Muscle cramp is a painful involuntary shortening of a muscle or a part of it. Experimental methods to induce a cramp of the flexor hallucis brevis muscle by means of repetitive electrical stimulation of a peripheral nerve have been reported: the stimulation frequency was found to be the determinant of whether cramp is induced and the minimum stimulus frequency capable of inducing cramp was termed threshold frequency (TF) (1,2). However, the reduced tolerability due to the direct stimulation of the posterior tibial nerve at the ankle limited their application to the study of both pathological subjects and healthy athletic populations. Our purposes were to test an alternative, more tolerable, method to electrically induce muscle cramp.

Eighteen healthy male volunteers (aged 22 ± 7, median ± interquartile range) were recruited. Each subject reported to the laboratory on three separate days. Two cramps of the abductor hallucis muscle of the dominant foot were induced on each of the three days, with the following protocol: identification of the main muscle motor point and placement of a stimulating adhesive electrode; placement of a surface electrode array (8 contacts, 5 mm apart) for EMG detection between the selected motor point and the distal tendon; identification of the maximal current intensity on the basis of M-wave peak amplitude; delivery of trains of electrical pulses of increasing frequency (150 stimuli; current intensity: 30% higher than maximal; frequency of the first trial: 4 Hz; recovery between trials: 1 minute), until a cramp developed. Once a cramp was induced, the delivery of trains of stimuli of increasing frequency was repeated after 30 min. To verify by EMG that cramp occurred, we calculated for each trial the ratio between average rectified value (ARV) estimate of the first second after the stimulus train and baseline ARV; thereafter, the Grubbs’ method for assessing outliers was applied to all ARV ratios of each session to identify the TF value.

TF intersession and interday reliability were assessed using intraclass correlation coefficients [ICCs (3,1)] (3). In each of the 18 subjects, we were able to elicit two cramps per day for all three days. No subject reported pain or discomfort due to either the stimulation or the cramp. We observed the following median (± interquartile range) values of TF: day 1 (session 1), 13(6); day 1 (session 2), 16(4); day 2 (session 1), 16(6); day 2 (session 2), 18(6); day 3 (session 1), 17(4); day 3 (session 2), 18(8). TF intersession reliability was 0.82, 0.92, and 0.90 for day 1, 2, and 3, respectively. TF reliability among all days was 0.85.

The absence of pain due to the stimulation and the demonstration of TF reliability support the use of the proposed neurostimulatory method for the laboratory study of muscle cramps.

3) Shrout PE, Fleiss JL. Psychol Bull 1979;86:420-8

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