A *step* to the FUTURE

IN A NEW ERA OF REHABILITATION, ROBOTIC TECHNOLOGY IS HELPING PEOPLE WHO HAVE HAD A STROKE REGAIN THEIR MOVEMENT, PHYSICAL STRENGTH AND INDEPENDENCE.

Words Sophia Auld

Imagine suddenly losing the ability to speak, walk, drive, or even dress and feed yourself. This frightening scenario can become a reality for some, with around 150 Australians having a stroke every day.

But the brain's ability to reorganise itself by forming new connections – known as neuroplasticity – means you can recover varying degrees of function after stroke. And robotics is here to help.

Rehab robots can provide physical support and assistance according to your needs. They can, for example, attach to your arm or leg and help you make a movement and, as you improve, increase resistance.

WHAT IS STROKE?

Stroke is one of Australia's leading causes of death and disability. In 2015, an estimated 394,000 people had suffered a stroke at some point, according to figures from the Australian Bureau of Statistics. That number is predicted to reach one million by 2050.

A stroke occurs when a vessel supplying blood to the brain becomes blocked, known as an ischaemic stroke, or ruptures and bleeds, known as a haemorrhagic stroke. Either incident can lead to part of the brain dying due to lack of oxygen. This then results in the sudden loss of function of whatever body parts are controlled by that area of the brain. ➤

Common effects are paralysis down one side of the body, swallowing difficulties, and problems with speech, vision, attention and memory. Around 65% of people who have had a stroke experience a disability that hinders being able to carry out everyday activities independently, like walking, dressing and eating.

RELEARNING MOVEMENT

Rehabilitation can be vital for recovery and regaining function for many, and it can begin in hospital. It then continues in a rehabilitation unit and at home.

The type of rehabilitation will depend on how a person's function has been affected. For example, it could help you to relearn how to walk through strengthening and stabilising your leg muscles.

Known drivers of neuroplasticity in rehabilitation include adequate intensity and repetitions of movements.

"We are rehabilitating the brain via the body," explains Professor Susan Hillier, the dean of research at the University of South Australia and clinical council member of the Stroke Foundation.

The necessary repetition can be difficult to achieve in rehab settings where staff time and energy is limited. But robots can help people complete repetitions that would otherwise be unrealistic.

ENGAGING EXERCISES

More than two-thirds of people have reduced arm and hand function after stroke. Melbourne occupational therapist (OT) Vicki Abraham runs an upper limb rehabilitation clinic that has used robots for four years. In 2013, she was awarded the George Alexander Foundation International Fellowship for investigating innovations in upper limb rehabilitation – including robotic therapy. Her clinic has two robots: one each for shoulder and finger retraining.

PREVIOUS PAGE AND ABOVE
Lokomat assists with intensive gait training.

RIGHT
Tyromotion technology can help with hand and arm rehabilitation.

PROFESSOR SUSAN HILLIER
Dean of research at the University of South Australia

The therapists set clients up and program the computer to provide the level of assistance they need.

"We can get 600 reps in 20 minutes, which is what you're wanting to achieve in order for the messages to get back to the brain," says Abraham. "Repetition increases the strength of the new patterns [but] as an OT... you can't sit there and bend your clients' fingers and extend them out [that] many times."

Prof Hillier says research confirms that robotic training isn't for everybody but can be ideal for people with very limited function. And as soon as someone can do the movements themselves, they should do them without robots.

A REWARDING EXPERIENCE

Robotic therapy can be highly motivating. Gaming technology makes the exercises engaging. Just like other computer games, the technology can keep scores and provide visual or auditory rewards for performance of the desired movements.

"A lot of the traditional therapy for post-stroke upper limb is obviously repetitive but really boring," Abraham says. "It's so much more fun incorporating robotics and

SOURCES: STROKE FOUNDATION; AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE; BETTER HEALTH VICTORIA; COCHRANE

> A lot of the traditional therapy is really boring. It's so much more fun incorporating robotics and computers, and **it makes it easier for [clients] to see what they're working towards."**

computers, and it makes it easier for [clients] to see what they're working towards."

Many trials on robotics in stroke rehab have been small, though some have seen promising results. A recent review that explored findings from 45 trials with 1,619 stroke patients found evidence that people who received electromechanical and robot-assisted arm training might improve their everyday activities, arm function and muscle strength.

But the authors note that results must be interpreted with caution because of the variation between trials, such as with the type of treatment used and the intensity, duration and amount of training.

FIRST STEPS

Robot Lokomat helps people learn how to walk again. Prof Hillier describes Lokomat as "a souped-up treadmill" with a big scaffold over it and an exoskeleton for the legs. The patient is suspended over the treadmill in a harness while the exoskeleton – a wearable frame that is strapped to the patient and driven by the computer – moves their legs. This robot is being used at several hospitals in Adelaide.

Robotic-assisted gait devices also incorporate virtual reality or computer-based games. A patient could be watching a screen that shows them walking through a paddock. As they get stronger, it might show them walking uphill.

A 2017 Cochrane review collected results from 36 studies involving 1,472 participants to see whether machine- and robot-assisted training improved walking after stroke. It found that people who received this training in combination with physiotherapy were more likely to achieve independent walking than people who received training without devices. People in the first three months after stroke and those who were completely unable to walk seemed to benefit most from the devices.

FUTURE TRENDS

Abraham would like to see robotic technology available in all major hospitals and says it's not something to be frightened of. "Technology's so deep in everyone's life – why not part of rehab?"

One of the barriers to wider implementation of robotic technology is the set-up cost, which can be hundreds of thousands of dollars, Prof Hillier says. Then there's the ongoing cost of training staff to use it.

Another issue for therapists is the time needed to set someone up in a robot, which varies with each device.

fast fact

Every 9 minutes someone has a stroke in Australia.

Source: Stroke Foundation

Professor Mary Galea, the academic director of the Australian Rehabilitation Research Centre at Royal Melbourne Hospital, says the future of robots in rehab boils down to the bottom line.

"Wider uptake of robotic and other technology will depend very much on its affordability." At this stage, only a handful of Australian hospitals have the more sophisticated technology.

Prof Hillier expects robots to become cheaper, better at mimicking real movements, and more portable. Work is continuing worldwide on exoskeletons with wearable motors, eliminating the need for use with a tabletop or bulky frame, she says.

There will also be increased integration between robotics and virtual or augmented reality, creating even more engaging and realistic training.

Prof Hillier emphasises that robotics will never take the hard work out of rehab, nor be a substitute for real-world practice. "The brain is really interested in reality and function," she says. "[Robots] will be a useful adjunct, but walking on a treadmill is never going to be like walking through a busy city street." But they might help many people take their first steps towards stroke recovery.