

The role of the motor cortex in muscle contractions evoked by peripheral nerve stimulation

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Neuromuscular electrical stimulation (NMES) can be used to generate contractions of muscles paralyzed by a spinal cord injury or stroke and is beneficial for rehabilitation. Part of the contraction is generated by signals that travel through the central nervous system, however, which parts of the nervous system are involved is presently unclear (i.e. brain vs. spinal cord). It was previously thought that contractions originate solely via reflex pathways through the spinal cord but it is possible that pathways through the brain (motor cortex) also contribute. This can be determined using transcranial magnetic stimulation (TMS). If pathways through the motor cortex contribute to a contraction, activity is indicated by inhibition of the ongoing contraction during a specific time frame and can be measured using electromyography (EMG). We hypothesize that pathways through the motor cortex contribute to electrically evoked muscle contractions. Our pilot experiment was conducted using one healthy volunteer who participated in a 2.5-3 hour session where NMES was administered without TMS as a control, and then with TMS at varying intensities. The process was repeated while the participant held a voluntary muscle contraction. The EMG data showed clear inhibition of the muscle contraction at the expected time during both NMES and voluntary contractions supporting our hypothesis. This pilot study demonstrates that pathways through the brain contribute to electrically evoked contractions. Additional trials involving a larger sample size should be carried out to confirm this finding. However, these pilot data contribute to our understanding about how NMES produces contractions in humans.