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Biophysical Agents

Fatigue response of the quadriceps to neuromuscular electrical stimulation in endurance trained versus untrained subjects: a pilot study

James W. Bellew, PT EdD, MS[1a], Faith Atkinson, BS, SPT[1], Madeline Moss, BS, SPT[1], Katherine Pierson, BS, SPT[1], Samir Hamlin, BS, SPT[1], Shane Holden, BS, SPT[1], Brock Hudkins, BS, SPT[1]

[1] Krannert School of Physical Therapy, University of Indianapolis

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Purpose

A variety of different NMES waveforms are used in clinical care yet limited data are available that have examined the fatigue response (FR) of muscle to these waveforms and even less is known regarding the effects of endurance training on FR during NMES. This study was designed to examine the FR in endurance trained versus untrained subjects using two commonly used NMES waveforms.

Methods

A single session repeated measures design was used to assess 20 young adults (23±2y/o) assigned to trained or untrained groups based on criteria from the American College of Sports Medicine. FR of the dominant side quadriceps was calculated as the percentage decrease in electrically elicited force (EEF) between the highest and lowest repetitions over a single set of 10 isometric knee extension repetitions using both burst modulated alternating current and symmetrical biphasic pulsed waveforms. Two-way repeated measures ANOVA was used to examine if training status or waveform affected the FR of the quadriceps.

Results

Across both groups, waveform selection was a significant factor ($F=33.583$, $p< .001$) showing an average FR of 54% with burst modulated alternating current but only 34% with symmetrical biphasic pulsed. Training status was not a significant factor in the FR of the quadriceps ($F=.017$, $p= .897$).

Conclusion

NMES waveform, not training status, had a greater effect on the FR of the quadriceps over ten NMES elicited contractions and these data further support previous studies reporting significantly greater fatigue and less force with burst modulated alternating current versus symmetrical biphasic pulsed waveforms. These findings may guide clinicians in selecting NMES waveforms to optimize treatment outcomes.

INTRODUCTION

NMES is an effective modality used for improving muscular strength,[1-3] as well as reducing muscle atrophy.[4,5] A variety of different NMES waveforms are used in clinical practice and two of the most common are burst modulated alternating current (i.e. Russian current) and symmetrical biphasic pulsed (SBP) current. To optimize the therapeutic effects of NMES it is important to understand both the biomechanical and physiological impacts that a chosen electrical waveform has on the targeted skeletal muscle including fatigue response (FR) where FR reflects the decline in muscle force following repeated stimulation over multiple contractions.

a Corresponding Author
bellewj@uindy.edu