Plasticity in the Spinal Cord to Enhance Motor Retraining after Stroke

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OBJECTIVE: Noninvasive neuromodulation targeting synapses that link corticospinal neurons onto the final common pathway via spike-timing-dependent mechanisms can alter distal limb motor output on a transient basis, yet these effects appear subject to individual differences. The objective of this study was to investigate how this form of noninvasive neuromodulation interacts with task repetition to influence early learning of force control during hand movements foundational to everyday tasks and susceptible impairment after neurological injury.

DESIGN: Experiments were conducted using a within-subject, repeated-measures design involving separate testing sessions under three counterbalanced conditions that were randomized within a subject and pseudorandomized across subjects: Rest, Sham, and Active. During conditioning stimulation, single-pulse TMS was used to depolarize corticospinal terminals and electrical current as applied to the ulnar nerve to depolarize spinal motor neurons antidromically. Depolarization of corticospinal terminals and spinal motor neurons occurred with hand muscles at rest in the Rest condition. Depolarization of *only* spinal motor neurons occurred immediately after precision grip force was stabilized in the Sham condition. Depolarization of corticospinal terminals and spinal motor neurons occurred immediately after precision grip force was stabilized in the Active condition. In this way, comparisons of PCMS alone, task repetition alone, and PCMS during task repetition was possible. RMSE was measured at baseline and following conditioning stimulation at three separate time points under each condition to quantify force stability.

STATISTICAL ANALYSIS PLAN: A 4 (time point) × 3 (condition) repeated-measures ANOVA was used to test for differences in RMSE. The Bonferroni test was used to correct for multiple comparisons.