

Robotic Technology Helps Patients With Neurological Injuries Walk Again

University of California, Davis (UC Davis)

University of Zurich



In her early days as a physical therapist, Candy Tefertiller says some patients were, figuratively, “left by the wayside.”

That’s because clinicians could not figure out a way to get patients upright and moving their legs on a treadmill without hurting themselves — or the therapist working with them.

That changed when her facility, the Shepherd Center in Atlanta, got a Lokomat — a robotic device that automates locomotor treadmill therapy. Patients essentially slip into an exoskeleton that supports their legs and off they go.

The device is made by a Swiss company called Hocoma. Appropriately, its motto is “We Move You.”

Big Improvement Over Manual Training

“The biggest difference in having the Lokomat is knowing that no matter what the person’s size is, within reason, or degree of debility or weakness, I will be able to get him or her upright and moving,” says Tefertiller, who is the clinical program director for Beyond Therapy and Multiple Sclerosis at the Shepherd Center, which obtained a Lokomat around two years ago.

Prior to that, patients underwent rehabilitation training on a treadmill where they were supported in a sling and

therapists manually assisted the clients in moving their legs in the appropriate walking pattern.

If the patients exhibited significant spasticity — involuntary contraction/ movement of the legs — manual locomotor training can be difficult, and is often not a very good tool for these patients, says Tefertiller, a therapist for almost eight years.

“I’m very thankful to have the Lokomat,” she says.

“*Beyond Therapy is a rigorous, activity-based program designed to help people with neurological disorders, including spinal cord injury, improve their lifelong health, minimize secondary complications and get the most out of any new neural links to their muscles.*”

“For many patients with stroke, traumatic brain or incomplete spinal cord injury, it’s a great way to get them moving and attempt to reintegrate their nervous system,” she says. “It helps them remember how to walk and goes through the same type of motor patterns that you and I do every day. It is essentially designed to reteach their bodies to walk again.”

A Promising New Technology and the Birth of a New Company

The Lokomat is the brainchild of Gery Colombo and two partners, fellow biomedical engineer Matthias Jörg and economist Peter Hostettler. Hocoma is a combination of the trio’s nicknames. They came up with the moniker when they were undergraduates in the middle 1980s.

Colombo is an electrical engineer who focused on biomedical technology in his studies at the Federal Institute of Technology in Zurich. Working primarily with incomplete spinal cord injury patients who have some feeling and motor control below their injuries, he looked into ways to improve their therapies.

“It was around 1995, and my team had the idea to develop a robot that could do manual treadmill training automatically,” says Colombo, the company’s chief executive officer.

In manually assisted treadmill training, a patient is suspended in a harness over a treadmill and two physical therapists are moving the legs of the patient while he is doing the training to relearn how to walk.

“Being an engineer, I had the idea that this could be done by a robot instead of two physical therapists. The robot is an exoskeleton that is worn by the patient,” says Colombo, who co-founded Hocoma with the two colleagues to fund the engineering work on the device.

“It was a dream back then,” Colombo muses. “We had a small project idea and thought we were geniuses. Funny that 10 years later we were really able to create something and use that name.”

Since its launch in 2000, Hocoma has sold 130 Lokomats for clinics in 28 countries at a cost of around \$200,000 each. Hocoma now has approximately 70 employees in Zurich and at a subsidiary in the United States. Hocoma, Colombo notes, was launched as a private company in 1996, but the three founders worked for free for the next four years on its development. In 2000, it raised about \$375,000 from private shareholders to hire staff and head down the commercialization road.

In one of the more recent developments, the company is adding feedback to measure the interaction of patients and the machine.

“We can then display how much the patient is participating during the training,” Colombo says. “And to make it more interesting, because treadmill work can be boring, we are adding a virtual environment program. It could be a virtual forest, subway or train station, and the patient, with his activity in the machine, can control how he is moving through this virtual environment. If the patient pushes harder, he will walk faster.”

Teaming up with Other Researchers

In addition to the Lokomat, which is for adults, Hocoma has a smaller version for children as well as another device that helps retrain severely weakened arms. The latter technology, for a device called Armeo, is the result of research led by David Reinkensmeyer, a professor in the mechanical and aerospace engineering department at the University of California, Irvine.

The key to the Armeo, Colombo says, is that it supports the arm with an exoskeleton featuring a spring mechanism that unloads the weight of the limb.

“For a healthy person, it’s easy to lift the arm,” he says. “But for a stroke patient, that weight (roughly 10 pounds) is already quite a challenge. If you can unload the arm from its own weight, then a patient can with much less force perform functional tasks.

“We also can measure the movements and give patients virtual feedback via a monitor. They can do simple tasks or more complex ones in a virtual environment such as a shop and pick something off a shelf and put it in a basket.”

Reinkensmeyer, who has been working with Hocoma for more than 18 months, says the collaboration has gone well and that he is looking forward to continuing it.

“I have been impressed with Hocoma’s commitment to quality and good design. They listen well, and have built multiple collaborations to produce the best product possible,” he says.

A Strong University-Business Partnership

Colombo describes the technology transfer process from the University of Zurich to his company as a straightforward, collaborative partnership.

“I think because I had worked there it was much easier,” he says. “Not only was the transfer on paper, but it was also in the brain, so to speak. We continue to work closely with the university.”

Herbert Reutimann, managing director at the University of Zurich technology transfer office, says backing for the Lokomat research and development came from the Swiss National Science Foundation and from CTI, the Commission for Technology and Innovation, a governmental institution that provides funding for joint research projects between universities and small- and medium sized enterprises. Without this support and financial backing, the Lokomat’s path to success likely would have been longer and more difficult.

Reutimann says the collaboration between the university and Hocoma went smoothly and continues to do so. “People on both sides wanted to see this apparatus become reality,” he explains. “Lokomat is a superb example to show the benefits which can result for patients and the society from the long-term collaboration between academia and an innovative company”.

Reutimann said the licensing agreement features royalties to the university from the sale of devices using its technology. UC Irvine also will receive royalties from the sale of Armeo devices.

“The people who developed this device are very close to the clinic and the patients, and had their interests at the forefront,” says Reutimann. “Whatever they did, they had the needs of their patients and the therapists in mind from the beginning. It was created right beside the patients in close collaboration with the physicians and the therapists, and was continually evaluated to meet the patients’ needs. I believe that is one of the key factors to its success.”

This story was originally published in 2008.

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