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# Robotics – A Viable Treatment Adjunct for Survivors of Cerebrovascular Accidents

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## Editorial

Cerebrovascular accidents (CVAs) are the fifth leading cause of death in the United States (US), resulting in approximately 140,000 deaths per year [1]. An estimated 795,000 persons have survived a stroke; out of this population, about 610,000 are initial attacks and 185,000 are recurrent incidents [1]. Neurological injuries as the result of CVAs have been known to be a leading cause of serious, long-term disability for independent adults of all races and ethnicities.

Costs resulting from a CVA were estimated at approximately 34 billion dollars per year [1]. This estimate included health care services, medications, and missed days of work. Diringer et al. found that the median total hospital cost per discharge was $4408, ranging from $1199 to $59,799 [2]. Given the high prevalence of CVAs and the high costs associated with these life-changing neurological incidents, a search for the most effective, efficient means of intervention is warranted.

Over the past ten years, robotic systems (robotics) have been increasingly considered as supportive aides for survivors of CVAs to improve function. Robotics may allow individuals to safely exercise both upper extremities (UE) and lower extremities (LE) at higher intensity levels. Functional activities involving LE, typically require greater effort by the therapist over UE activities. For example, gait-training systems may be used to assist the client with ambulating on the treadmill [3]. Thus, robotics for the LE will allow not only safe treatment for the client, but also be assistive with preventing injury to the therapist.

Robotics may also be used as a motivator, encouraging individuals to move the involved limb over longer periods of time, which could lead to greater outcomes in a more efficient manner. Matarić et al. [4] compared the use of a physically-present robot to two other interactions, including a robot in another room, but controlled by a remote and a 3-dimensional simulated virtual robot. This pilot study concluded that the physically-present robot had the best outcomes for six individuals, post-CVA [4].

There is much evidence that improved learning occurs through practice, practice, and more practice. Robotics may allow repetitive practice in an efficient manner. Depending on the individual's goals, the clinician may set up the system to be passive, assistive, or resistive with the movement of limbs**.** The goals may address impairments or functional limitations. For example, improved range of motion of the hand may be addressed by a hand end-effector or exoskeleton [5,6]. A functional limitation, such as ambulation may be addressed with a gait training system [3].

Furthermore, the clinician may combine this adjunct, robotics with a treatment approach, such as constraint-induced therapy (CIT). The CIT approach has been shown to be effective with motor recover [5]. However, the clinician does not have multiple hours to assist one client; robotics could fill this void in a socially active way. In other words, robotics could monitor progress during the therapy and/or daily life, as well as provide tireless encouragement, and guidance to the individual [4,7].

Along with the benefits, robotic systems have some challenges [8]. One major concern is the ability of the robotic system to engage the user safely, achieve good outcomes and be responsive to the dynamic needs and requirements of the user. By addressing the technology, the majority of the safety and efficacy concerns may be alleviated. However, the clinician needs to be properly trained on the use and appropriateness of the systems. Ideally the robotics should not require an expert operator or extensive training for use. Finally, the biggest barrier is the financial, time, and space needs. The use of robotic systems must be feasible for all parties.

Given such a promising glimpse of robotic systems, clinicians need to determine the direction to go with future research for robotics as a viable intervention for survivors of CVAs. Not only should studies consider external outcomes, such as functional changes, but also internal changes at the cellular level. The most efficient way to proceed is through collaboration with all stakeholders such as rehabilitation engineers, scientists, physicians, and clinicians.

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