Background

Neuromuscular electrical stimulation (NMES) evokes contractions through delivery of electrical pulses to electrodes over a muscle belly or nerve trunk. NMES can reduce muscle atrophy and restore movement for individuals who have had a stroke or a spinal cord injury.

However, contractions fatigue rapidly and high stimulation intensities create discomfort, both of which limit the use of NMES in rehabilitation.

To address these issues, we investigated a novel form of NMES, interleaved NMES (iNMES), in which stimulus pulses are alternated between mNMES and nNMES.

Fatigue: nNMES and mNMES recruit different motor units, thus alternating pulses reduces motor unit discharge rates by half.

Discomfort: Pilot data suggest that to generate contractions of equal amplitude, iNMES requires lower stimulation intensities than either nNMES or nNMES. This may reduce discomfort associated with NMES.

Purpose

Compare contraction fatigue and discomfort between three types of NMES (mNMES, nNMES and iNMES) applied to generate contractions of the tibialis anterior muscle.

Hypothesis

iNMES will generate contractions with the least fatigue and discomfort, followed by nNMES and mNMES, respectively.

Methods

• N = 8 able-bodied participants

• Volunteers participated in three experimental sessions (one per method of stimulation)

• Fatigue protocol: NMES was delivered to generate 250 contractions (2 s on, 2 s off) with an initial amplitude of 10-15% of a maximum voluntary contraction (MVC).

• iNMES was applied at 40 Hz. Each pulse had a duration of 50 μs.

Conclusion

There were no significant differences in fatigue index or discomfort scores between protocols (p>0.05).

Although iNMES appears to generate contractions that fatigue less, more data need to be collected to determine if this trend is significant.

Identifying NMES protocols that produce the most fatigue-resistant contractions with the least discomfort will help to increase participation in NMES-based rehabilitation programs and maximise its benefits.

Reference


Acknowledgements

We thank Alejandro Ley for his expert technical assistance.