Conclusions:

Ke words:

Background

Spinal cord injury (SCI) results in life-altering consequences in terms of morbidity, mortality, functional status, employment, and quality of life [1]. SCI prevalence is approximately 291,000 individuals in the United States, with nearly 17,730 new SCI cases each year [2]. SCI often results in reduced or complete loss of walking function and creates challenges with activities of daily living (ADL) [3, 4]. Persons with SCI may also experience secondary conditions, such as impairment of respiratory, cardiovascular, bladder, and bowel function, spasticity, pressure ulcers, osteoporosis and bone fractures, and chronic pain [5–8]. These functional limitations and secondary conditions often result in reduced community participation and quality of life [

Procedures

Forty-eight adults completed a preliminary survey using REDCap [22] to report demographic information and to describe their experience with robotic exoskeletons. We attempted to recruit all survey participants for focus groups based on their availability and ability to travel to the local site. Research team members developed a focus group topic guide based on their research expertise and clinical experience (see Appendix). The moderator has 40 years of experience in designing and conducting qualitative research projects, and led focus groups while a court reporter took verbatim notes and provided a transcript. Focus groups were also audio-recorded. Per-

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Participants indicated that they saw other individuals with SCI in the robotic exoskeleton and that encouraged them to try it themselves. Additionally, participants described interest in participating in research with the goal of walking.

"I saw him doing it and I was like, oh, wait. I want to do that!"

"... just any way to help the advancement of helping individuals with spinal cord walk, I'm down. If I can be a part of that research, I want to be a part of it ...".

Because of limited access, FDA requirements, and the purchase cost, participants said that the most experience they had with robotic exoskeleton was in a research setting.

"The robot they use for outpatient is also used for research and then there's a long list of people in outpatient that want to use it. Basically it's like you can try it in outpatient, and then if you like it and you want to continue more than you can sign up for research."

Participants commented on the learning curve involved in learning to operate the robotic exoskeleton, indicating that it was difficult during the first few attempts but eventually was much easier to operate.

"The first few sessions are really awkward -- just kind of learning the nuance of how that particular device moves and balance is a big thing, certainly for me based on the level of my injury and my core

device, risk of falls, slow gait speed, spasticity limiting device use, difficulty transferring in and out of an automobile, and limited feasibility in a work environment. The cost to purchase an exoskeleton was also a concern.

"Other than it's too hot, too expensive. Can't afford it."

"It costs as much as an investment property."

Participants discussed the contrast between their desired outcomes of using the device compared to the reality of using the device. Using a robotic exoskeleton requires both hands to balance and stand upright, limiting the participant from simultaneous activities that require use of both hands.

"Even if you could fit into a car with it, are you going to go to the grocery store and take an hour to go down aisle one to grab a jug of milk and come back?"

"It requires you use both hands. So, you can't do too many other things but walking or stand, that's it."

Although participants did not find practical value in the device in their everyday world, they thought that the robotic exoskeleton was of great utility in therapy.

"I love the thing as far as therapy, I'm there 100 percent, but my everyday life I couldn't use it."

T   4:
The fourth topic area, "User Suggestions," describes the ways participants hoped that robotic exoskeletons could be improved to address their concerns.

Participants suggested various items or functions to device manufacturers, of which greatero ma7(009.s567-7(a7i1(as)-ty0.9(f)-41fl.m9a96rT41651.2206TL9.714895649.7999ow)-481

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References