

# **Effect of Body Weight Support Treadmill Training on Kinematic, Kinetic and Clinical Outcome Measures of Hemiparetic Gait: A Single Subject Design**

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## **Introduction**

Body weight support treadmill training (BWSTT) is a task-specific tool that promotes essential elements of locomotion in an environment that assists with balance control. As patients post-stroke practice their locomotor skills with BWSTT, the physical therapist frequently guides the hemiparetic limb to optimize joint kinematics and interlimb coordination of weight acceptance and unloading, as these events may be problematic in this population.[1] BWSTT has been shown to be effective in contributing to changes in clinical outcome measures such as overground walking speed, endurance, and balance in patients post-stroke, but these findings have yet to be correlated to kinematic and kinetic changes in hemiparetic gait patterns.[2] A single subject design offers a unique opportunity to study such a relationship and elucidate the effects of BWSTT in a single subject under controlled and clinically relevant conditions. The purpose of this study was to determine the effect of BWSTT on kinematic and kinetic variables in the gait of a single subject with chronic stroke, and to correlate these findings with clinical outcome measures of gait and balance.

## **Statement of Clinical Significance**

Correlating kinematic and kinetic changes in the gait pattern of a single subject post-stroke to clinical outcome measures of gait and balance provides insight into how BWSTT affects function.

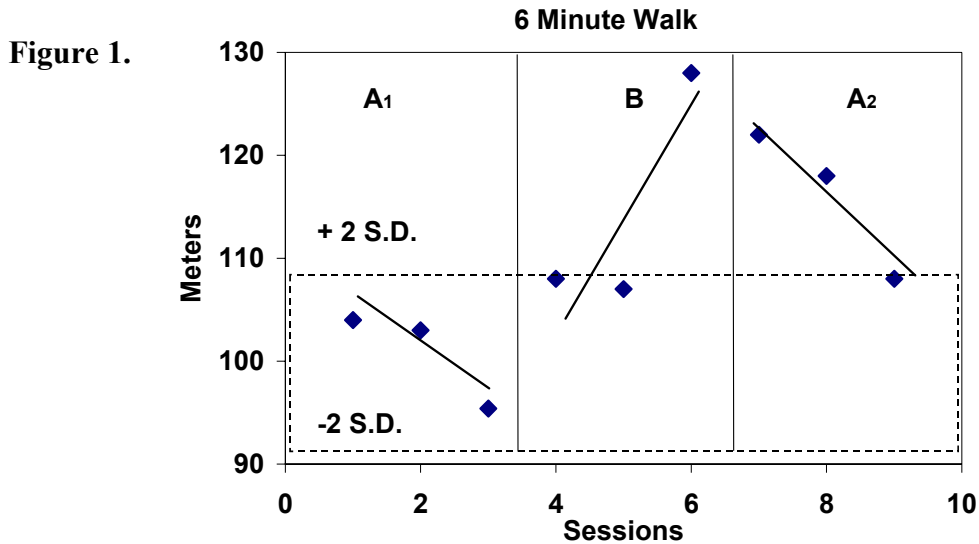
## **Methods**

**Subject:** The subject was a 64 year old female who was one year post-onset of a left middle cerebral artery infarct with resultant right hemiplegia. Subject weight was 65.8 kg and height was 1.64 m. She was independent in household ambulation with the use of a right polypropylene ankle foot orthosis (AFO) with a plantar flexion stop at neutral and free dorsiflexion. Immediately prior to the onset of this study, she was receiving home-based physical therapy for gait and balance training 2 times per week. **Study design:** An A<sub>1</sub>-B-A<sub>2</sub> withdrawal design was used in this study. During the first baseline phase, A<sub>1</sub>, the subject received conventional physical therapy training 2 times per week, 2.5 hours per session for 2 weeks. Treatment consisted of lower extremity strengthening, balance activities, and gait / functional training in simple and complex environments. During the second baseline phase, A<sub>2</sub>, the exact same treatment protocol was used. During the intervention phase B, which lasted 6 weeks, conventional therapy was augmented with the use of BWSTT using the Lite Gait® Body Weight Support System. Training sessions ran 3 times per week, 2 hours per session. 3 trials of BWSTT were given per session. **Outcome measures:** Clinical tests consisted of the 6 minute walk test, 10 meter velocity, Timed Up and Go (TUG), and the Berg Balance Scale. Data was collected 3 times during A<sub>1</sub> and A<sub>2</sub> and at 2, 4, and 6 weeks into B. Segment kinematics were tracked using the Optotrak Motion Analysis System. Kinematic data was subsequently combined with ground reaction force (Kistler, Switzerland) and

anthropometric data to estimate joint angles, moments and power (Mishac Kinetics, Waterloo, CAN). Data analysis consisted of visual analysis of graphical data to detect trends within a phase (Fig 1). Significance was discerned when 2 consecutive data points fell outside  $\pm 2$  standard deviations of the mean of the A<sub>1</sub> data.

### Results

The Berg Balance scores improved significantly from A<sub>1</sub> to B and into A<sub>2</sub>. Six minute walk distances improved in B but declined in A<sub>2</sub> (Fig 1). During the A<sub>1</sub> phase the subject showed low knee power generation associated with a knee extensor moment at 12% of stance and high power absorption at 20% of stance. The power absorption at 20% of stance was associated with knee hyperextension and a knee flexor moment. Clinically, this is referred to



as a knee extension thrust pattern. During the B phase, knee power generation increased, primarily reflecting a higher knee extensor moment. The power absorption associated with the knee extension thrust pattern was reduced, partially resulting from a decreased knee flexor moment. However, the knee kinetics returned to similar values as A<sub>1</sub> during the A<sub>2</sub> phase.

### Discussion

The findings suggest that BWSTT was responsible for improving walking endurance (6 minute walk) and functional balance skills in this subject. The biomechanical data suggested similar trends during BWSTT, with improved knee stability demonstrated in weight acceptance and single limb support. The walking endurance findings and biomechanical data suggest these effects did not carry over when the intervention was removed. Further research is warranted to determine whether or not there is an optimal intervention dosage that will strengthen the carryover effect of this training in subjects with chronic stroke.

### References

1. Olney SJ, Richards C. *Gait & Posture* 1996;4:136-148.
2. Visintin M et al. *Stroke* 1998;29:1122-28.

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