Strategies for Rapid Muscle Fatigue Reduction during FES Exercise in Individuals with Spinal Cord Injury: A Systematic Review

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Abstract

Background

Rapid muscle fatigue during functional electrical stimulation (FES)-evoked muscle contractions in individuals with spinal cord injury (SCI) is a significant limitation to attaining health benefits of FES-exercise. Delaying the onset of muscle fatigue is often cited as an important goal linked to FES clinical efficacy. Although the basic concept of fatigue-resistance has a long history, recent advances in biomedical engineering, physiotherapy and clinical exercise science have achieved improved clinical benefits, especially for reducing muscle fatigue during FES-exercise. This review evaluated the methodological quality of strategies underlying muscle fatigue-resistance that have been used to optimize FES therapeutic approaches. The review also sought to synthesize the effectiveness of these strategies for persons with SCI in order to establish their functional impacts and clinical relevance.

Methods

Published scientific literature pertaining to the reduction of FES-induced muscle fatigue was identified through searches of the following databases: Science Direct, Medline, IEEE Xplore, SpringerLink, PubMed and Nature, from the earliest returned record until June 2015. Titles and abstracts were screened to obtain 35 studies that met the inclusion criteria for this systematic review.

Results

Following the evaluation of methodological quality (mean (SD), 50 (6) %) of the reviewed studies using the Downs and Black scale, the largest treatment effects reported to reduce muscle fatigue mainly investigated isometric contractions of limited functional and clinical relevance (n = 28). Some investigations (n = 13) lacked randomisation, while others were characterised by small sample sizes with low statistical power. Nevertheless, the clinical