

New treatment allows some people with spinal cord injury to regain hand and arm function

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Fatma Inanici applies small patches that will deliver electrical currents to the injured area on a participant's neck. Note: This photo was taken in 2018. Credit: Marcus Donner/Center for Neurotechnology

Almost 18,000 Americans experience traumatic spinal cord injuries every year. Many of these people are unable to use their hands and arms and can't do everyday tasks such as eating, grooming or drinking water without help.

Using physical therapy combined with a noninvasive method of stimulating nerve cells in the spinal cord, University of Washington researchers helped six Seattle area participants regain some hand and arm mobility. That increased mobility lasted at least three to six months after treatment had ended. The research team published these findings Jan. 5 in the journal *IEEE Transactions on Neural Systems and Rehabilitation Engineering*.

"We use our hands for everything—eating, brushing our teeth, buttoning a shirt. Spinal cord injury patients rate regaining hand function as the absolute first priority for treatment. It is five to six times more important than anything else that they ask for help on," said lead author Dr. Fatma Inanici, a UW senior postdoctoral researcher in electrical and computer engineering who completed this research as a doctoral student of rehabilitation medicine in the UW School of Medicine.

"At the beginning of our study," Inanici said, "I didn't expect such an immediate response starting from the very first stimulation session. As a rehabilitation physician, my experience was that there was always a limit to how much people would recover. But now it looks like that's changing. It's so rewarding to see these results."

After a spinal cord injury, many patients do physical therapy to help them attempt to regain mobility. Recently, a series of studies have shown that implanting a stimulator to deliver [electric current](#) to a damaged spinal cord could help paralyzed patients walk again.

The UW team, composed of researchers from the Center for

Neurotechnology, combined stimulation with standard physical therapy exercises, but the stimulation doesn't require surgery. Instead, it involves small patches that stick to a participant's skin like a Band-Aid. These patches are placed around the injured area on the back of the neck where they deliver electrical pulses.

The researchers recruited six people with chronic spinal cord injuries. All participants had been injured for at least a year and a half. Some participants couldn't wiggle their fingers or thumbs while others had some mobility at the beginning of the study.

To explore the viability of using the skin-surface stimulation method, the researchers designed a five-month training program. For the first month, the researchers monitored participants' baseline limb movements each week. Then for the second month, the team put participants through intensive physical therapy training, three times a week for two hours at a time. For the third month, participants continued [physical therapy](#) training but with stimulation added.



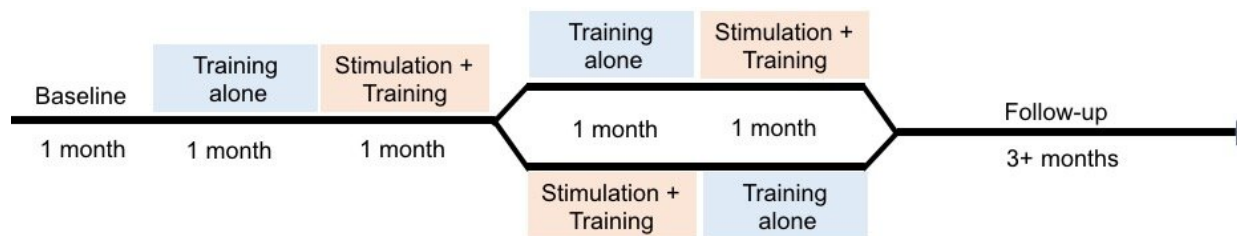
Participants progressed to more difficult versions of the training exercises (for example, going from picking up a ping pong ball to picking up a tiny bead, shown here) as they improved. Note: This photo was taken in 2019. Credit: Marcus Donner/Center for Neurotechnology

"We turned on the device, but they continued doing the exact same exercises they did the previous month, progressing to slightly more difficult versions if they improved," Inanici said.

For the last two months of the study, participants were divided into two categories: Participants with less severe injuries received another month of training alone and then a month of training plus stimulation. Patients with more severe injuries received the opposite—training and stimulation first, followed by only training second.

While some participants regained some hand function during training alone, all six saw improvements when stimulation was combined with training.

"Both people who had no hand movement at the beginning of the study started moving their hands again during stimulation, and were able to produce a measurable force between their fingers and thumb," said senior author Chet Moritz, a UW associate professor of electrical and computer engineering, rehabilitation medicine and physiology and biophysics. "That's a dramatic change, to go from being completely paralyzed below the wrists down to moving your hands at will."



The researchers designed a five-month training program that included month-long regimens of training alone or training with stimulation. Credit: Inanici et. al, IEEE Transactions on Neural Systems and Rehabilitation Engineering

In addition, some participants noticed other improvements, including a more normal heart rate and better regulation of body temperature and bladder function.

The team followed up with participants for up to six months after [training](#) and found that these improvements remained, despite no more [stimulation](#).

"We think these stimulators bring the nerves that make your muscles contract very close to being active. They don't actually cause the muscle to move, but they get it ready to move. It's primed, like the sprinter at the start of a race," said Moritz, who is also the co-director of the Center for Neurotechnology. "Then when someone with a spinal cord injury wants to move, the few connections that might have been spared around the injury are enough to cause those muscles to contract."

The research is moving toward helping people in the clinic. The results of this study have already informed the design of an international multi-site clinical trial that will be co-led by Moritz. One of the lead sites will be at the UW.

"We're seeing a common theme across universities—stimulating the [spinal cord](#) electrically is making people better," Moritz said. "But it does take motivation. The stimulator helps you do the exercises, and the exercises help you get stronger, but the improvements are incremental. Over time, however, they add up into something that's really astounding."

More information: Fatma Inanici et al. Transcutaneous spinal cord stimulation restores hand and arm function after spinal cord injury, *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (2021). [DOI: 10.1109/TNSRE.2021.3049133](https://doi.org/10.1109/TNSRE.2021.3049133)

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