Impact of Exoskeletons on Post-Stroke Gait Training at Villa Beretta

Organization Description

Villa Beretta is a 90-bed non-profit rehabilitation center with 30 PTs, 4 OTs, and 15 MDs located in Costa Masnaga, Italy. With inpatient and outpatient facilities, the center provides high-quality, compassionate medical care and rehabilitation for individuals with traumatic brain injury, spinal cord injury, stroke and neuromuscular disease.

Program Overview

Stroke is the second leading cause of disability in Europe and the sixth leading cause worldwide. Post stroke hemiparesis can lead to impairment of upper and lower limb motor control with related coordination deficits. Literature shows motor deficits are not only associated to the affected side, but also to the non-affected one. Investigating locomotor responses during robotic training is fundamental to understanding how robotic exoskeletons may improve locomotor functions following a stroke.

Challenge

The Villa Beretta staff wanted to measure the impact that robotic exoskeletons could make on a stroke patient's efforts to regain walking ability. Additionally, the staff wanted to gauge how that impact might vary with the time between the stroke and the introduction of the robotic exoskeleton to their rehabilitation. It was critical to the staff to measure not simply the number of steps patients were able to take, which has been done in other studies on spinal cord injury patients, but also the quality of their gait.

Proposed Solution

Villa Beretta selected the Ekso GT™ in concert with a measure of surface Electromyography (sEMG) to provide a quantification of the interaction between subject and robot and demonstrate the effectiveness of robotic exoskeletons in improving stroke patient's' walking ability. Ekso is a wearable bionic suit that enables individuals with weakness or paralysis of the lower limbs, due to spinal cord injury (SCI) and stroke, to stand up, sit down and walk over ground in a rehabilitation institution.* The exoskeleton can be used as a therapeutic device, in which patients can relearn proper step patterns and weight shifts using a functional based platform, or as an assistive device, in which the device essentially moves the patient's legs through a kinematic pattern.

> " With the Ekso, we can get the patient standing and walking early in the rehabilitation process with an intelligent supported gait. As the patient progresses the Ekso will adjust to their development, and the clinical team has the possibility to easily customize the device after each patient to improve patient outcome. "
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> Franco Molteni, MD
> Director Dpt Rehab and Movement Analysis Lab Medicine
> H. Valduce Villa Beretta Costa Masnaga

Implementation/Approach

Twenty-two stroke patients were recruited to walk in the Ekso GT robotic exoskeleton. The walking ability of the hemiparetic subjects in this study ranged from non-ambulatory to mildly impaired. An evaluation of acute changes of sEMG pattern of both sides during a robotic over-ground walking was performed.

Early Findings

Data collected in post stroke subjects revealed important changes of sEMG of the lower limbs' neuromuscular pattern passing from standard to Ekso guided training. In particular, an improvement in sEMB activation patterns, both in terms of timing and amplitude, was registered for affected and non-affected sides, passing from standard to wearable robotic training condition.

Conclusions

This data suggests that a combination of limb loading and highly tuned interlimb/interjoint coordination is able to modulate the motor output (sEMB) of the muscles analyzed; in fact all patients in this group were able to walk with the robotic device, even those non-ambulatory in standard condition. Wearable robotics allow a completely new strategy – task oriented gait training after stroke with an effect of modulation on motor control that potentially could induce neuroplasticity and long-term potentiation.