

**NERVE STIMULATION PAIRED WITH TASK-ORIENTED TRAINING IMPROVES CHRONIC, SEVERE HEMIPARESIS AFTER STROKE: A RANDOMIZED TRIAL**

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**Background:** A sensory-based intervention called peripheral nerve stimulation (PNS) can enhance outcomes of motor training for people with mild-to-moderate hemiparesis after stroke. Further research is needed to establish whether this paired intervention can have benefit in cases of severe hemiparesis.

**Hypothesis:** Active PNS paired with intensive task-oriented training will lead to more improved upper extremity movement function than sham PNS paired with intensive task-oriented training.

**Methods:** Subjects with chronic, severe post-stroke hemiparesis (n=36) were randomized to receive 10 daily sessions of either active or sham PNS immediately preceding intensive task-oriented training. Upper extremity movement function was assessed using Fugl-Meyer Assessment (primary outcome measure), Wolf Motor Function Test, and Action Research Arm Test at baseline, immediately post-intervention, and at 1-month follow-up.

**Results:** Statistically significant difference between groups favored the active PNS group on Fugl-Meyer at post-intervention (95% CI, 1.1-6.9; p=0.008) and 1-month follow-up (95% CI, 0.6-8.3; p=0.025); Wolf Motor Function Test at post-intervention (95% CI, -0.21 to -0.02; p=0.020); and Action Research Arm Test at post-intervention (95% CI, 0.8-7.3; p=0.015) and 1-month follow-up (95% CI, 0.6-8.4; p=0.025). Only the active PNS condition was associated with 1) statistically significant within-group benefit on all outcomes at 1-month follow-up, and 2) improvement exceeding minimal detectable change, as well as minimal clinically significant difference, on 1 or more outcomes at 1 or more timepoints following intervention.

**Conclusions:** Active PNS paired with intensive task-oriented training can effect significant improvement in severely impaired upper extremity movement function after stroke. Further confirmatory studies with a larger group, as well as longer follow-up, are needed.

**Closed-Loop Afferent Electrical Stimulation for Recovery of Hand Function in Individuals with Motor Incomplete Spinal Injury: Early Clinical Results**

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Afferent electrical stimulation is known to augment the effect of rehabilitative therapy through use-dependent cortical plasticity. Experiments pairing transcranial magnetic stimulation (TMS) with peripheral nerve stimulation (PNS) have shown a timing-dependent effect on motor evoked potential (MEP) amplitude suggesting that PNS applied in closed-loop (CL) mode could augment this effect through positive reinforcement. We present early results from a clinical trial in which an EEG brain-machine interface (BMI) was used to apply PNS to five subjects in response to motor intent detected from sensorimotor cortex in a cue-driven hand grip task. All subjects had stable incomplete

cervical spinal cord injury (SCI) with impaired upper limb function commensurate with the injury level. Twelve sessions of CL-PNS applied over a 4-6 week period yielded results suggesting improved functional outcomes in three of four subjects. Seven sessions were applied to a fifth subject who decided to exit the study for reasons unrelated to the study. Functional outcomes evaluated were hand grip strength, task-related modulation of the EEG, and TMS-measured motor map area. These observations indicate that rehabilitation using such interactive therapies could benefit affected individuals.