Acute Physiologic Responses Between Voluntary Exercise and Electrical Stimulations

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Electrical stimulations (E-STIM) have been proposed as a feasible alternative for those unwilling or incapable of performing resistance exercise. Studies comparing the efficacy of E-STIM and voluntary exercise have employed different exercises for both conditions (i.e. comparing isometric E-STIM with isotonic voluntary exercises). This makes it difficult to make a fair comparison as the results are contingent upon the arbitrarily chosen voluntary exercises to be completed.

PURPOSE: To assess differences in physiologic responses to isometric knee extensions completed either voluntarily or via E-STIM. METHODS: Two testing sessions were completed each separated by 48h. Each session involved three sets of 10 isometric leg extensions completed on a dynamometer. One leg completed maximal voluntarily isometric contractions and the opposite leg completed E-STIM with the amplitude increased to the maximal tolerable intensity. Before and after each of the exercises, individuals had their muscle thickness measured using B-mode ultrasound and isometric torque measured via dynamometry. RESULTS: Twenty-nine individuals (10 females and 19 males) completed the study. Results are expressed as mean (95% confidence interval). The magnitude of torque production during the exercises was greater (p<0.001) in response to voluntary exercise [258 (227, 290) Nm] as compared to E-STIM [34 (13, 54) Nm]). There was no condition x day interaction (p=0.112) nor were there main effects for muscle thickness which increased to a similar extent in response to both E-STIM [0.10 (0.02, 0.18) cm] and voluntary [0.15 (0.08, 0.23) cm] exercise. For isometric strength, there was no interaction (p=0.104) nor were there main effects. Isometric strength did not change in response to either E-STIM [-1.4 (-11.5, 8.7) Nm] or voluntary [-6.5 (19.5, 6.4) Nm] exercise. CONCLUSION: Despite substantially greater torque production resulting from voluntary exercise, there were no differences in muscle swelling or fatigue between protocols. These results may suggest that long-term adaptations between voluntary exercise and E-STIM may be similar when the same exercises are employed. SIGNIFICANCE/NOVELTY: This is the first study to our knowledge to compare physiologic responses between E-STIM and voluntary exercise that incorporate the exact same exercise (isometric knee extensions). These results provide some support for the efficacy of E-STIM for those who cannot or are unwilling to perform resistance exercise.