Annals of Physical and Rehabilitation Medicine 59 (2016) 235–241

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com

Original article

Bodyweight-supported treadmill training for retraining gait among chronic stroke survivors: A randomized controlled study

Abhishek Srivastava [a,*], Arun B. Taly [b,c], Anupam Gupta [b,*], Sendhil Kumar [b], Thyloth Murali [d]

[a] Center for Physical Medicine & Rehabilitation, Kokilaben Dhirubhai, Ambani Hospital & Medical Research Institute, Mumbai, 400053, India
[b] Department of Neurological Rehabilitation, National Institute of Mental Health & Neuro Sciences (NIMHANS), Bengaluru 560029, India
[c] Department of Neurology, National Institute of Mental Health & Neuro Sciences, (NIMHANS), Bengaluru 560029, India
[d] Department of Psychiatry, MS Ramaiah Medical College, Bengaluru, Previously Head, Department of Psychiatric & Neurological Rehabilitation, NIMHANS, Bengaluru, India

ARTICLE INFO

Article history:
Received 10 November 2015
Accepted 30 January 2016

Keywords:
Bodyweight-support treadmill training
Chronic stroke survivors
Gait training
Stroke rehabilitation

ABSTRACT

Objective: To evaluate the role of bodyweight-supported treadmill training (BWSTT) for chronic stroke survivors.
Design: Prospective, randomized controlled study.
Methods: Patients with a first episode of supratentorial arterial stroke of more than 3 months' duration were randomly allocated to 3 groups: overground gait training, treadmill training without bodyweight support, and BWSTT (20 sessions, 30 min/day, 5 days/week for 4 weeks). The primary outcome was overground walking speed and endurance and secondary outcome was improvement by the Scandinavian Stroke Scale (SSS) and locomotion by the Functional Ambulation Category (FAC). We analyzed data within groups (pre-training vs post-training and pre-training vs 3-month follow-up) and between groups (at post-training and 3-month follow-up).
Results: We included 45 patients (36 males, mean post-stroke duration 16.51 ± 15.14 months); 40 (89.9%) completed training and 34 (75.5%) were followed up at 3 months. All primary and secondary outcome measures showed significant improvement ($P < 0.05$) in the 3 groups at the end of training, which was sustained at 3-month follow-up (other than walking endurance in group I). Outcomes were better with BWSTT but not significantly ($P > 0.05$).
Conclusion: BWSTT offers improvement in gait but has no significant advantage over conventional gait-training strategies for chronic stroke survivors.

1. Introduction

Stroke is a leading cause of disability in adults. More than half of the people who survive the acute stroke are not able to walk and require a period of rehabilitation to achieve a functional level of ambulation [1,2]. Therefore, restoring gait is the major goal of stroke rehabilitation, which requires different techniques and often demands considerable assistance from therapists to help patients support their body weight and control balance. Both animal research and human studies have shown that the type of training method adopted to retrain walking after any neurologic deficit significantly affects the degree of locomotor recovery [3,4].

Step training on a treadmill with bodyweight support is now an established neuro-rehabilitation approach that incorporates findings from basic science [5] to promote functional locomotor recovery after stroke. Earlier studies suggest that gait training on a treadmill without bodyweight support as compared to conventional methods leads to better recovery of overground walking parameters such as speed and endurance [4,6–13] along with better symmetry of gait [14,15]. Similarly, use of bodyweight-supported treadmill training (BWSTT) leads to a unequivocal/better recovery of ambulation, with effects on overground walking speed, endurance, and physical assistance required to walk [16–31].

Some randomized controlled trials with acute [32], sub-acute/chronic stroke patients reported no significant differences between

* Corresponding author. Department of Neurological Rehabilitation, National Institute of Mental Health & Neuro-Sciences (NIMHANS), Bengaluru, India.
Tel.: +91 80 26995282; Mobile: +91 9481207449; fax: +91 80 26564830.
E-mail addresses: drgupta159@yahoo.co.in, anupam@nimhans.ac.in (A. Gupta).

http://dx.doi.org/10.1016/j.rehab.2016.01.014
1877-0657/

the 2 groups at discharge and at follow-up in terms of balance and gait parameters [33] or at best, a trend for increased gain in gait speed and stride length [34–36]. Similar conclusions were drawn by a Cochrane review [37]. Only one study compared the effects of gait training on treadmill with than without bodyweight support on clinical outcome measures in patients with stroke and reported better walking abilities when the patient's body weight was supported, both at the end of the training and at 3-month follow-up [38].

Gait training interventions, with a mix of components from different approaches, may be more effective than no treatment or placebo control in the recovery of functional independence after stroke [39,40]. Studies have compared conventional gait training and a combination of bodyweight support and treadmill training. The results suggested that bodyweight support with treadmill training enhanced locomotor recovery, but the contribution of bodyweight support to retraining has not been addressed adequately. Further investigation is needed to determine whether unloading of lower limbs contributes to improved gait.

The aims of the study were to:

- evaluate the effectiveness of gait training on a treadmill with and without partial bodyweight support for retraining gait after chronic stroke hemiparesis;
- at the end of 4-week training, assess whether treadmill training and BWSTT approaches are better than conventional gait training for improving gait parameters such as gait speed and endurance;
- assess whether the improvement (if any) in gait parameters after treadmill training and BWSTT is sustained at 3-month follow-up.

2. Methods

The study was conducted in the neurological rehabilitation department of a university tertiary research hospital in India. Patients were recruited from the inpatient and outpatient service of the department. The study was approved by the institute's internal ethics committee. Informed consent was obtained and only patients willing to participate were included. Participants were assured of confidentiality, participation was voluntary and no incentive was offered.

2.1. Patients

The study included patients with hemiparesis fulfilling the following:

- first clinical episode of stroke due to an ischemic or hemorrhagic supratentorial lesion;
- right or left hemiparesis, age 16 to 65 years, duration of hemiparesis > 3 months;
- impaired ability to walk independently or need for one person to help with balance and coordination (Functional Ambulation Category [FAC] II–IV) [41].

We excluded patients with recurrent stroke, receptive aphasia with inadequate comprehension to understand and follow the training schedule, significant cognitive deficits affecting participation (Mini Mental Status Examination score ≤ 23) [42], significant depression interfering with active participation (score < 12 on the 24-item Hamilton Rating Scale for Depression) [43], movement disorders interfering with training, recent myocardial infarction (< 6 months), ischemia or angina at rest or during exercise, and orthopedic conditions such as severe arthritis and total hip or knee joint replacements.

2.2. Design

The study was a randomized, controlled, single-blind design. The sample size was computed before the study based on the primary outcome measures and gait parameters required to be recorded. Included patients were randomly allocated to 1 of 3 groups by a table of random numbers. Group I received overground task-oriented gait training by a conventional physiotherapy approach. Group II received gait training on a treadmill without bodyweight support (full weight bearing); patients wore an overhead harness for security and to ensure similar experimental conditions, but no mechanical support was provided. Group III received gait training on a treadmill with bodyweight support (40% unweighting of body weight), which remained unchanged throughout all training sessions. Horizontal movement was provided by a slow moving treadmill, the speed of which was gradually increased on the basis of the patient's comfort with the speed in both groups II and III. The gait training was provided by the therapists giving routine physiotherapy. Patients in groups II and III were blinded by ensuring similar experimental conditions (harness ± unweight-unweighting), but patients in group I were not blinded because they received overground task-oriented gait training. The physical therapist who assessed the gait parameters before and after the gait-training protocol was blinded to patient group for patients in groups II and III.

All patients received simultaneous comprehensive rehabilitation input in the form of medical management, routine physiotherapy, occupational therapy, orthotics, speech therapy and cognitive retraining, as needed. They all received basic physiotherapy in the form of stretching and strengthening exercises, spasticity-reducing exercises, balance and weight-shifting activities and postural control activities for 40 min/day.

Gait training was given for 30 min/day in all 3 groups. For group I, receiving conventional physiotherapy, overground task-oriented gait training involved walking in front of a mirror and walking along a straight line to give visual feedback for reducing gait deviations, walking a minimum distance during each session and gradually being encouraged to walk with increased speed. Patients trained on a treadmill were allowed to walk for a maximum of 5 trials during each session, each 6 min long, with intermittent rest for a total duration of at least 30 min.

Patients were evaluated before the start of training (baseline or pre-training) and at the completion of 20 sessions of training, 5 days/week for 4 weeks (post-training). Follow-up evaluation was at 3 months after completion of the training. Patients who did not return for the scheduled follow-up were contacted by mail and telephone. A blinded evaluator performed all evaluations and was not aware of group assignment for groups II and III.

2.3. BWSTT (Biodex Gait Trainer™)

The BWSTT system used was the Biodex Gait Trainer™, which is designed specifically for rehabilitation and retraining of gait for patients with neurologic and orthopaedic gait dysfunctions. The treadmill permits walking to be initiated from 0.0 km/h and increased by increments of 0.16 km/h. The patient can also hold onto a horizontal bar attached to the front of the treadmill for stability. The bodyweight support system includes an overhead harness with a pelvic band that attaches around the hips and 2 thigh straps with anterior and posterior attachments to the pelvic band. The harness vertically supports the patient over the treadmill and is attached to a suspension system with a force transducer that signals the amount of body weight supported.