Clinical Pathways in Neurorehabilitation

Electromechanical-Assisted Training for Walking After Stroke – Updated Evidence

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ABSTRACT

BACKGROUND: Improving walking after stroke is one of the main goals of rehabilitation. Electromechanical-assisted gait training uses specialist machines to assist walking practice and might help to improve walking after stroke.

OBJECTIVES: Our systematic review examined the effects of electromechanical and robotic-assisted gait training devices for improving walking after stroke and also assessed the acceptability and safety of this type of therapy.

METHODS: We searched the Cochrane Stroke Group Trials Register (last searched April 2012), the Cochrane Central Register of Controlled Trials (CENTRAL; The Cochrane Library 2012, Issue 2), MEDLINE (1966 to November 2012), EMBASE (1980 to November 2012), CINAHL (1982 to November 2012), AMED (1985 to November 2012), SPORTDiscus (1949 to September 2012), the Physiotherapy Evidence Database (PEDro, searched November 2012), and the engineering databases COMPENDEX (1972 to November 2012) and INSPEC (1969 to November 2012). We also handsearched relevant conference proceedings, searched trials and research registers, checked reference lists, and contacted authors in an effort to identify further published, unpublished, and ongoing trials. Two review authors independently selected trials for inclusion, assessed methodological quality, and extracted the data. The primary outcome was the proportion of participants walking independently at follow-up; secondary outcomes were walking speed and walking capacity. We included only randomized controlled trials comparing electromechanical and robot-assisted gait training for recovery of walking function with other rehabilitation interventions or no treatment.

MAIN RESULTS: In this updated review, we included 23 trials involving 999 participants. Electromechanical-assisted gait training in combination with physiotherapy increased the odds of participants becoming independent in walking (odds ratio [OR], 2.39; 95% confidence interval [CI], 1.67 – 3.43; $P < 0.00001$; Figure) but did not significantly increase walking velocity (mean difference [MD], 0.04 m/s; 95 % CI, 0.03 – 0.11; $P = 0.26$) or walking capacity (MD, 3 metres walked in 6 minutes; 95% CI, 29 – 35; $P = 0.86$). Our subgroup analysis suggests that people in the acute phase may benefit and people who are nonambulatory may benefit from this type of training. We found no differences between the types of devices regarding ability to walk, but found significant differences between devices in terms of walking velocity.

CONCLUSIONS: Patients who receive electromechanical-assisted gait training in combination with physiotherapy after stroke are more likely to achieve independent walking than people who receive gait training without these devices.

FURTHER DETAILS (FROM THE COCHRANE REVIEW)

The above mentioned Stroke paper is a short version of a recent Cochrane review update by Mehrholz et al. (2013). The objective of this review was to evaluate the effects of electromechanical and robotic-assisted gait training devices (with body weight support) for improving walking after stroke. The authors' aim was to estimate the likelihood or chance of becoming independent in walking as a result of these interventions (as compared to control interventions), which is a main rehabilitation goal for patients after stroke.

Training

The duration of study intervention (time frame during which experimental interventions were applied) was heterogeneous, ranging from 10 days to eight weeks. Most studies used a three- or four-week study intervention period. Frequency (in terms of therapy provided per week) of treatment ranged from two or three times a week to five times a week. Intensity (in terms of duration of experimental therapy provided) of treatment ranged from 20 minutes to 50 minutes. Except for one study, in none of the included studies did the gait training time differ between control and experimental groups. Thirteen studies investigated the robotic-assisted device 'Lokomat' as the experimental intervention, eight studies investigated the electromechanical-assisted device 'Gait Trainer', one study the 'Gait Master4', and one study the robotic-assisted device 'AutoAmbulator'.

Main outcome measures

Most studies investigated improvement in walking function as a primary outcome for analysis and used the Functional Ambulation Category (FAC) or comparable scales to assess independent walking. Furthermore, frequently investigated outcomes included assessment of walking function using gait velocity in metres per second.

Risk of bias

Of the 23 included studies, 13 described adequate random sequence generation, 13 described adequate allocation concealment, seven reported blinding of the primary outcome assessment and nine reported incomplete outcome data (attrition bias).

Further results

Twenty-three trials with a total of 999 participants measured independent walking at study end, but for 10 included trials, no effect estimate (OR) was feasible because no events (e.g. no participant reached the ability to walk) or only events (e.g. all participants regained walking) were reported.
Of the total population of 999 participants, approximately 45 % were independent walkers at the start of the study.
Five trials, with a total of 319 participants, investigated dependent walkers. In these trials, the use of electromechanical devices for gait rehabilitation of people after stroke did increase the chance of walking independently (OR (random) 3.43, 95% CI 2.00 to 5.86; $P < 0.00001$; level of heterogeneity, $I^2 = 0\%$). In this subgroup, the use of electromechanical devices for gait rehabilitation did also significantly increase the walking velocity. The pooled mean difference (random-effects model) for walking velocity was 0.12 m/s (95 % CI 0.02 to 0.22; $P = 0.02$; level of heterogeneity $I^2 = 77\%$).
Nine trials, with a total of 470 participants, used an end-effector device as the experimental intervention. Fourteen trials, with a total of 529 participants, used an exoskeleton device as the experimental intervention. The authors did not find statistically significant differences in regaining independent walking between participants treated with end-effector or exoskeleton devices ($Chi^2 = 0.01$, $df = 1$; $P = 0.93$). However, walking velocities at the end of the intervention phase were higher when end-effector devices were used (compared with participants who received training by an exoskeleton device) ($Chi^2 = 16.68$, $df = 1$; $P < 0.0001$).
The authors used the primary outcome of independently walking at the end of the intervention phase for all included patients (OR 2.39) to calculate the number needed to treat to benefit (NNTB). Together with the control event rate of 51 % (214 out of 480 control participants were independently walking), they calculated an NNTB of 5 (with a 95 % CI 4 to 6). This means that every fifth dependency in walking ability after stroke could be avoidable if electromechanical-assisted devices were used.
Nine trials with a total of 241 participants investigated people in the chronic phase, defined as more than three months after stroke. In these trials, the use of electromechanical devices for gait rehabilitation of people after stroke did not increase the chance of walking independently (OR (random) 1.20, 95 % CI 0.40 to 3.65; $P = 0.74$; level of heterogeneity, $I^2 = 29\%$).
Adverse events, drop-outs and deaths did not appear to be more frequent in participants who received electromechanical or robotic-assisted gait training. This indicates that the use of electromechanical-assisted gait training devices was safe and acceptable to most patients included in the trials analysed by this review.

References (Cochrane Review):
Mehrholz J, Elsner B, Werner C, Kugler J, Pohl M. Electromechanical assisted training for walking after stroke. Cochrane Database Syst Rev. 2013; 7: CD006185.

CLINICAL PATHWAY COMMENT

During the last two decades, electromechanical and robotic-assisted gait training devices have become available and augment the options for rehabilitative locomotor training after stroke.
This review suggests that receiving electromechanical or robotic-assisted gait training for 3 to 5 times a week for 20 minutes to 50 minutes over a couple of weeks (3 to 4) raises the changes of non-ambulatory, subacute stroke patients to become independent walkers and enhances there walking velocity. In that time frame, every fifth dependency in walking ability after stroke could be avoidable if electromechanical-assisted devices were used.
Thus, there is a group of patients, i.e. subacute non-ambulatory stroke patients, who benefit from electromechanical and robotic-assisted gait training devices in terms of their chance to become independent walkers within a couple of weeks of training.
Why electromechanical and robotic-assisted gait training had superior training effects in this subgroup of stroke victims cannot be deduced from the data analysed in the review. The fact that “walking” of non-ambulatory patients can be realised with these devices during therapeutic sessions, and the relatively high number of “steps” that can be trained in each therapeutic session (e.g. as compared to over ground assisted walking) might play a causal role.
Given the costs implied in the provision of electromechanical and robotic-assisted gait training, a cost-benefit analysis would be warranted.
For ambulatory stroke patients and chronic stroke patients (more than 3 months post stroke) a clear benefit was not demonstrated. Other locomotor training strategies might have to be considered for these patient groups.

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