The Effects of Locomotor Training on Neural and Muscle Activation.

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INTRODUCTION

There is generally limited quantitative kinematic and electromyography (EMG) regarding the effect of Locomotor Training using body weight support Treadmill Training (BWST) for an extended period of time on a person with ASIA B classification. The objective of this case study is to determine the effects of Locomotor Training using BWST on kinematics, neural, and muscle activation changes for an individual with an incomplete SCI, one year post injury.

METHODS

The participant (male, 26 years, ASIA B, no motor function below level of injury, injury level C6) trained for 35 sessions of Locomotor Training (T1), stopped training for 8.6 weeks, and recommenced training for another 62 sessions (21 weeks) (T2). Before T1 (PRE-T1), and before T2 (MID) kinematic and EMG data were collected [at 60% and 40% body weight support (BWS), treadmill speed at 1.6 mph]. After T2 (POST-T2) was completed, kinematic and EMG were collected bilaterally for 60%, 40% and 20% BWS.
A 6-camera Vicon system (sampled at 60Hz) was used to collect kinematic data. Spherical reflective markers were placed on right and left second and fifth metatarsal, calcaneous, tibial tuberosity, femoral epicondyle, greater trochanter, anterior inferior iliac spine, posterior inferior iliac spine. EMG was recorded using surface EMG for left and right medial gastrocnemius (L/R G), tibialis anterior (L/R TA), rectus femoris(L/R RF) and bicep femoris(L/R BF). EMG was collected at a bandwidth of 10-600 Hz, and sampled at 1500 or 1560 Hz. Raw EMG signals were filtered at a bandwidth of 30-150 Hz, full-wave rectified, then root mean squares (RMSs) were calculated over a 120ms window (2). EMG data was processed using MATLAB (MathWorks Inc., Version 6.1). Calculation of sagittal plane segment motion for the thigh, shank and foot was determined using MATLAB.
Limb kinematics were calculated in the local moving plane with calculation of orientation angles for each segment relative to the right horizontal (3). 6-8 gait cycles were analyzed per condition.

RESULTS AND DISCUSSION

After training, EMG firing patterns were consistent to kinematic profiles at the hip and knee. Before training the EMG firing profiles were not. Higher EMG amplitudes were observed after training [Pre vs. post (60%BWS): LBF: 19.64±.23 vs. 43.76 ±5.10uV; LR: 19.64 ± 1.36 vs. 43.76 ± 1.13uV; LG:3.96 ± 1.29 vs. 23.73 ± 1.01uV].
For the LRF, LBF, and LTA the EMG activity were more rhythmical and less tonic after the first series of Locomotor Training sessions (Figure 1). Significantly, at PRE-T1, the LBF was firing for most of the gait cycle (GC) [i.e., mean burst duration (BD) was 88.1 ± 6.1% of the GC] whereas at MID, the mean BD decreased to 55 ±15% of the GC and at POST-T2 its BD decreased further to 41±15%. In general, the BD for the LTA and LG at MID and POST-T2 decreased with increasing load.
Further, there was a positive linear response in mean EMG amplitude to bodyweight (BW) load. At mid, mean EMG amplitudes for all muscles (LR, LBF, LTA, and LG) increased with loading from 40% to 60% BW and at POST-T2 the mean EMG amplitude for LG (at 40%, 60%, and 80% BW load) also increased. The results for LBF and LTA were more variable. Both of these muscles showed a decrement in mean EMG RMS amplitude (from 40% to 60% BW load) followed by an increase (from 60% and 80% BW load).
All of these results demonstrate the positive neural and muscle activation changes that occur after Locomotor Training for an individual with an incomplete SCI (ASIA B, 1-year post).

REFERENCES

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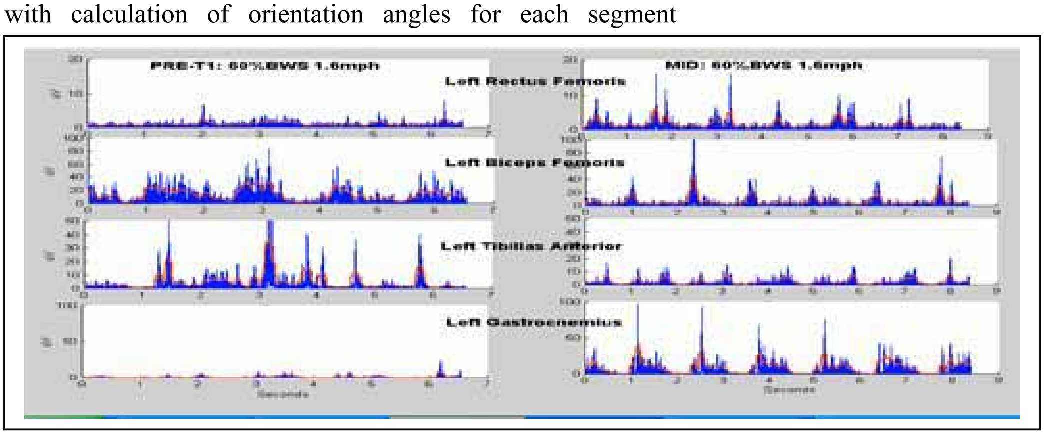

Figure 1. At PRE –T1 & MID. Rectified EMG and EMG RMS amplitude (uV) versus time (sec) for 5 gait cycles LRF, LBF, LTA, LG.

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