VIBRATION TILT-TABLE IMPROVES TRAINING PERFORMANCE IN A WEARABLE ROBOTIC EXOSKELETON: TWO CASE OBSERVATIONS FOR INDIVIDUALS WITH SEVERE LOWER EXTREMITY SPASTICITY

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Background & Purpose

Rehabilitation technology designed to augment mobility and recovery for individuals with neurologic dysfunction is becoming more prevalent. Unfortunately, research and clinical expertise of these devices may be limited when they are first introduced into market. A unique challenge may include how multiple technologies can be combined to improve patient care.

A relatively new technology that shows considerable clinical promise is the wearable robotic exoskeleton (WRE). For this product, however, passive range of motion limitations and severe spasticity may exclude patients from attempting use.

The purpose of this case study report is to describe an application of a whole-body vibration tilt table (WBVTT) for the purpose of improving performance in and outcome from a wearable robotic exoskeleton (WRE).

Case Descriptions

Case 1: 17 year-old female; 16 months post incomplete SCI (AIS-C) who was ambulating with a walker and one KAFO at the initiation of treatment (swing-to gait for ~20 feet. Bilateral lower limb (LL) spasticity measured 3-4 on the modified Ashworth Scale (MAS).

Case 2: 28 year-old female with a diagnosis of cerebral palsy (spastic quadriplegia) who was walking with a walker and two AFOs. Bilateral lower limb spasticity measured 3-4 on the MAS. Right hip and knee flexion contractures (18º and 20º respectively) that excluded her from WRE use.

Rehabilitation Technology

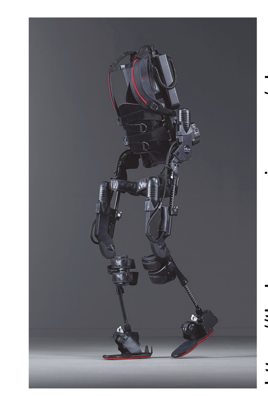
Whole-body vibration tilt table

- Galileo® Delta A tilt table
- Side-alternating vibration training
- Vibration frequency 5 – 27Hz
- Variable amplitude based on foot placement

http://stimdesigns.com

Wearable robotic exoskeleton

- Eksobionics Ekso®
- Fully powered motors at bilateral hips and knees
- Adaptive-assist mode adjusts motor output based on user capacity
- Requires PT supervision



https://thebossmagazine.com/ekso-bionics-superhero-solutions/

Treatment Intervention

Case 1: Treated 2d/week. WBVTT training occurred prior to use of WRE. Two 3-minute bouts at 18Hz, 0.5 amplitude and 50º tilt for first bout and 26Hz, 0.5 amplitude and 70º tilt for second bout. WRE training immediately followed WRVTT sessions.

Case 2: Initial 10 sessions performed just WBVTT and passive stretching owing to ROM restrictions. WBVTT sessions included 2 to 4, 3-minute bouts at 18 and 24Hz with up to 70º tilt. Following these initial WBVTT sessions and home stretching the client was able to meet the ROM inclusion criteria for the WRE.

Subsequent sessions at 1d/week for 8 weeks began with WBVTT followed by passive stretching and WRE use.

Outcomes

For both clients, spasticity was observed to be reduced immediately following WBVTT. This allowed for improved quality of gait training in the WRE. Sit-to-stand and walking in the WRE improved which decreased motor demands, increased battery life and allowed for longer WRE training sessions. Clients quickly progressed to the adaptive mode of the WRE (vs. maximum assistance) allowing for active participation. Case 1 reported subjective benefits related to: walking confidence and distance (~300 feet); bowel sensation, LL circulation and sleep; reduced Gabapentin use; as well as improved strength and decrease tone. Case 2 reported similar benefits related to: walking confidence and speed; bowel and bladder function; circulation in her feet; decreased nerve and muscle pain; and improved strength and decreased tone. WRE training time and total steps per session increased for both clients.

Discussion

Clinical observations suggest that WBVTT use prior to WRE walking can improve session performance and potentially improve clinical outcome. In addition to direct training benefits, the combination of WBVTT and WRE training resulted in subjective improvements in daily bodily function. Collection of additional objective data on future clients is needed to determine if combining these 2 technologies is beneficial for a larger group of individuals with a variety of neurological conditions.

References

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