern of co-activation of ipsilateral thigh muscles and contralateral dorsal flexors. It was developed progressively from the 40th to 60th s on accompanying drop in force. In case of one leg plantar flexion ipsi- and contralateral activations developed as well. By both legs tasks the distal-to-proximal activation patterns remained present. Quantitative analyses proved the EMG pattern to be repeatable (.73<R<.94) and sensitive to intra-individual differences. Using the 100% MVC goal force evoked generalized activation of all lower extremities muscles and thus blurred the gradual development of irradiation.

The results show that co-activation of several muscle groups of the lower limbs during isometric uni- and bilateral plantar- and dorsiflexion is regularly seen. In one-side tasks coactivation first appear proximally on the ipsilateral side followed by contralateral activation of the homonym muscle group to that of the required motor task. Insensibility of the EMG pattern to the mechanical modulations points to the neurogenic origin.

Keywords: Fatigue, Neuromuscular System