

Armed With Robo Rehab, Stroke Patients Gain Mobility And Hope

Massachusetts Institute of Technology



Some robotic devices are designed to give people superhuman powers. Others are made to unleash the power of human potential.

Such is the case with the Myomo e100 NeuroRobotic System, a wearable robotic brace that helps stroke patients recover the use of their arms. While the 1 lb., 11 oz. Myomo system is decidedly more compact — and less complicated — than futuristic exoskeletons that offer super strength and extra protection, this “smart” elbow brace has the potential to help millions of stroke survivors perform the tasks of daily living and reduce one of the nation’s major causes of disability.

The Stroke Effect

According to the American Heart Association, every year in the United States nearly 800,000 people suffer a stroke, a potentially life-threatening event in which the blood supply to the brain is temporarily disrupted. Of those who survive, as many as half experience partial paralysis in one arm — and only one in five regain full use of the limb.

Because brain cells and neurological pathways are damaged by stroke, patients cannot effectively control their weak

muscles, resulting in partial paralysis. But new studies reveal that the brain is capable of re-wiring — making new connections in order to complete a desired movement. For new connections to form, brain cells must begin communicating — which is where the Myomo system comes in.

How the Myomo System Works

When patients attempt to move their arms, electrical muscle activity signals are sent from the brain to the arm muscles along the skin's surface. The Myomo system detects and processes these signals with software and forwards the data to a robotic device that provides just enough assistance to help patients complete the intended movement.

With repeated use over a period of weeks or months, the patient performs simple tasks they would do at home — such as opening a jar, turning on a light switch or carrying a laundry basket — all while wearing the elbow brace. The experience of attempting and then completing the movement — a process completed with the help of a “power assist” from the Myomo device — appears to be the impetus for the brain's relearning process.

The theory, according to leading stroke rehabilitation expert Joel Stein, M.D., is that, by facilitating patients' ability to practice tasks repeatedly, new connections are formed in the brain and existing connections are reinforced, resulting in improved ability to move the arm. Results of a pilot study showed that, after six weeks of rehabilitation with the Myomo elbow brace, patients experienced a 23 percent improvement in arm movement.

Myomo's Inventors

“*The Myomo NeuroRobotic System was developed by John McBean and Kaila Narendran as part of their graduate studies at Massachusetts Institute of Technology (MIT) in Cambridge, Mass.*

As kids, both McBean and Narendran suffered fractures that required rehabilitation to reawaken atrophied muscles.

Using those experiences as a jumping off point, the two friends applied their knowledge of robotics and a cursory understanding of neurology to create a prototype of the Myomo device.

Early feedback from Stein, professor and chair at the Department of Rehabilitation Medicine at New York's Columbia University College of Physicians and Surgeons, empowered the inventors to push forward with their idea.

“Dr. Stein was convinced that stroke survivors could benefit from the device,” McBean says.

MIT's Entrepreneurial Ecosystem

Receiving a grant from MIT's Deshpande Center for Technology Innovation in 2001 put the Myomo invention on the fast track. In addition to providing the inventors with critical funding, the center also supplied valuable support services including a volunteer mentor named Steve Kelly, an entrepreneur with three successful technology startups under his belt.

With guidance from the Deshpande Center, Kelly and other mentors, the inventors scored the top prize at the 2004 MIT \$50K Entrepreneurship Competition.

“MIT sets a model for commercialization of late-stage research projects and tech transfer,” says Kelly, who eventually became president and CEO of the Boston based Myomo Inc.

The Myomo inventors continued to tap into what Narendran calls MIT's “entrepreneurial ecosystem,” an array of support services that includes the Venture Mentoring Service and Technology Licensing Office (TLO).

“MIT’s licensing office is viewed as among the best by entrepreneurs because they are straightforward and consistent to negotiate with; you know what the rules of the game will be and they don’t change. They also have a lot of support infrastructure,” says Kelly.

Working with MIT’s TLO, Myomo completed a license agreement in 2006, and, in 2007, the company received approval from the U.S. Food and Drug Administration for its robotic elbow brace.

The experience was validating for McBean and Narendran, who, despite their initiative and drive, were surprised by the product’s success.

“As graduate students, we didn’t know a lot about business, but we had this idea and it seemed to us it should work,” says McBean. “We couldn’t believe it when it actually did and no one had done it.”

Myomo Market Potential

Kelly says the market potential for the Myomo NeuroRobotic System is vast.

“Our potential is embarrassingly large,” he says. “There are more than 5 million stroke survivors in the country, and about 3 million of them have some level of arm disability. Personal robotics, like PCs, have portability and multiple uses. We can take the Myomo and drive it across the care continuum from rehab hospitals to home health agencies.”

What’s more, recent studies — as well as clinical experience with the Myomo device — show that patients can improve up to 20 years following a stroke, not just within a six-month window as originally thought.

There are also rehabilitative needs for other joint braces as well as different patient groups, such as those with spinal cord injuries and degenerative diseases, who could benefit from wearable robotic devices.

But Kelly says the company will expand slowly and deliberately to a national footprint.

“We’re eager to get this out to people who need it, but we are conservative about making sure everyone has a positive first experience,” he says.

According to MIT’s James R. Freedman, technology licensing officer, the company’s strategy is a good one.

“Myomo has done a good job of staying focused and on track,” Freedman says. “For startup companies, it can be hard to take a manageable bite and digest it. Myomo has stayed focused on how to bring value back to their investors and what they need to do to create commercial value in the face of market realities.”

Putting Myomo to Work

For now, under Kelly’s leadership, Myomo has established some half-dozen clinical partnerships. Now deployed throughout myriad hospitals, long-term care facilities and home health agencies, the robotic elbow brace is receiving positive reviews.

“Rehabilitation specialists, including both occupational and physical therapists, are all finding the product very useful,” Kelly says. Some therapists have dubbed Myomo therapy “robo rehab,” while others say that seeing hope return to patients’ faces after using the device validates their choice to work in rehabilitation.

“Seeing the reaction on someone’s face when they move their arm for the first time, it’s powerful,” says Kelly. “For people who had a stroke yesterday, they put the brace on and realize all is not lost. For stroke patients who lost use of an arm years ago, it’s powerful to see that limb move again.”

Patient reaction to the Myomo device even inspired the company's name, according to Narendran. A stroke survivor, surprised by her newfound ability to move her arm after using the device, exclaimed, "It's my own motion!"

The success has had an equally big impact on its inventors.

"It's every engineer's dream to make something that goes on to affect a lot of people in a positive way," says Narendran. McBean couldn't agree more. "It's not hard to drag yourself to work when you know you're restoring quality of life for people who had otherwise given up hope."

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