Walking again with an end-effector gait trainer

15 million strokes worldwide each year

There are 15 million strokes worldwide each year. Some 270,000 of them happen in Germany alone. The numbers are expected to double by 2030 [8, 14, 6].

Restoring walking ability and associated activities as part of neurological rehabilitation is one of the main concerns in physiotherapy. An important objective is to enable patients to participate actively in society once more [21]. Yet three months following a stroke, 70 % of stroke survivors rely on a wheelchair [23]. Roughly 20 percent of those affected do not recover the ability to walk and are permanently dependent on a wheelchair. A third of the patients who recover walking ability find that their walking speed and endurance are significantly reduced and they lack confidence when crossing the road [5]. Recovering walking ability after a stroke is one of the biggest therapy objectives among stroke survivors themselves [1, 22]. The more problems patients have with walking, the more devastating the consequences that they experience as a result of their illness [7].

The chances of recovering walking ability are greatest within the first six months following an acute event. So choosing the right method for walking rehabilitation is essential.

Development of automated walking therapy

In rehabilitation, practising walking on a repetitive basis comes under the umbrella term locomotion therapy [3]. Locomotion is the "active movement of an individual from place to place powered by the rhythmic movement of the limbs" [3]. Initial attempts at walking should be undertaken as soon as patients are sufficiently resilient. This is where practising walking function is critical. Task-specific and repetitive training should be the preferred option. The manual treadmill with body weight support was a first step in this direction [13]. The development of modern robotic-supported systems has continuously broadened the range of options – so much so that locomotion therapy in the last 20 years has developed into an integral part of neurological rehabilitation and become an area of physiotherapy [3].

In addition to treadmills with and without safety belts and partial body weight support, there are essentially two distinct stationary electromechanical devices: exoskeleton gait trainers and end-effector gait trainers. While the exoskeleton is constructed in such a way that the hip and knee joints are moved during the walking cycle with leg orthoses fitted with electric motors, the end-effector systems are characterised by having no proximal guidance at the hips and knees but instead at the distal tips of the limbs. The patient's feet are held in place on mobile foot plates. The trajectory of the foot plates corresponds to the human gait cycle, which is repetitively simulated during training. The systems are generally fitted with belts for body weight support, which opens up the possibility of using locomotion therapy in patients who are unable to walk [13].

The latest findings lead to the conclusion that treadmill training is particularly suitable for patients who are already able to walk in order to improve walking distance and walking speed. Electromechanical-assistive gait training, on the other hand, is suitable for patients who are not able to walk in order to restore walking ability. The German working group headed by Jan Mehrholz and Marcus Pohl brings this into focus in its systematic review work with network meta-analysis published at the end of 2018 and produces some new findings. The evaluation included 95 randomised controlled trials with a total of 4458 patients after a stroke. Mehrholz and his colleagues state that "What is special about this network meta-analysis is that, for the first time, competing approaches to improving walking after a stroke were jointly evaluated and made statistically directly comparable, so that their effects could be assessed in a differentiated way." The work can thus be seen as a supplement to the previous Cochrane Reviews and meta-analyses [20].

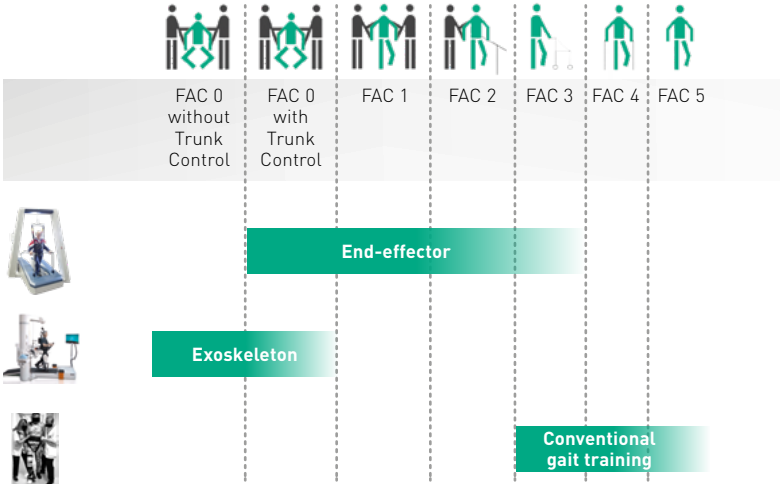

Figure 1: Overview of the use of gait robots and treadmill systems (source: THERAPY Magazine 2/2019, p. 17))

The existence of all device types is therefore justified. However, training a severely impaired patient on a treadmill frequently requires up to two therapists who, mostly under intense physical exertion, position the patient's feet in order to reproduce repetitive gait cycles [24]. Using an electromechanical gait trainer therefore offers clear advantages, particularly in the acute and sub-acute stage of rehabilitation. It is important to add that gait therapy with the gait trainer is not automatically superior to conventional gait training. The predictor here is the number of repetitions of the gait cycle. If both forms of therapy can generate the same number of repetitions, no one therapy is superior to the other. However, it is often the case with severely affected patients that the patient can practise a higher number of repetitions of gait cycles in one unit due to a significantly lower stress for the therapists, which is crucial for restoring walking ability [2].

Studies favour end-effector gait trainers – DGNR has been recommending their use since December 2015

Numerous clinical studies over the last ten years have investigated the therapeutic effect of automated gait therapy in stroke patients. What these studies have revealed is that a combination of electromechanical gait training and physiotherapy is significantly more advantageous compared to purely conventional therapy [4, 11, 12].

The large-scale, multi-centre German gait trainer study (DEGAS study) showed in 2007 that, when compared to 45 minutes of conventional physiotherapy over 20 treatment units, the combination of a 20-minute gait training session on an end-effector trainer and 25 minutes of conventional physiotherapy increases the chance of being able to walk independently again by a factor of 2.5 [15]. Electromechanical gait therapy is highly effective for repetitively practising a physiological gait pattern. It also enables controlled cardiovascular training and functional strengthening of the muscle groups needed for walking [13]. This type of intervention is particularly beneficial to stroke patients who are unable to walk in the sub-acute stage (<3 months following a stroke) [9].

It is assumed that one in five cases of inability to walk can be prevented with intensive gait training. The therapy chances also depend on the type of device used for therapy. The group of end-effector trainers performs significantly better compared to exoskeletons [9].

The S2e Guideline "Rehabilitation of Mobility after Stroke (ReMoS)" published by the DGNR in December 2015 classified the use of end-effector trainers for stroke patients who are unable to walk as a "Should" recommendation [21]. In practice, the results mean that electromechanically assisted gait therapy, due to its demonstrable advantages, is currently probably the best therapy option for improving the various dimensions of walking [10].

THERA-Trainer lyra end-effector gait trainer

The THERA-Trainer lyra gait trainer is based on the scientifically established end-effector principle and enables highly repetitive and specific gait training as part of rehabilitation. Severely affected patients can be gently guided back into daily life, step by step, using gradually adjusted training settings (body weight support, step length, speed). The patented robotics accurately reproduce the human gait pattern through which the neuroplasticity processes are stimulated.

Level access and a dynamic body weight support system also enable severely affected patients to prepare quickly and easily for gait therapy straight from their wheelchair. In addition, all settings can be adjusted with a few simple touches so training can get under way within minutes. Easy patient transfer and intuitive operation require only a limited amount of training. This means that the system can be operated by assistants. During training, the therapist has direct access to the patient from all sides and can provide optimal support. Additional safety and stabilisation accessories can be used to provide severely affected patients with additional support around the hips and arms. This will motivate but not overexert patients depending on their individual motor conditions.

Outlook

In addition to strokes, there are other neurological diseases: Spinal cord injuries, MS, Parkinson's disease, cerebral palsy and TBI. These diseases also frequently lead to impairments in walking ability. Various studies have demonstrated the potential in the use of automated gait therapy even for these disorders [19, 17, 18].

Despite all the good evidence for automated gait therapy, questions still remain and are currently the subject of research. THERA-Trainer is asking these questions too. In addition to the valuable findings that we gain from close collaboration with our reference clinics, high-quality research projects with stroke, TBI and MS patients in Germany and Switzerland are on the agenda.

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