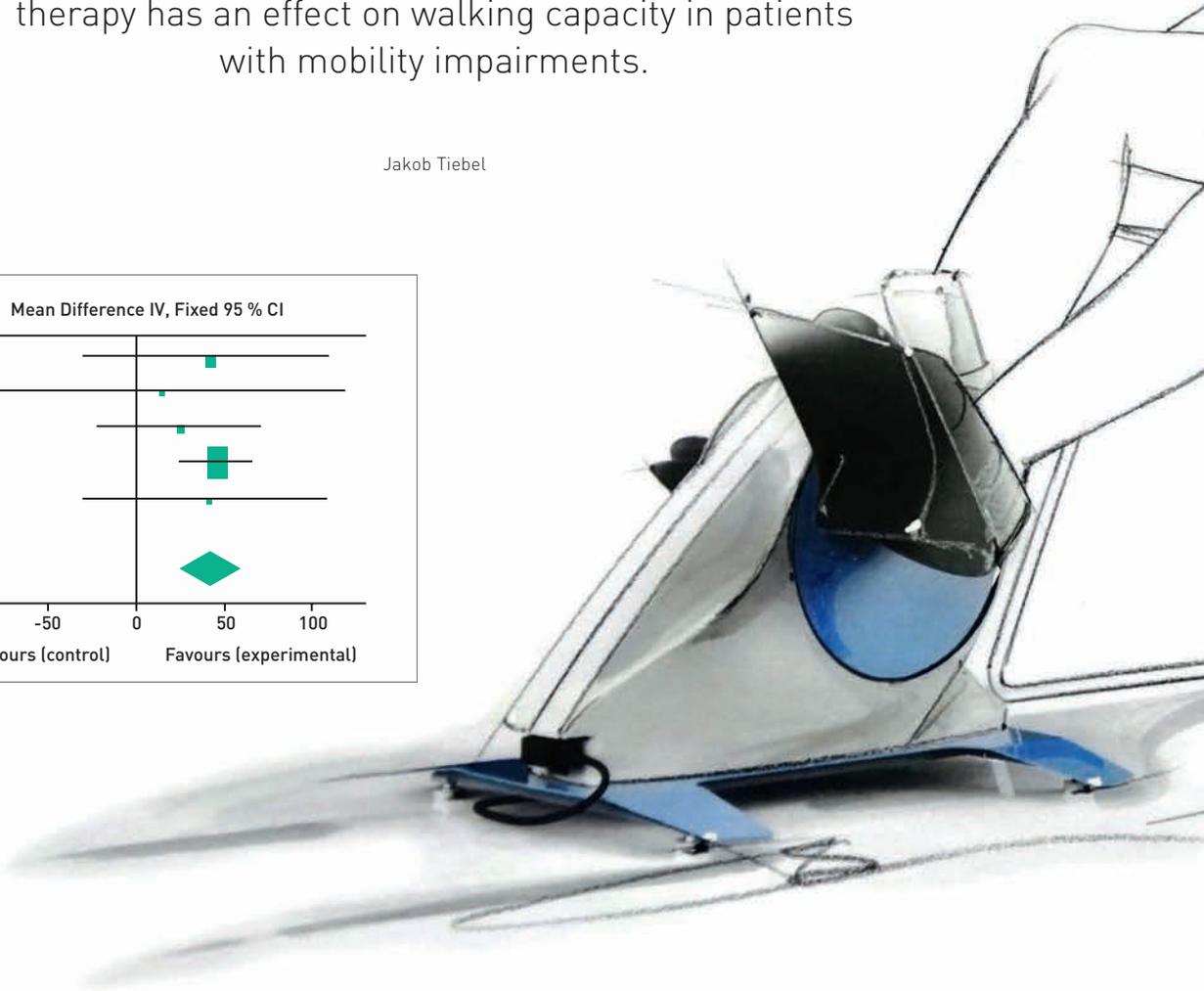
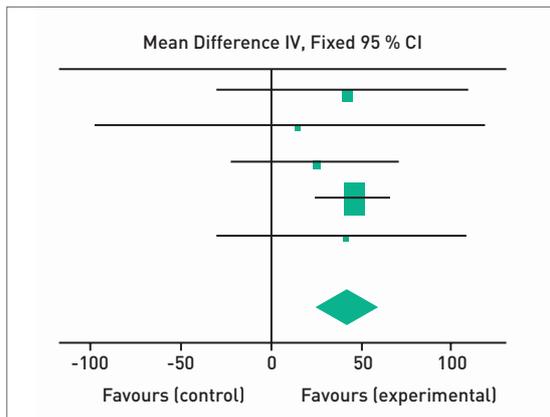
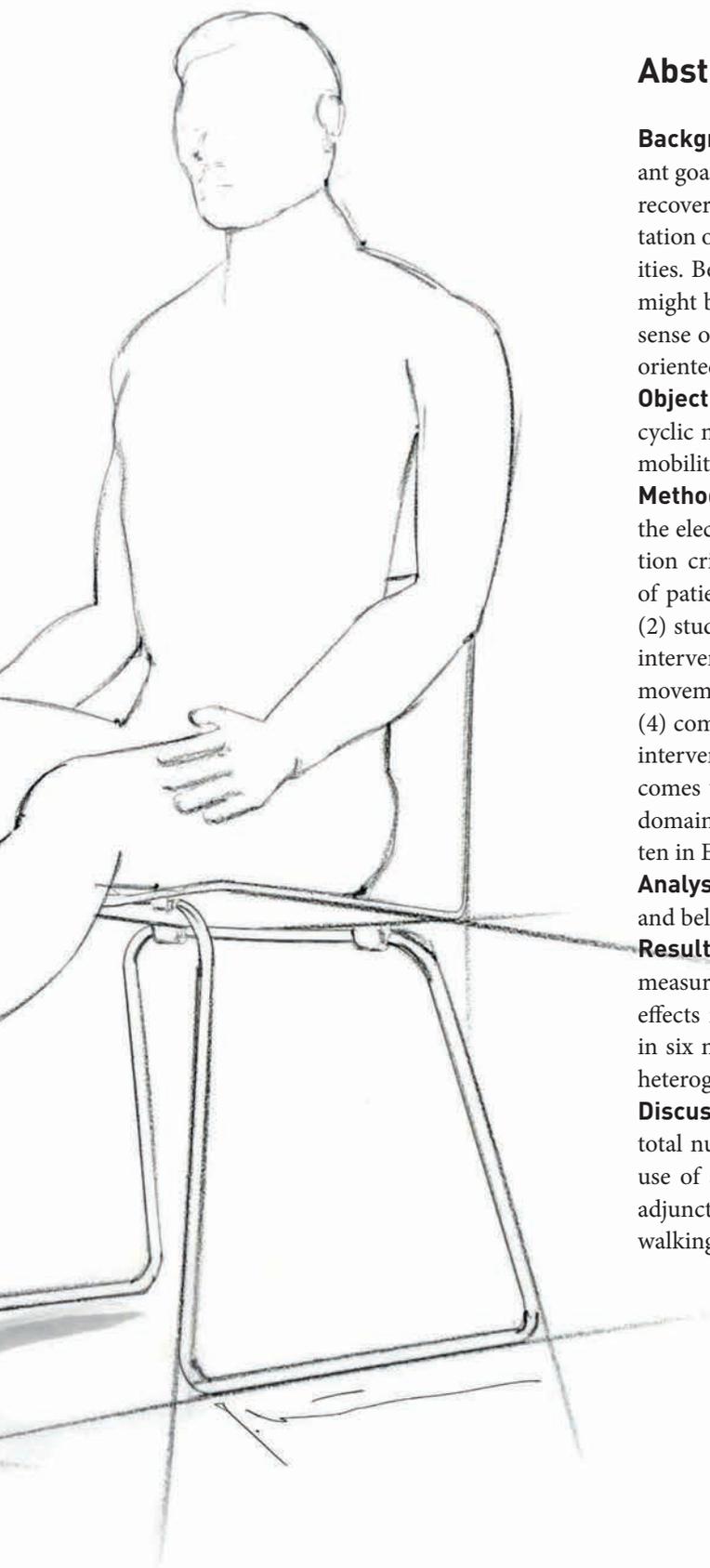


Cycling for walking after stroke

Aim of this rapid meta analysis was to find out, whether additional lower limb cyclic movement therapy has an effect on walking capacity in patients with mobility impairments.

Jakob Tiebel





Abstract

Background: Regaining the ability to walk is a very important goal for people with mobility impairments. For this reason, recovery of walking capacity is a major objective in the rehabilitation of patients with motor impairments of the lower extremities. Because of similarities with walking, cycling leg exercise might be a beneficial motor function rehabilitation method in sense of an add-on therapy intervention next to intensive task oriented walking practice.

Objectives: To examine potential benefits of a lower limb cyclic movement therapy on walking capacity in patients with mobility impairments.

Methods: Relevant publications were identified by searching the electronic databases PubMed, EMBASE and PEDro. Selection criteria: (1) study sample analysed consisted exclusively of patients with mobility impairments aged 18 years or over; (2) study was designed as an CT or RCT (3) the experimental intervention delivered fitted the domain of lower limb cyclic movement therapy with the aim to improve walking capacity; (4) comparator was usual care, another intervention, the same intervention with a different dose, or no intervention; (5) outcomes were measured post intervention and belonged to the domain of walking capacity (6) full-text publication was written in English or in German.

Analysis: The outcomes had to be measured post intervention and belonged to the domain of walking capacity.

Results: Walking capacity (metres walked in six minutes) was measured at study end. The pooled mean difference (fixed-effects model) for walking capacity was 41.71 metres walked in six minutes (95%CI -23.86 to 59.56; $P = <0.00001$; level of heterogeneity $I^2 = 0\%$).

Discussion: In this meta-analysis we included 5 trials with a total number of 161 participants and found evidence that the use of a cyclic movement trainer device may be a beneficial adjunct to physiotherapy in rehabilitation settings to improve walking capacity in patients with mobility impairments.

Study or Subgroup	Experimental			Control			Mean Difference		
	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95 % CI	Year
Kamps	237.8	115.7	16	195.3	88.3	15	6.1 %	42.50 [-29.69, 114.69]	2005
Lee	261.5	162.7	12	247.2	148.8	12	2.0 %	14.30 [-110.45, 139.05]	2008
Diehl	284.7	70.2	15	259.9	60.6	15	14.5 %	24.80 [-22.13, 71.73]	2008
Tang	334.2	33.1	23	288.4	38.9	22	71.3 %	45.80 [24.65, 66.95]	2009
Dobke	237.8	115.7	16	195.3	88.3	15	6.1 %	42.50 [-29.69, 114.69]	2010
Total (95 % CI)			82			79	100.0 %	41.71 [23.86, 59.56]	

Heterogeneity: Chi2 = 0.83, df = 4 (P = 0.93); I2 = 0%
Test for overall effect: Z = 4.58 (P < 0.00001)

Background

Regaining the ability to walk is a very important goal for people with mobility impairments. Especially a reduced walking capacity often results in dependency of others in activities of daily living. For this reason, recovery of walking capacity is a major objective in the rehabilitation of patients with motor impairments of the lower extremities [1].

It's a high intensity of practice that proves to be an important aspect of effective therapy interventions in this context. Research findings suggest, that intensity is a key factor of meaningful training interventions. The more practice is better and the intensive more is even the best [10].

A difficulty is, that patients often are not able to perform specific exercise for rehabilitation of walking in sufficiently high intensity. On the one hand patients do not receive enough therapy in total and on the other hand patient's muscle force often is too weak. A reduced aerobic endurance affects the performance in task practice. Therefore, there is a demand for additional rehabilitation methods oriented on the recovery of strength and endurance, which positively influence walking capacity [1, 2, 3].

Because of similarities with walking, cycling leg exercise might be a beneficial motor function rehabilitation method in sense of an add-on therapy intervention next to intensive task oriented walking practice [1, 8].

Objective

The aim of this meta-analysis is to examine potential benefits of a lower limb cyclic movement therapy on walking capacity in patients with mobility impairments.

Methods

Relevant publications were identified by searching the electronic databases PubMed (last searched December 2017), EMBASE (last searched November 2017) and the Physiotherapy Evidence Database (PEDro, last searched December 2017).

The databases were searched by indexing terms and free-text terms used with synonyms and related terms in the title or abstract. We searched for “cyclic” and “movement therapy”, and “cycling” or “pedaling” and “exercise”, and “assistive” and “movement therapy”.

Additional searches were performed, based on initial findings; we manually searched relevant literature, checked reference lists and compared the results of our search with references from other relevant studies and reviews we found.

Studies were included if they met the following inclusion criteria: (1) the study sample analysed consisted exclusively of patients with mobility impairments aged 18 years or over; (2) the study was designed as an CT or RCT including those with a two-group parallel, multi-arm parallel, crossover or cluster design and with a level of evidence IIb or higher; (3) the experimental intervention delivered fitted the domain of lower limb cyclic movement therapy with the aim to improve walking capacity; (4) the comparator was usual care, another intervention, the same intervention with a different dose, or no intervention; (5) the outcomes were measured post intervention and belonged to the domain of walking capacity (6) the full-text publication was written in English or in German.

To classify the outcome measures we used the ICF Framework into the following domain: walking [d450] (distance, independence, falls).

A review protocol was not published before. An ethics statement was not required for this work.

Analysis

Meta-analysis were performed if at least two trails with comparable outcomes were identified. Based on post intervention outcomes (Means and SDs), the individual effect sizes with their 95% confidence intervals (CI) were calculated.

The I-Square statistic was used to determine statistical consistency (between-study variation). An I-Square of 50.0% was considered to reflect substantial heterogeneity and in that case a random-effects model was applied, while a fixed-effect model was applied in case of statistical homogeneity.

A significant positive effect indicates that the experimental intervention is beneficial for patients, compared to the comparator. A significant negative effect indicates that the intervention has unfavourable effects for patients, compared to the comparator.

Results

In this meta-analysis we included 5 trails with a total of 161 participants [4, 5, 6, 7, 9].

Walking capacity (meters walked in six minutes) was measured at study end. The pooled mean difference (fixed- effects model) for walking capacity was 41.71 meters walked in six minutes (95%CI -23.86 to 59.56; $P = <0.00001$; level of heterogeneity $I^2 = 0\%$) (Analysis 1).

Discussion

The aim of this meta-analysis was to evaluate the effects of a lower limb cyclic movement therapy on walking capacity in patients with mobility impairments.

In this meta-analysis we included 5 trials with a total number of 161 participants and found evidence that the use of a cyclic movement trainer may be a beneficial adjunct to physiotherapy in rehabilitation settings to improve walking capacity in patients with mobility impairments.

Implications

This meta-analysis provides evidence that the use of cyclic movement trainer therapy in combination with physiotherapy increases walking capacity in people with mobility impairments.

LITERATURE

- [1] **Barbosa D, Santos CP, Martins M.** The application of cycling and cycling combined with feedback in the rehabilitation of stroke patients: A review. *Journal of Stroke and Cerebrovascular Diseases* 2015; 24(2), 253-273.
- [2] **Brown DA, Nagpal S, Chi S.** Limb-loaded cycling program for locomotor intervention following stroke. *Phys Ther* 2005; 85:159-168.
- [3] **Dickstein R.** Rehabilitation of gait speed after stroke: a critical review of intervention approaches. *Neurorehabil Neural Repair* 2008; 22:649-660.
- [4] **Diehl W, Schuele K, Kaiser T.** Use of an assistive movement training apparatus in the rehabilitation of geriatric patients. *NeuroGeriatric* 2008; 5(1):3-12.
- [5] **Dobke B, Schüle K, Diehl W, Kaiser T.** Use of an assistive movement training apparatus in the rehabilitation of stroke patients. *Neurol Rehabil* 2010; 16(4):173-185.
- [6] **Kamps A, Schüle K.** Cyclic movement training of the lower limb in stroke rehabilitation. *Neurol Rehabil* 2005; 11(5):1-12.

- [7] **Lee, MJ, Kilbreath SL, Singh MF, Zeman B, Lord SR, Raymond J, Davis GM.** Comparison of effect of aerobic cycle training and progressive resistance training on walking ability after stroke: A randomised sham exercise-controlled study. *Journal of the American Geriatrics Society* 2008; 56(6), 976-985.
- [8] **Raasch CC, Zajac FE.** Locomotor strategy for pedalling: muscle groups and biomechanical functions. *J Neurophysiol* 1999; 82:515-525.
- [9] **Tang A, Sibley KM, Thomas SG, Bayley M. T, Richardson D, Mcilroy WE, Brooks D.** Aerobic Capacity, Spatiotemporal Gait Parameters and Functional Capacity in Subacute Stroke. *Neurorehabilitation and Neural Repair* 2008; 23(4), 398-406.
- [10] **Veerbeek JM, Van Wegen E, Van Peppen R, Van Der Wees PJ, Hendriks E, Rietberg M, Kwakkel G.** What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. *PLoS ONE* 2014; 9(2).