MUSCLE ACTIVATION DURING MANUALLY ASSISTED TREADMILL TRAINING AFTER INCOMPLETE SPINAL CORD INJURY

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INTRODUCTION

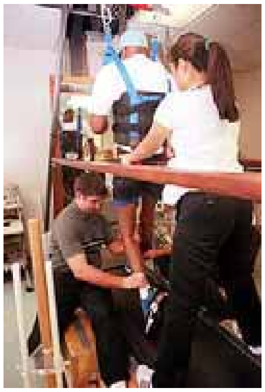

Figure 1: Manually assisted locomotor training

Partial body weight supported training (BWST) is effective in improving the gait of those with incomplete spinal cord injury [1,2]. In this treatment, the patient is suspended above a treadmill with a harness so that the patient bears only a portion of her weight on her legs (Figure 1). A therapist on each side of the patient manually assists the patient's legs through the motions of walking. Although this treatment is effective in improving walking ability, the neural mechanisms of locomotor recovery are not clear.

There are two competing hypotheses on how electromyographic (EMG) activity might be affected by BWST. One possibility is that manual assistance decreases the patient's effort, reducing EMG amplitudes. An alternative possibility is that manual assistance provides more normal kinematic patterns, thus resulting in more appropriate sensory feedback and increasing EMG amplitudes. The purpose of this study was to determine how manual assistance at the lower limbs specifically modifies EMG activity.

METHODS

Four subjects with incomplete spinal cord injury (ASIA Impairment Scale Classification of C or D) at the cervical or thoracic level participated in the study. Subjects were at least 12 months post-injury and free of any conditions that would limit their ability to safely complete testing. Subjects were community ambulators with preferred overground walking speeds of 0.41-0.95 m/s. Three of the four subjects used canes. All subjects gave informed consent prior to participating.

Subjects stepped with and without manual assistance at 0.36 m/s with body weight support (30% or 50%, depending on the subject's tolerance). The same trainers manually assisted all subjects following the procedures described by Behrman and Harkema for locomotor training with partial bodyweight support [1]. While walking under the two experimental conditions, we collected kinematic and EMG data (tibialis anterior, TA; soleus, SO; medial gastrocnemius, MG; lateral gastrocnemius, LG; vastus lateralis, VL; vastus medialis, VM; rectus femoris, RF; and medial hamstring, MH). After averaging EMG RMS for each muscle, we normalized to the highest RMS that occurred without manual assistance. We also found separate RMS values for the stance and swing phases of gait. We used a two-way ANOVA to test for significant differences.

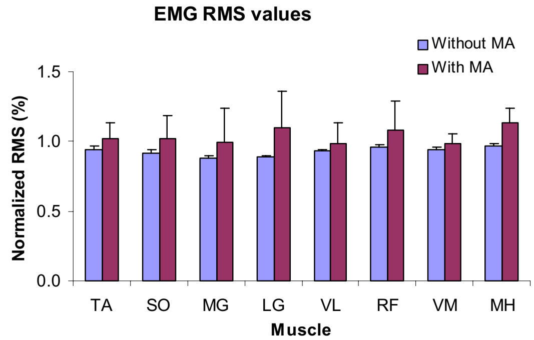

Figure 2: Averaged and normalized EMG RMS values with standard error bars. EMG amplitudes were greater in all muscles with manual assistance, but not significantly ($p > 0.3$).

RESULTS AND DISCUSSION

EMG RMS values for the complete gait cycle were greater with manual assistance, but the differences were not significant (Figure 2). Stance phase and swing phase EMG RMS were similar to the overall gait cycle EMG RMS. Power analyses revealed that effect sizes for EMG amplitudes were all less than 0.11, indicating any real difference between conditions would be very small. To have at least a 50% chance of detecting a significant difference would require ~245 subjects [3].

CONCLUSIONS

The two competing hypotheses are based on valid neural control principles. It is likely that both ideas are at least partially correct in explaining how manual assistance affects muscle activation during BWST. The overall result, however, is that EMG amplitudes change little with manual assistance for subjects with this level of incomplete spinal cord injury. Thus, therapists' fears that manual assistance will promote passivity by subjects are unfounded.

REFERENCES

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