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Distinction of a holding and a pushing isometric muscle action: Results of an experimental study

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Isometric muscle action can be subjectively distinguished into a holding and a pushing mode. During Holding Isometric Muscle Action (HIMA), one resist an impacting force statically, during Pushing Isometric Muscle Action (PIMA), one work against a stable resistance. The purpose of this study was to investigate if HIMA and PIMA can be differentiated by objective parameters. Ten subjects performed HIMA and PIMA at 80% of MVC realized by use of a pneumatic system. During HIMA the subject resisted isometrically the impacting force of the system, whose pressure cylinder works in direction of the subjects elbow flexion. During PIMA the subject worked isometrically against a stable position of the system at the same force level (direction of elbow extension). The signals of pressure, force, acceleration and Mechano-Myography/-Tendography (MMG/MTG) of the elbow extensor (MMGtri/MTGtri) and the abdominal muscle (MMGobl) were recorded and evaluated concerning the duration of maintaining the force level and the characteristics of MMG-/MTG signals. During HIMA the subjects showed a significant shorter time of stable isometric position (19±8 s) compared to PIMA (41±24 s; p=0.005). The longest isometric plateau during PIMA amounted average 59.4% of the total isometric measuring duration, during HIMA, it lasted 31.6% (p=0.000). The power in the frequency range of 8-15 Hz was significantly higher in MTGtri performing HIMA compared to PIMA. The amplitude of MMGtri at exhaustion (last 10% of duration) showed significantly higher amplitudes during PIMA. The frequency of MMG/MTG and the amplitude of the total duration did not show significant differences. The results suggest that two forms of isometric muscle action exist and are distinguishable concerning their capability of maintaining a given force. We hypothesize that HIMA entails more complex neural control strategies than PIMA. Therefore, the capability of holding may open possibilities in diagnostics. A special measuring system to identify the adaptive holding capability was constructed.

Recent Publications

1.Schaefer L, Bittmann F (2017) Are there two forms of isometric muscle action? Results of the experimental study support a distinction between a holding and a pushing isometric muscle function. *BMC Sports Science, Medicine and Rehabilitation*; 9: 11.

2.Schaefer L, Hoff M, Bittmann F (2017) Measuring system and method of determining the Adaptive Force. *Eur J Transl Myol*; 27(3): 1-8.

Biography

Laura V Schaefer is a passionate Postdoctoral Research Assistant at the University of Potsdam, Germany, Department of Sports and Health Sciences, Regulative Physiology and Prevention. Her research fields are the regulative processes of the neuromuscular system, especially concerning neuromuscular oscillations and the capability of adapting to external forces (Adaptive Force). She leads research groups with the focus on the adaptive force and the characteristics of mechanomyography at patients with Parkinson's disease. In the area of basic research her main focus lies on the intra- and interpersonal synchronization of EEG and MMG as well as on the characteristics of the two forms of isometric muscle action. She teaches at the university and other advanced education and is active in biomechanical and clinical diagnostics and therapy concerning regulatory medicine.

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