Robot-assisted therapy can help treat stroke survivors, study finds

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Research led by UTHealth showed potential for the Ekso 1.1TM exoskeleton to correct impaired walking patterns on a weak or paralyzed leg, and increase its motor coordination. Credit: Fangshi Zhu, PhD/UTHealth

Exoskeleton-assisted rehabilitation can be beneficial in treating stroke

survivors, according to researchers at The University of Texas Health Science Center at Houston (UTHealth).

The study was published in the *Journal of Neural Engineering*.

"Stroke is one of the leading causes of death in the United States and is a major cause of serious, long-term disability worldwide," said Fangshi Zhu, Ph.D., postdoctoral research fellow in the Department of Physical Medicine and Rehabilitation with McGovern Medical School at UTHealth. "Post-stroke survivors suffer from neurological deficits and impairments that may cause several disabilities, like diminished mobility and basic activities of daily living."

A critical step in post-stroke rehabilitation is the recovery of the gait-related motor functions caused by hemiparesis—mild or partial weakness on one side of the body—or hemiplegia—severe or complete loss of strength of paralysis. The conditions can include asymmetric step times and step length, slowed gait velocity, impaired joint and posture control, muscle weakness, abnormal muscle tone, and abnormal muscle activation patterns.

The current accepted methods of therapy can be taxing on both the patient and the therapists. According to Zhu, conventional gait rehabilitation therapies can be very labor intensive, and involve two to three therapists to guide affected limbs.

Researchers found the Ekso 1.1 exoskeleton showed the potential to correct impaired walking patterns on a weak or paralyzed leg, and increase its motor coordination.

"We found that assistance from direct robot usage had a significant immediate impact on the stroke subjects' lower-limb muscle synergy pattern. This demonstrated the possibility of using a powered

exoskeleton to augment impaired gait and the potential for helping stroke survivors regain their normal walking ability in a long-term exoskeleton-assisted rehabilitation program," Zhu said. "Recent advances in robot-assisted rehabilitation allow precise and automated training. Compared to conventional therapy, the use of a robot enables longer training time, more precisely controlled forces delivery in repetitive exercises, and kinematics and kinetics monitoring during training."

Zhu and his team collected data from 11 able-bodied subjects and 10 individuals with chronic post-stroke hemiplegia or hemiparesis.

In the first phase of the study, each subject walked continuously for 3-5 minutes on a treadmill at a self-selected, comfortable speed determined in a practice walk prior to data collection. During the walk, subjects wore gravity-compensating harnesses connected to an over-head body weight suspension frame to ensure safety and eliminate a potential loss of balance.

The second stage of the study consisted of 10 to 15 sessions of exoskeleton-assisted walk training over a course of three to four weeks. In each session, patients walked over-ground with an Ekso 1.1 exoskeleton for up to 50 minutes while guided by a physical therapist. The subjects were encouraged to walk continuously as much as possible, but short breaks were allowed.

"This study gave us some critical insight into how a powered exoskeleton affects the stroke subjects' neuromuscular coordination during gait and demonstrated the potential to use muscle synergy as a method to evaluate the effect of the exoskeleton training," Zhu said. "Acute and chronic hemiplegic and hemiparesis patients who suffer from severe asymmetric gait coordination, serious foot drop, and reduced joint range of movement could benefit from the Ekso assistance."

More information: Fangshi Zhu et al, Effects of an exoskeleton-assisted gait training on post-stroke lower-limb muscle coordination, *Journal of Neural Engineering* (2021). DOI: 10.1088/1741-2552/abf0d5