SPINAL AND CORTICAL PLASTICITY INDUCED BY PRACTICE AFTER STROKE AND SPINAL CORD INJURY

Bruce Dobkin
Reed Neurological Research Center
University of California Los Angeles

Brain-computer neural communication to drive functional neuromuscular stimulation and robotic devices have become feasible as neural network modeling and computer algorithms for translating thought into action evolve. Adaptive algorithms will better decode neural signals and provide more physiologic feedback for multijoint movements. Multiple cortical motor representations are tuned to aspects of movement, observation, and imitation. A neuroprosthesis that draws these regions will interact with mechanisms of CNS plasticity in ways that aid or in ways that may interfere with success. Functional neuroimaging techniques can be used as physiologic markers of representational plasticity during skills learning in patients with stroke or spinal cord injury. Similarly, these techniques can provide information about where to place cortical stimulators or sensors and how training and activations over time alter functional neuroanatomy.

Hemiparetic subjects were trained with a specific technique called body weight-supported treadmill training to try to improve overground walking ability. This physical therapy intervention optimizes sensory feedback related to the step cycle at walking speeds that are greater than subjects can achieve with over ground, conventional training. Training is associated with an evolution of changes in the primary sensorimotor cortex and supplementary motor areas that parallel gains in motor control and behaviors. Greater intensity of locomotor training further alters these representational changes when such changes would not be expected clinically.Such CNS changes may be derived from interactions within the distributed motor network. The effects of repetitive locomotor-related sensory inputs during the practice of a skill such as walking provides insights into how functional neuroimaging may be employed in developing neuroprostheses and in designing training paradigms for subjects.