Plasticity in the Corticospinal System after Spinal Cord Injury

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The corticospinal tract is an important target for motor recovery after spinal cord injury (SCI) in humans. Using noninvasive electrophysiological techniques we have demonstrated the presence of plasticity in corticospinal projections targeting spinal motoneurons of muscles located close and at a distance from the injury site in individuals with chronic anatomically incomplete cervical SCI. We developed tailored protocols for precisely timing the arrival of descending and peripheral volleys at corticospinal-motoneuronal synapses of hand muscles. We found that the arrival of presynaptic volleys prior to motoneuron discharge enhanced corticospinal transmission and hand voluntary motor output. These findings are the first demonstration that spike timing-dependent plasticity of residual corticospinal-motoneuronal synapses provides a mechanism to improve motor function after SCI. Modulation of residual corticospinal connections may present therapeutic target for enhancing voluntary motor output in motor disorders affecting the corticospinal tract.