TACSM Abstract

Effects of Low-Intensity Fatigue on Motor Unit Firing Properties During Maximal Voluntary Isometric Contractions

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ABSTRACT

Rehabilitation from injuries impairing the neuromuscular system is often difficult to quantify due to task specificity of the affected or immobilized limb or limbs. Often, exercise regimens with clinical practitioners are designed to progress motor performance to a capacity that reflects muscle force production to pre-injury capacity. Modulation of force production from these tasks are regulated from various mechanism in the central and peripheral nervous system. The neural activation of these systems can be recorded as electrical impulses using several non-invasive techniques. Recently, the ability to examine these during fatiguing exercise has provided further insight into activation patterns and firing properties in central (i.e., motor and pre-motor cortex) and peripheral locations (i.e., skeletal muscle). Tracking motor neuron activation from these affords opportunities to investigate the regulation and modulation of task specific performances and can improve the capacity to derive performance criteria for rehabilitation. **PURPOSE:** The purpose of this investigation was to examine the effects of low-force isometric fatiguing contractions on motor unit firing properties during maximal voluntary contractions (MVCs). **METHODS:** Following 3 MVCs, four lower-body resistance trained males (23 yrs. ± 3, ht.176cm ±6., 89kg wt. ±16) performed 60 second submaximal (30% MVC) isometric ramp contraction of the knee extension exercise. Knee extensions were performed on a custom-built seat using an S-beam load-cell to measure isometric force production of the quadriceps muscle group. During the fatiguing contractions, participants were encouraged to perform as many trapezoidal ramp contractions (i.e., 30%) as possible, until they could no longer sustain the required force production. Fatigue was established when the participant could no longer maintain the contraction force within 10% for no less that 3 seconds during the isometric hold. Surface electromyography signals were collected from the vastus lateralis of the right leg and were decomposed into their constituent motor unit action potential (MUAP) trains for further analysis. Paired samples t-tests were used to compare the changes in slope and y-intercepts of the MUAP amplitude vs mean firing rate relationships before (PRE) and after (POST) fatigue. **RESULTS:** There were significant differences between the PRE and POST slopes and y-intercepts of the MUAP amplitude vs mean firing rate relationships ($p < 0.05$). **CONCLUSION**: The low-intensity fatiguing contractions elicited responses in motor unit firing properties that are consistent with previous findings. Although there were fewer motor units identified in the POST MVCs, the accuracy in the recordings following decomposition analysis were able to accurately validate a quantifiable amount of motor units for further processing techniques and statistical analysis. These advanced technologies and techniques in identifying local (peripheral) responses in skeletal muscle fatigue will continue to provide robust information in the modulation of force production of motor performance.