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Introduction

Muscular fatigue remains a persistent problem during functional electrical stimulation (FES). One technique known as spatially distributed sequential stimulation (SDSS), uses multiple electrodes to stimulate distinct pools of motor-units at a lower frequency to decrease fatigue. Although literature claims clear benefits, interpretation of the results and applicability proves difficult due to heterogeneous testing strategies. Thus, we present a standardized method for fatigue testing in individuals with spinal cord injury (SCI), tailored to the requirements of a practical application (e.g. FES-Cycling).

Methods

The fatigue-development of 6 paralysed quadriceps muscles of 3 different participants with complete paraplegia was assessed via a fatigue-index during 180 dynamic contractions, comparing different SDSS electrode-configurations against conventional single-channel stimulation. For standardisation, testing was conducted at 40% of the peak-torque during a maximal evoked contraction (MEC), in previously trained individuals with SCI.

Results

Our results were unable to detect a significant difference in the fatigue-development comparing SDSS against conventional stimulation. Indifferent results regarding the potential benefits of SDSS in a practical setting are widely reported across various international research groups. We hypothesise that the positive effects of SDSS diminish with increasing stimulation amplitudes (required to elicit strong contractions), due to a loss of selectivity.

Conclusion

Assessing muscular fatigue is not a trivial task. To allow for a successful practical translation of a technique, it is crucial to perform fatigue-testing tailored to the requirements of a potential use-case. In practical applications, FES is often used to elicit forceful dynamic contraction in individuals with SCI who already conducted a dedicated FES-training program. Therefore, we recommend to assess fatigue-development at higher forces (e.g. 40% MEC) in pre-trained individuals with SCI to better reflect the practical demands of FES-applications.