

ALTERATIONS IN MOTOR UNIT FIRING RATE AND ACTION POTENTIAL PROPERTIES DURING ISOMETRIC FATIGUE IN STROKE SURVIVORS

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BACKGROUND AND AIM: The limited number of studies that have investigated fatigue in chronic stroke survivors during voluntary contractions to the endurance limit have reported relatively higher central fatigue and lower peripheral fatigue on the affected side when compared to the less-affected side and healthy controls (Riley and Bilodeau, 2002; Knorr et al., 2011). Although these changes have been investigated using global indices of motor unit (MU) activation, alterations at the level of the single motor unit have not yet been examined.

METHODS: Surface EMG activity was recorded during isometric abduction of the first dorsal interosseous muscle in twelve chronic stroke survivors, before, during and directly after a sustained fatiguing contraction at 30% maximum voluntary contraction (MVC) held until the endurance limit. A series of 10 second duration contractions were performed pre- and post-fatigue, four at 20% MVC and three at 40% MVC. Individual motor unit spike trains were extracted from the surface EMG signal using the decomposition algorithm outlined in Nawab et al., (2010). The MU action potential waveform was characterised by using the identified MU firing times to spike trigger average the surface EMG signal. Motor units were accepted for further analysis based on the reliability tests outlined in Hu et al., (2013).

RESULTS: Motor units on the affected side displayed a greater decline in firing rate during the sustained, fatiguing isometric contraction than on the less-affected side in chronic stroke survivors. Motor unit mean firing rates on both sides exhibited a tendency to be lower directly post-fatigue when compared with pre-fatigue. This was accompanied by evidence of a derecruitment of motor units as fatigue progressed on both the affected and less-affected sides. A significant increase in action potential duration was observed on both sides. However, the magnitude of the change was lower on the affected side.

CONCLUSIONS: These results collectively indicate that a higher level of central fatigue is present on the affected side during isometric, fatiguing contractions in stroke survivors. In addition, this study demonstrates that manifestations of peripheral fatigue at the motor unit level, i.e. changes in MUAP duration, are greater on the less-affected side following voluntary fatiguing protocols.

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[4] Hu, X., Rymer, W. Z., & Suresh, N. L. (2013). Motor unit pool organization examined via spike-triggered averaging of the surface electromyogram. *Journal of neurophysiology*, 110(5), 1205-1220. Alterations in motor unit firing rate and action potential properties during isometric fatigue in stroke survivors