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BODY-WEIGHT SUPPORT TREADMILL TRAINING IN THE CLINIC

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When we opened Neuro-Ability's new clinic location a few months ago, our concept was to establish a practice dedicated to neurological rehabilitation with a unique family-inclusive clinic design and atmosphere. With the relaxed waiting room to the open treatment space, we help the patients and families develop connections among each other. We feel that all these factors offer a unique contribution to private practice in Vancouver and the lower mainland.

At our Open House in the summer, our Body-Weight Support Treadmill Training (BWSTT) drew so much attention that PABC asked us to share our findings with our colleagues through this article.

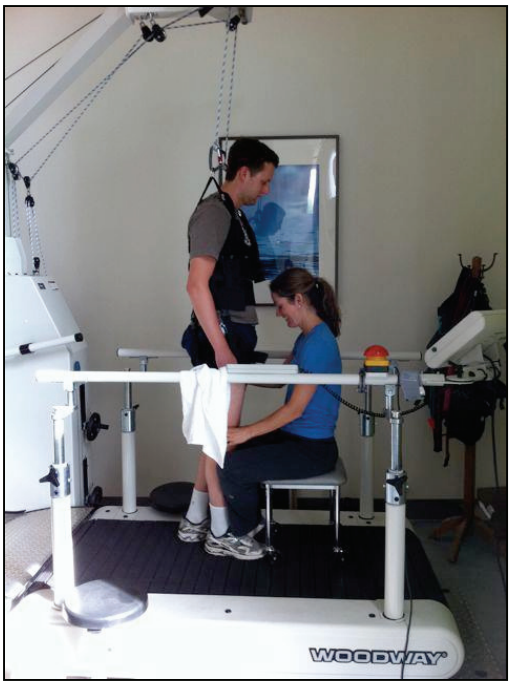
History
BWSTT is an excellent example of knowledge translation from theory to clinical practice. It derived from studies of adult cats that recovered the ability to step on a treadmill following low thoracic spinal transection when trained with truncal support, extensor tone stimulation, and assisted paw placement (Barbeau and Rossignol 1987; Lovely et al. 1986 cited in Sullivan et al. 2002). Finch et al. (1991) and Barbeau and Rossignol (1991) proposed the idea of suspending an individual from an overhead lift and assisting the legs to step following stroke or spinal cord injury. This has led to the development of specialized treadmills, support systems, and rehabilitation approaches.

What is BWSTT?
BWSTT requires a specially designed apparatus to take up some of the weight of an individual as they walk and/or run on a treadmill. A harness both supports and lifts the trunk to take up some of the individual's body weight and cleverly allows for variable loading and unloading during walking and running.

BWSTT improves the ability of some individuals to walk and/or run. BWSTT can create conditions and demands to generate patterned muscle activation throughout the legs for reciprocal, symmetrical loading and unloading required for efficient walking and running. Concurrently, the displacement of the limbs and body challenges anticipatory and reactive postural control influencing postural alignment, loading and balance.

Neuro-Physiology underlying Reciprocal Rhythmical Walking and Running
Locomotion is a rhythmic motor activity generated by spinal neural networks called central pattern generators (CPG's). CPG's are neuronal networks that generate the rhythm for walking and shape the pattern of the motor bursts of motor neurons in the leg muscles (Duysens and Van de Crommert 1998). These spinal networks are activated, modulated and stopped by supraspinal structures for initiation and adaptive control of goal-directed locomotion (Kandel et al. 2000). CPG's can produce self-sustained patterns of behaviour independent of sensory input (Grillner et al. 2008). However, sensory feedback is an integral

part of the overall motor control system and is critical in modifying CPG-generated motor programs in order to facilitate constant adaptations to the environment (MacKay-Lyons 2002). Sensory feedback adapts the CPG to the real world (Frigon and Rossignol 2006).



Recovery of walking relies on task-specific sensory feedback (Lynskey et al. 2008). To encourage experience-dependent plasticity in the central nervous system BWSTT ought to be built on principles of motor learning and performed at speeds, lower-extremity loads, and with limb kinematics that optimize inputs that the spinal and supraspinal locomotor networks can interpret as normal walking inputs (Sullivan et al. 2002).

Stance phase extensor muscle activation throughout the lower limb is reinforced with increasing load detected by cutaneous receptors (Van de Crommert et al. 1998) and load receptors (golgi tendon organs and Ib afferents) (Dietz and Duysens 2000; Buschges et al. 2004).

Cynthia Wilson treating a patient using the Neuro-Ability body-weight support treadmill.

Phase transition from stance to swing requires termination of extensor and initiation of flexor activity. Decreasing load on the stance leg together with lengthening of the hip flexors and ankle plantar flexors are the most significant signals for this transition (Van de Crommert et al. 1998; Pearson 2008; Buschges et al. 2004).

Efficacy of BWSTT

Task-oriented treadmill training has produced measurable changes in fitness, function, and indices of cardiovascular-metabolic health after stroke (Ivey et al. 2008) as well as muscle composition and metabolism and psychological well-being and health-related quality of life (Hicks and Ginis 2008). BWSTT can increase walking speed post-stroke.

Higher walking velocities are correlated with greater likelihood of being an independent community ambulator (Sullivan 2002). For efficacy of BWSTT specific to stroke refer also to the Cochrane review by Moseley et al. (2005) and the systematic review by Ada et al. (2010) as well as the LEAPS trial (Duncan et al. 2011). For efficacy of BWSTT specific to spinal cord injury refer to systematic reviews by Mehrholz et al. (2008) and Wessels et al. (2010).

Translation of Research to Clinical Practice

Neuro-Ability relocated the practice to accommodate the high ceiling and space needed for the BWST, which we purchased in the spring of 2011. Our clients and therapists are all very excited to add this equipment to the tools we have available for treatment. To date we have used this equipment with a large variety of neurological diagnoses as well as complex musculoskeletal conditions. All patients must gain medical clearance from their family physician in respect of cardiovascular, bone density and seizure history. In addition patients

must have sufficient postural control so that the experience leads to adaptive plasticity not maladaptive plasticity. In patients for whom cardiovascular status is an issue, blood pressure and heart rate are monitored. Measurable goals must be set and may include any/all of the following:

- Increased walking speed
- Increased exercise endurance
- Normalized aberrant muscle tone in upper limbs
- Facilitated postural control & decreased dependence on upper limbs
- Facilitated running
- Lower limb strengthening/increased lower limb range of motion
- Facilitated stepping response
- Facilitated symmetrical gait pattern
- Ability to cope with incline and decline of walking surface
- Increased gait confidence

Access to BWSTT Equipment

Neuro-Ability Rehabilitation Services now has the equipment to offer BWSTT. In addition to treating our own clients, we are open to exploring the possibility of some selected physiotherapists renting our facilities to treat their own clients for whom BWSTT might be an excellent complement to the current treatment program. If you have some interest in exploring this with us please email us cathy@neuro-ability.ca or libby@neuro-ability.ca.

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Cathy Eustace and Libby Swain are co-owners with Cynthia Wilson and Michelle Burt of Neuro-Ability Rehabilitation Services (at Fraser and E17th). This new clinic is a leader and innovator in best practice neurological rehabilitation, with a team of nine physiotherapists and two rehabilitation assistants who are all PABC members. All therapists working at Neuro-Ability have a special interest treating individuals with conditions impacting the nervous system such as stroke and brain injury, incomplete spinal cord injury, Parkinson's disease, multiple sclerosis and complex musculo-skeletal conditions. http://neuro-ability.ca