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Study explores spinal cord stimulation to treat paralysis

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A Vanderbilt neurosurgeon is looking to recruit patients with paraplegia to investigate whether intraspinal microstimulation technology can restore complex body movements.

The implantation of tiny electrodes along the spinal cord has caused paralyzed animals to walk, but it has yet to be tested with humans. Peter Konrad, M.D., Ph.D., and his research team are seeking volunteers willing to participate in a proof of concept experiment.

The study requirements are very specific. The participants must be undergoing a previously scheduled spinal surgery for a reason other than the experiment. And they should have a completely severed spinal cord between the thoracic 3 and thoracic 8 vertebrae without further damage below that point.

"I want absolutely no question that we are creating the movement and that there is no accidental circuitry input," Konrad said.

Konrad is looking to do the proof of concept experiment with two patients before seeking to expand the study. Joseph Cheng, M.D., director of the Neurosurgery Spine Program, is overseeing the data safety and monitoring of the study.

"This is such a landmark study, and one which has the potential to help paralyzed people walk again," Cheng said. "Even at this early stage, I feel the concept of intraspinal microstimulation has shown the best

promise at this time for our patients who suffer from paraplegia. I think whoever volunteers for this study will be leading the way for those suffering with paraplegia, and who really have no other options for treatment."

However, with this initial proof of concept study the patient volunteers cannot expect any permanent improvements in movement from the experiment.

"We are not going to implant anything," Konrad said. "We are just going to test the concept in the spinal cords of paralyzed people coming in for another reason for surgery."

While the brain may send movement signals to the body, there are areas along the spinal cord, central pattern generators, that are already programmed to elicit certain types of body responses—a theory that has been proven in animals with research conducted at the University of Alberta, Canada, by Vivian Mushahwar, Ph.D., a neuroscientist and bioengineer.

"Dr. Mushahwar basically showed there are some very small areas inside the spinal cord regions in the lower thoracic area where there is a sweet spot of stimulation that can induce complex stepping movements," Konrad said.

These areas direct smoother, coordinated movements in animals, he noted, and if the same is true in humans, intraspinal microstimulation should prove superior to other paths researchers are pursuing. Other methods that have shown promise for people who are paralyzed, such as peripheral stimulators, have produced fast movement that quickly results in rapid fatigue, he said.

"You are stimulating out on the muscle," Konrad said. "You are not

roping in on the efficiency of the spinal cord circuitry."

Researchers at the University of Louisville have used a method called epidural stimulation, which involves the placement of electrodes along the outside of the spinal cord to spur movement. This procedure is commonly used to implant stimulators for pain control. However, Konrad said intraspinal microstimulation should elicit more controlled stepping and movement.

The concept of placing tiny wires into the spinal cord is similar to the deep brain stimulation (DBS) surgery that Konrad performs every week at Vanderbilt. However, the location of the micro-wires will be applied to mapping spinal cord circuits instead of the deep brain circuits.

The wires will be much smaller than a strand of human hair.

"We are talking about a 0.1 millimeter to 0.2 millimeter sweet spot in the cord," Konrad said. "That makes it a very small area. If you stimulate one area of the cord, you can get a certain type of movement. You move it half a millimeter; you get another type of movement. If we can find that this sweet spot is lying dormant in paralyzed people, then there will be an enormous incentive to develop a device to awaken it."

Provided by Vanderbilt University Medical Center