AUGMENTING MOTOR CONTROL IN SPINAL CORD INJURY

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The lumbar spinal cord contains locomotor neural circuitry which can be activated by tonic stimulation of lumbar afferents with epidural stimulation in humans with spinal cord injury (SCI). Transcutaneous spinal cord stimulation (tSCS) has been developed as a non-invasive method to activate these afferents with the objective of using tonic tSCS to augment locomotor output during body weight supported treadmill stepping (BWSTS) assisted manually or by the Lokomat robotic gait orthosis.

Stimulating electrodes are applied paraspinally and over the lower abdomen to generate an electrical field that would activate posterior roots. Continuous electrical stimulation at 10-50 Hz is applied during BWSTS. Muscular activity is recorded by EMG from proximal and distal flexors and extensors of the lower extremities and joint positions or forces are monitored with goniometers (manually assisted stepping) or the Lokomat respectively.

In motor complete SCI, tonic tSCS at modest intensities during BWSTS increases leg muscle EMG amplitudes relative to those generated during BWSTS alone. With greater stimulation, rhythmic activities are generated in the leg muscles that could be synchronous in flexors and extensors or alternating but not linked to the gait cycle. Tonic tSCS in motor incomplete SCI with manually assisted BWSTS causes gait-phase appropriate augmentation of motor output by EMG and improved limb kinematics, mostly enhanced flexor activation during swing. In the Lokomat, adding loading and increasing gait speed improves EMG output but this is augmented with tSCS, with increased limb force generation recorded by the Lokomat and with improved ankle flexor function during swing. In conclusion, tSCS can be used to augment locomotor output in motor complete and incomplete SCI.

PUBLICATIONS
MINASSIAN, KAREN, HOFSTOETTER, URSULA, TANSEY, KEITH, MAYR, WINFRIED. NEUROMODULATION OF LOWER LIMB MOTOR CONTROL IN RESTORATIVE NEUROLOGY. CLINICAL NEUROLOGY AND NEUROSURGERY 114 (2012) 489-497.

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