TASK-ORIENTED TRAINING IN REHABILITATION OF GAIT AFTER STROKE: SYSTEMATIC REVIEW

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Abstract

TITLE: Task-oriented training in rehabilitation after stroke: systematic review.
AIM: The aim of the present study is to provide an overview of the evidence in the literature on task-oriented training to improve balance and gait of stroke survivors.

BACKGROUND: Stroke is the second leading cause of death and one of the leading causes of adult disability in the Western world. One of the major purposes of the rehabilitative process is to help patients achieve high a level of functional independence as possible within the limits of their particular impairments. Task related training (TRT) is a rehabilitation strategy that involves the practice of goal-directed, functional movements in a natural environment to help patients derive optimal control strategies for alleviating movement disorders.

DATA SOURCES: A range of databases was searched to identify papers addressing task-oriented training in stroke rehabilitation, including Pubmed Papers published in English between English between April 2000 to 2015 were included. There were 5 papers in the final dataset, including.

REVIEW METHOD: The selected randomized controlled trials and systematic reviews were assessed for quality. Important characteristics and outcomes were extracted and summarized.

CONCLUSION: Generally, task-oriented rehabilitation after stroke has proved to be effective and relevant for stroke practice. The possible mechanism for effectiveness of task related training may be attributable to an enhancement of presynaptic inhibition of the hyperactive stretch reflexes in spastic muscles, decrease in the cocontraction of spastic antagonists, and disinhibition of descending voluntary commands to the motoneurons of paretic muscle.

Keywords
Task oriented training, Task related training, Balance, Gait, Stroke, Transcutaneous electrical nerve stimulation (TENS)

Introduction

Stroke is defined as “Rapidly developed clinical signs of focal (or global) disturbances of cerebral function lasting more than 24 hours or leading to death, with no apparent cause other than vascular origin.” Due to abnormality in the cerebral circulation with resultant signs and symptoms that correspond to involvement of focal areas of brain, stroke is an acute onset of neurological dysfunction.

In India, prevalence of stroke according to the information received by K Anand and colleagues (2001) was 203 per 100,000 populations above 20 years old amounting to a total of 1 million cases. A Stroke is the third commonest cause of death according to the statistics.

Human ambulation, or gait, is one of the basic components of independent function commonly affected by stroke. Although majority of patients with stroke walk independently, they are not able to walk efficiently. Patients walk with altered spatiotemporal variables. They exhibit uneven stride length and shorter step length. Patients spend longer time in double support. They even walk with decreased velocity. Walking with decreased speed increases energy expenditure. Due to these patients lack flexibility in performances. Increased environmental demands such as walking on uneven surfaces, walking on slopes, crossing the road, walking on busy streets leads to reduced movement capacity within final leads to depression.

One of the major purpose of the rehabilitative process it to help patients achieve as high a level of functional independence as possible within the limits of their particular impairments. The gait deviations in people with Hemiplegia have been described according to their biomechanical and kinesiological abnormalities and in terms of loss of centrally programmed motor control mechanisms. Perry described the common problems as loss of controlled movement from heel strike to midstance and loss of normal combination of movement patterns at the end of stance. Conventional gait training focuses on improving the mechanics and quality of walking. Parallel bars and ambulation aids (e.g., walking, hemi walkers, quads canes) can assist in early gait stability and safety.

Task related training (TRT) is a rehabilitation strategy that involves the practice of goal-directed, functional movements in a natural environment to help patients derive optimal control strategies for alleviating movement disorders. In a TRT program, the patient is required to work in a task-specific or self-driven or goal-driven activity. Studies with stroke populations have shown that TRT with specific strengthening exercises for paretic muscles improve locomotion, lower limb weight bearing in sitting, and standing up. Recent studies using functional MRI and optical imaging system demonstrated that lower limb TRT induces use-dependent plastic changes of brains in

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patients with stroke. Hence, TRT is expected to promote recovery of lower limb functions in hemiparetic patients. In task related training, gait and gait-related tasks are practiced using a functional approach. Moreover, there is growing evidence that intensive, task-oriented practice results in greater improvement than conventional therapy in walking competency of people with stroke. After stroke, task-related circuit training improves the balance, mobility and performance of locomotor tasks more than other training interventions.

In the task-oriented approach, movement emerges as an interaction between many systems in the brain and is organized around a goal and constrained by the environment (Shumway Cook & Woollacott 2001). Task-oriented training includes a wide range of interventions such as treadmill training, walking training on the ground, bicycling programmes, endurance training and circuit training, sit-to-stand exercises, and reaching tasks for improving balance. In addition, use is made of arm training using functional tasks such as grasping objects, constraint-induced (movement) therapy (CIMT) and mental imagery. Such training is task and patient focused and not therapist focused.

Task related training improves the gait and additional task-related practice improves mobility and upper limb function early after stroke. Gait of the hemiplegic stroke patient is generally greatly disturbed causes weakness of the ankle dorsiflexor weakness and insufficient hip flexion and absence of knee flexion, with or without recurvatum, lead to circumduction. Weakness of the flexors muscles, spasticity of the extensor muscles, and a synergistic extension motor pattern may be the main causes of gait disturbances.

There are many interventions which can help to improve gait in post stroke patient, of which Task-related training (TRT) has shown to have a significant effect on quality of gait. Hence the aim of the current study is to evaluate the extend of the effectiveness of Task related training in improving the balance and gait in patient with stroke.

AIM

The aim of the present study is to provide an overview of the evidence in the literature on task-oriented training to improve balance and gait of stroke survivors.

METHOD

INCLUSION CRITERIA

- Types of participant: stroke survivors in the acute phase, the rehabilitation phase.
- Type of event: ischemic and haemorrhagic stroke.
- Types of outcome measure: outcomes of interventions focused on balance and gait.
- Publication date: published in English between April 2000 to 2015.
- Review design: randomized controlled trials
- Types of intervention: Only studies with interventions aimed at task-oriented exercises that are feasible and suitable for daily practice in a stroke ward or at home with minimal technical equipment were selected.

Interventions aimed towards the following domains were considered

Balance Exercises

i.e. use of specific activities and movements to maintain, enhance or restore balance. Task-oriented training involves (1) lifting and maintaining the lower extremity; (2) lifting the heels; (3) lifting the lower extremity over the footstool followed by lowering; (4) lifting the lower extremity and lowering in onto a footstool; (5) step-downs and down (6) balance beam, (7) kicking a ball (8) standing with the base of support constrained, with feet in parallel and tandem conditions reaching for objects, including down to the floor, to improve standing balance (9) reciprocal leg flexion and extension using the Kinetron in standing to strengthen leg muscles

Ambulation Exercises

Promotion and assistance with walking to maintain or restore autonomic and voluntary body functions (1) walking back and forth over a 3-m distance to a chair; and going back and forth at a constant pace over 10-m distance (2) stand up and walk (3) obstacle course (4) treadmill, (5) walk and carry, (6) speed walk, (7) walk backwards, and (8) stairs (9) walking with rhythm auditory cues generated by a metronome

DISCUSSION

This review shows important evidence in favour of task oriented training in patients with stroke. Suraj bhimraokanseet al.(2014) did a study on "Effect of task related training versus conventional training on walking performances in post Stroke patients" to compare the two treatments and find out the best which improves the walking performances.30 subjects were included according to inclusion and exclusion criteria in their study. They were splitted into two groups. Group A was of Task Related Training (8m+4f) and Group B was of Conventional training (7m+6f). Interventions were given for 4 weeks and changes in spatial (stride length, step length), temporal (cadence, speed) and two Minute walk test were noted. The results showed statistically significant improvement in spatial and temporal variables in task related training group and speed was reversed in conventional training group. So they concluded that the study concluded that task related training was significantly effective in improving walking performances. Conventional training is effective in reversing the speed. However, task related training can be useful in improving quality of gait including performances in society level. The possible reason for improvement in task related training can be supported by plasticity following brain lesion. Reorganization after brain lesion takes place as a result of structural and functional changes. Repetitive exercises and training in real life task following stroke may be a critical stimulus to the making of new more effective functional connections within remaining brain tissue. Training and practice using methods that facilitate motor releasing would be essential to the formation of new functional connections. Neural system is inherently flexible adaptive and responding according to many factors like patterns of
use. (NUDO AND COLLEAGUES, 2001) suggested that the complex organization provides the foundation for functional plasticity in motor cortex. Study by Pascular Leone et al on cortical representation reflects changes associated with skill development that and provoked by active, repetitive, training and practice. So it can be because of specificity of training with respect to different environmental conditions as practiced in Task Related Training might had helped in post training improvement in spatial variables. Improvement in temporal variables in Group I (TRT) is because as patients achieved skill in walking, task was made more complex by increased stepping over objects, difference in heights of objects, walking without stopping. These complexities were useful in real life activities. This might be the explanation for post training improvement in temporal variables. This suggests that – with interventions of Task Related Training, long term stroke subjects are able to improve walking performances. This suggests that to maximize potential stroke rehabilitation need to continue in long term rather than cease within 3 months post stroke.

Bo Hyun Kim et al conducted a study to evaluate The Effect of a Task-oriented Training on Trunk Control Ability, Balance and Gait of Stroke Patients. 20 subjects were randomly divided into two groups; Ten patients in the experimental group performed the task-oriented training (3 times/wk) and received general physical therapy (5 times/wk) for 4 weeks, and 10 patients in the control group received only general physical therapy (5 times/wk) for 4 weeks. The study results showed significant improvements in trunk control ability, balance, and gait in the experimental group compared to the control group. The findings suggest that task-oriented training may be a useful intervention for stroke rehabilitation. The study was published in the Journal of Medical Biomedical and Applied Sciences.
weeks. The Trunk Impairment Scale, Berg Balance Scale, Timed Up & Go test (TUG), and 10 m walking time, were measured before and after the 4 weeks of therapy. Result suggested that the experimental group showed significant improvements in trunk control ability, balance and gait after 4 weeks of task-oriented training. Except for TUG, significant differences in trunk control ability, balance and gait were observed between the experimental and control groups and this study demonstrated that task-oriented training after a stroke can improve the trunk control ability, balance and gait, which be effective in stroke rehabilitation. This study also examined the relationships between task-oriented training and static and dynamic control, and coordination. In static control, there was some difference between the two groups but it was not significant. This is because all subjects in this study were able to walk independently, so they had no difficulties in maintaining static sitting balance.

A study by Catherine M. to find out effectiveness Task-Related Circuit Training on Performance of Locomotor Tasks in Chronic Stroke. It was a Randomized, controlled pilot study with 2-month follow-up. A convenience sample consisting of 12 chronic stroke subjects was used. Subjects were randomly assigned to the experimental or the control group. Three subjects withdrew from the study. Both experimental and control groups participated in exercise classes three times a week for 4 weeks. The exercise class for the experimental group focused on strengthening the affected lower limb and practicing functional tasks.
involving the lower limbs, while the control group practiced upper-limb tasks. Lower-limb function was evaluated by measuring walking speed and endurance, peak vertical ground reaction force through the affected foot during sit-to-stand, and the step test. Result showed The experimental group demonstrated significant immediate and retained (2-month follow-up) improvement (p < .05) compared with the control group in walking speed and endurance, force production through the affected leg during sit-to-stand, and the number of repetitions of the step test. They concluded that the pilot study provides evidence for the efficacy of a task-related circuit class at improving locomotor function in chronic stroke. The laboratory walking assessment indicated that this improvement was associated with concomitant increases in the power generated by the ankle plantarflexors and hip flexors in late stance and early swing, with these changes being larger at the ankle compared with the hip. This observation provides support for the proposal that at near-normal walking speeds (i.e., in excess of 1.0m/sec), plantarflexor strength may be one important determinant of walking speed. The improvement in peak vertical ground reaction force through the affected foot demonstrated by experimental subjects suggests that these subjects had improved the force generating capacity of the affected lower-limb muscles during that action. Further analysis of center of pressure data identified that the improvement seen in the experimental subjects was mediated by one or more of the following factors: a reduction in
movement time, increased loading of the affected lower limb, and/or a change in preferred foot position.\textsuperscript{18} 

Shamay S.M. Ng conducted this study to investigate whether combining electrically induced sensory inputs
through transcutaneous electrical nerve stimulation (TENS) with task-related training (TRT) in a home-based program augmented voluntary motor output in chronic stroke survivors better than either treatment alone or no treatment. They included eighty-eight patients with stroke and were assigned randomly to receive a home-based program of (1) TENS, (2) TENS+TRT, (3) placebo TENS+TRT, or (4) no treatment (control) 5 days a week for 4 weeks. Outcome measurements included Composite Spasticity Scale, peak torques generated during maximum isometric voluntary contraction of ankle dorsiflexors and plantarflexors, and gait velocity which was recorded at baseline, after 2 and 4 weeks of treatment, and 4 weeks after treatment ended. Result suggested that when compared with TENS, the combined TENS+TRT group showed significantly
greater improvement in ankle dorsiflexion torque at follow-up and in ankle plantarflexion torque at week 2 and follow-up (P<0.01). When compared with placebo+TRT, the TENS+TRT group produced earlier and greater reduction of plantarflexor spasticity and improvement in ankle dorsiflexion torque at week 2 (P<0.01). When compared with all 3 groups, the TENS+TRT group showed significantly greater improvement in gait velocity (P<0.01). So they concluded in patients with chronic stroke, 20 sessions of a combined TENS+TRT home-based program decreased plantarflexor spasticity, improved dorsiflexor and plantarflexor strength, and increased gait velocity significantly more than TENS alone, placebo+TRT, or no treatment. Possible mechanisms behind using TENS to acupoints decreased plantarflexor spasticity and enhanced dorsiflexor force production in patients with chronic stroke could be attributable to an enhancement of presynaptic inhibition of the hyperactive stretch reflexes in spastic muscles, decrease in the cocontraction of spastic antagonists, and disinhibition of descending voluntary commands to the motoneurons of paretic muscles. TENS+TRT and PLBO+TRT group showed improvement in plantarflexors strength and the mechanisms underlying improvements in muscle strength appear multifactorial and could be attributed to enhancement of descending voluntary commands to the paretic muscles reduced agonist-antagonist cocontraction, and reorganization of synapses and cortical representation after repetitive practice of functional tasks. TENS+TRT and PLBO+TRT groups showed increased ankle dorsiflexion torque with the improvement occurring 2 weeks earlier in the combined TENS+TRT group because TENS was found to reduce plantarflexor spasticity and increase dorsiflexing torque, the addition of TENS to TRT could have enabled patients to exert extra efforts during the earlier phase of training, thereby achieving earlier improvement in peak torques.

The objective of study by Seong Doo Park was to determine the effect of transcranial direct current stimulation (tDCS) during task-related training (TRT) on the gait ability of patients with chronic stroke. The 24 patients were included who were diagnosed with hemiplegia due to stroke. Three groups were created: subjects who performed TRT for general exercise therapy (TST), subjects who received sham tDCS during TRT for general exercise therapy (TST), and subjects who received tDCS during TRT for general exercise therapy (TT). Result revealed that the stance phase symmetry profile, the swing phase symmetry profile, and gait velocity all decreased significantly in the TT group compared with the TRT group. However, there was no significant difference in the step length symmetry profile among the groups. They concluded that an application of tDCS, that affects the excitatory regulation in the cortical motor area, is an effective rehabilitation method for gait improvement.

In this study 5 reviews were studied out of which 4 were RCT’s and they showed significant improvement in the balance and gait in patient with stroke. Hence it is proved that Task related training is effective in improving balance as well as gait in patients with stroke.

**Conclusion**

Generally, task-oriented rehabilitation after stroke has proved to be effective and relevant for stroke practice. The possible mechanism for effectiveness of task related training may be attributable to an enhancement of presynaptic inhibition of the hyperactive stretch reflexes in spastic muscles, decrease in the cocontraction of spastic antagonists, and disinhibition of descending voluntary commands to the motoneurons of paretic muscles.

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