

Supplementary Information

Corticospinal-Motoneuronal Plasticity Further Promotes Exercise-Mediated Recovery in Humans with Spinal Cord Injury

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Materials and Methods

Experimental set up. During testing of hand muscles and deltoid, participants were seated in an armchair with both arms relaxed and flexed at the elbow by 90° with the forearm pronated and the wrist and forearm restrained by straps. MVCs were performed for 3–5 s into index finger abduction and thumb abduction, for first dorsal interosseous and abductor pollicis brevis, respectively, and into arm abduction for deltoid. When the biceps brachii was tested, individuals were seated in an armchair with a custom device attached to maintain the position of the tested arm with the shoulder and elbows flexed at 90°. MVCs were performed into elbow flexion for biceps brachii. When the tibialis anterior was tested, both feet were placed on a custom platform with the ankle flexed at 90° and restrained by straps. MVCs were performed into ankle dorsiflexion for tibialis anterior.

TMS and PNS interstimulus interval (ISI). For deltoid and biceps brachii, CCT was calculated by adding to the latency from TMS of the C-root to 1.5 ms [estimated time of synaptic transmission plus conduction to the nerve root at the vertebral foramina^{1,2}] and subtracting from the MEP

latency [MEP – (C-root + 1.5)], as in our previous study³. PCT was calculated by subtracting the M-max latency from the C-root latency and adding 0.5 ms, the estimated time of antidromic conduction time from the vertebral foramina to the dendrites⁴ [(C-root – M-max)+ 0.5].

Response latencies and conduction times are compared between PMSC and sham-PCMS in Table 2.

Exercise training. During gross grasping, subjects were asked to reach and grasp a cylinder (6-cm diameter and 16-cm height, 100 gms), block (6.5×6.5×6.5 cm, 110 gms), cup (6-cm diameter at the bottom and 10-cm height, 50 gms) and lid (10-cm diameter and 1-cm height, 15 gms) randomly presented on a table located in front of them at a height of ~20 cm. Then, subjects were asked to reach and grasp the object to put it back on the table. These sets of movements were repeated 20 times for each object for 30 min with breaks as needed.

Functional outcomes. During jar opening, subjects were asked to open a jar lid with a tested hand while holding the jar (7-cm diameter and 9-cm height) with the other hand as fast as possible.

During the water bottle test, subjects were asked to lift a bottle (6-cm diameter and 20-cm height, filled with water ~200mL) from the table and pour water into the cup, approximately $\frac{3}{4}$ full.

During the key test, subjects were asked to lift a key from the table, insert it in a lock, and turn it 90°. During the nine-hole peg test, subjects were instructed to pick up nine pins and position each one of them into a reservoir as fast and accurately as possible. The distance and position between each subject's hand and the apparatus was recorded and maintained constant for pre- and post-assessments.

References

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