ABSTRACT

OBJECTIVES: To investigate the effect of walking speed on the emergence of locomotor electromyogram (EMG) patterns in an individual with chronic incomplete spinal cord injury (SCI), and to determine whether central pattern generator activity during robotic locomotor training (RLT) transfers to volitional EMG activity during overground walking.

DESIGN: Single-case (B-A-B; experimental treatment-withdrawal-experimental treatment) design.

SETTING: Freestanding rehabilitation research center.

PARTICIPANT: A 50-year-old man who was nonambulatory for 16 months after incomplete SCI (sub-T11).

INTERVENTIONS: The participant completed two 6-week blocks of RLT, training 4 times per week for 30 minutes per session at walking speeds up to 5km/h (1.4m/s) over continuous bouts lasting up to 17 minutes.

MAIN OUTCOME MEASURES: Surface EMG was recorded weekly during RLT and overground walking. The Walking Index for Spinal Cord Injury (WISCI-II) was assessed daily during training blocks.

RESULTS: During week 4, reciprocal, patterned EMG emerged during RLT. EMG amplitude modulation revealed a curvilinear relationship over the range of walking speeds from 1.5 to 5km/h (1.4m/s). Functionally, the participant improved from being nonambulatory (WISCI-II 1/20), to walking overground with reciprocal stepping using knee-ankle-foot orthoses and a walker (WISCI-II 9/20). EMG was also observed during overground walking. These functional gains were maintained greater than 4 years after locomotor training (LT).

CONCLUSIONS: Here we report an unexpected course of locomotor recovery in an individual with chronic incomplete SCI. Through RLT at physiologic walking speeds, it was possible to activate the central pattern generator even 16 months postinjury. Further, to a certain degree, improvements from RLT transferred to overground walking. Our results suggest that LT-induced changes affect the central pattern generator and allow supraspinal inputs to engage residual spinal pathways.