Research Paper

Effects of Mental Practice on Functional Mobility and Quality of Life in Ambulant Stroke Subjects-at Pilot Randomized Controlled Trial

Medical Science

KEYWORDS : Mental Practice in Stroke, Functional Mobility, Balance and Gait, Quality of Life

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ABSTRACT

Background: 50%-65% of stroke survivors have residual motor deficits; principal among them is hemi paretic gait that limits mobility, increases the risk of falls and promoting sedentary life style. Motor imagery (MI) an active process during which a specific action is reproduced within working memory without any real movements. There are evidences for MI training in enhancing motor learning, neural reorganization and cortical activation in stroke patients. However efficacy of Mental practice training involving lower extremity mobility tasks are limited in literature.

Aim: To investigate the effect of combining mental practice with physical practice on functional mobility and quality of life in ambulant stroke subjects.

Methodology: 24 hemi paretic patients(>6 months post-stroke) who can able to walk 10 m with good imagery ability in KVIQ-20 ≥ 60 and Time dependent motor imagery screening test were recruited and randomly allocated into physical practice group(n=12)and physical+ mental practice group(n=12). Subjects in both groups underwent task orientated training for lower extremity 45 minutes, 6 days a week for 3 weeks. In addition, the experimental group received 15 minutes of Audio-based lower extremity tasks for imagery practice. Berg Balance Scale (BBS), Functional Gait Assessment (FGA) and Stroke Impact Scale-16 (SIS-16) were the outcome measures used to measure functional mobility and compared between the groups.

Results: Post treatment there was a significant difference in BBS, FGA and SIS-16 scores for both the groups. Between groups the mean (SD) differences scores for BBS, FGA and SIS-16 was statistically significantly after three weeks of intervention in Mental Practice group (p< 0.05).

Conclusion: The results of this study support lower extremity imagery training provide additional benefits to regular physiotherapy to improve functional mobility in chronic ambulant stroke patients.

Introduction

STROKE is the leading cause of adult neurologic disability resulting in limited mobility, activities of daily living, communication, and cognition.[1] Stroke is among the most common neurological disorders and impacts on all domains in the International Classification of Functioning, Disability and Health (ICF).[2] Walking impairments are one of the most severe disabilities associated with post-stroke hemiparesis and is usually recovered 12 weeks after stroke.[3-6] However, the recovery is often incomplete, and some specific gait-related problems remain and they have been implicated in the poor recovery of activities of daily living (ADL) mobility and an increased risk of falls. Therefore, complete recovery of walking function is ranked as a primary goal in stroke rehabilitation.[7-10]

Reduced physical activity level after stroke is common and may induce further deconditioning and decline in walking capacity which remains limited for many community-dwelling stroke survivors.[11] Quality of life measures should be used in stroke patients because they are multidimensional instruments which comprise functional, physical, cognitive, psychological and social elements. Additionally they are patient centered which fairly accurately represent patients perspective of health and a given treatment. Quality of life instruments also measure quality as well as quantity of the further life.[12] Several studies have described training programs to improve gait and gait-related activities and quality of life in the chronic phase after stroke.[13-26] In addition, a number of systematic reviews have shown that task specificity and intensity of training, in terms of hours of therapy, are the main determinants of functional improvement after stroke.[11, 13, 26, 27]

However physical practice of patients with hemiparesis is usually restricted in terms of time spent (once or twice a day for only a few minutes), space available (within institutional confines) and cost-effectiveness. To overcome such disadvantages, several investigators have suggested the use of imagery training in physical rehabilitation since it is an easily applicable and safe means of promoting motor recovery after stroke.[28] Motor imagery practice is an active practice in which the patient imagines or visualizes the performance of a function, a movement or a task without overt movement.[29-33] Beneficial effects of motor imagery practice have been supported through studies of brain imaging that the same areas of the central nervous system are activated during real performances and during motor imagery practice of the equivalent tasks.[34,35] Neuroplasticity of motor activity arising from physical therapy is also reproduced on the neural substrate in the brain involving motor imagery practice of the same activity.[34,36] Motor imagery practice provides additional, available benefits to regular physiotherapy or occupational therapy to improve function in patients with stroke.[36,37]

Several research groups have examined the clinical efficacy of motor imagery in post stroke patients, especially in functional training of the affected upper limb,[38] and learning of foot sequence[39] and weight-bearing during simple tasks, with performing alone or incorporating into physical tasks.[40] A few studies have recognized the effect of imagery training on movement tasks associated with walking ability.[41,42] However the effects motor imagery training specific to lower extremity tasks are limited in stroke subjects. This study was aimed to find the combined effects of Mental Practice to improve functional mobility and quality of life in ambulant stroke survivors.

Materials and Methods

This study was approved by Ethical Committee, Manipal University,Karnataka,India. Volunteer stroke subjects were recruited using a brochure describing the study purpose, inclusion criteria and information about the researchers. All subjects signed an informed consent. Participants were screened to ensure they met the following inclusion/exclusion criteria: a) Unilateral first onset stroke (ischemic / hemorrhagic) with residual hemi paresis with at least 6 months post stroke duration at the beginning of the intervention b) Brunnstorm recovery stage ≥ 3 for lower extremity c) Ability to walk at least 10 m with or without unilateral assistive device/ support d) Mini –Mental state examination score ≥24 e) Kinesthetic and visual imagery score (KVIQ-20) ≥ 60[43] f) Able to do Time dependent motor imagery screening test.[43] Subjects were excluded from the study if they were a) diagnosed other CNS diseases like Parkinson's, Neuro psychiatric diseases b) Cerebellar or Brain stem stroke c) Unilateral hemi neglect d) Walking limited due to Dizziness or Vertigo, visual defects like homonymous hemianopia , Peripheral Vascular Diseases and other co morbid conditions like osteoarthritis e) Major orthopedic surgical procedures in lower extremities f) Those that are participated mental practice program related to physical activity within previous three months.24 subjects were randomly assigned to experimental (n=12) and control (n=12) groups through concealed allocation using block randomization of 4 blocks with 6 subjects in each block.

Design
The study was an observer-blinded pilot randomized controlled study.

Interventions
Subjects in both experimental and control group underwent task orientated training for lower extremity 45-60 minutes per day 6 days for 3 weeks. All the sessions, delivered one-to-one by qualified trained physical therapist. Lower extremity Task-oriented exercises[44] are (1) performing double-legged stance (2) performing tandem stance (3) rising from a chair without the use of the arms; (9) walking forward and backward with a tandem walking pattern (toes of one foot touching the heel of the foot in front) (4) performing single legged stance (5) stepping forward, backward, and sideways on the exercise step (6) stepping over blocks of various heights (7) standing up from a chair, walking four steps forward, performing a bilateral stool touch and walking backwards to the chair; (8) standing up from a chair, walking four steps forward, turning to the right, stepping over the exercise step, turning to the right again and walking forwards to the chair (repeat the exercise circuit in opposite direction) (9) walking forward and backward with a tandem walking pattern (toes of one foot touching the heel of the foot in front). Adequate rest periods were given to the participants during the training program to overcome fatigue.

In addition, the experimental group received 15 minutes of mental practice program for 3 weeks. Training program started with a familiarization period for first week followed by training of mobility tasks for next 2 weeks with each session lasting 15 minutes. Mental Practice protocol was developed based on the 'active relaxation, imagery and mental rehearsal' strategy, which is commonly used in studies of motor imagery practice for sports. Video tapes were used for familiarization period which include subjects used comparative information for feedback while comparing their task with that of a normal young adult performing the same task. In training period the participants performed motor imagery mental practice according to a five-stage protocol which includes progressive relaxation, external imagery (analysis of task sequences), problem identification, internal imagery and mental rehearsal. In all the sessions' mental practice was trained first to overcome subject's fatigue and practiced in a non-distractible environment with subjects in supine or semi reclined position.

First week, the mental practice sessions were training of simple tasks (task 1 to task 5) and in second week, the mental practice sessions were training of complex tasks(task 6 to task 9) from the above mentioned task oriented exercises. To enhance the imagery ability, verbal instructions and explanation of the lower extremity task components which are practiced in physical practice, by means of pre-recorded audio tape in subjects own language. The taped intervention consists of 2 min relaxation followed by 12 min of cognitive visual images related to the task characteristics. (E.g. Imagine yourself in a warm, relaxing place and you are bending your knee and feel the tightness in your muscles) subjects are then taught to visualize themselves performing the required task and also experience kinesthetic sensation. This will be followed by refocusing of attention to the immediate surroundings and genuine body position (1 min) with total duration of 15 minutes. [45]

Outcome measures
Berg Balance Scale (BBS) consists of 14 tasks common in everyday life. The items test the subject´s ability to maintain positions or movements of increasing difficulty by diminishing the base of support from sitting, standing, to single leg stance, the ability to change positions is also assessed. Each item is scored on a scale from 0-4, for a maximum of 56 points. The BBS is a psychometrically sound measure of balance impairment for use in post stroke assessment.[46] The Functional Gait Assessment is a 10-item test that contains 7 of the 8 items (except walking around obstacles) from the Dynamic Gait Index and 3 additional tasks, including walking with a narrow base of support, walking with the eyes closed, and ambulating backward. The total score ranges from 0 to 30.The FGA measures functional ambulation and has good psychometrically property in stroke patients.[47] The Stroke Impact Scale -16 is a health related quality of life in stroke includes ADL/Instrumental ADL, Mobility domains which assess social and physical function.[48]

All the outcome measures were collected pre and post intervention following 3 weeks in both the groups by an independent observer who was blinded to the subject's allotment to the groups.

Statistical Analysis
Data analysis was performed using SPSS for windows version 14.0 and the level of significance for all analyses was set at $p < .05$.Descriptive statistics were generated in order to obtain frequency tables for all independent variables. Mann- Whitney U Test was used to test difference between the scores of control group with that of the experimental group. Wilcoxon Signed Rank Sum test was used to test the within group difference in pre and post intervention scores.

Results
All subjects in the experimental as well as the control group participated in all treatment sessions. There was no missing data. We did not observe any adverse events during treatment. The mean age of the subjects in experimental group was 62±5.2 years while in the control group was 58 ±4.5 years. The mean post stroke duration in the experimental group was 12±4.8 months while in the control group was 15±2.5 months. In the experimental group 9 subjects were stage 4 and 3 were stage 3 in Brunnstrom recovery stage and in control group 10 subjects and 2 subjects' respectively. The Mean score for KIVS Questionnaire was 77±10.5 in control group and 65±5.5 in experimental group. Demographic and clinical characteristics of the 12 subjects are presented in table 1.

Table 1: Demographic characteristic of the subjects in the study

Variables	Control group	Experimental group
Gender Male Female	 9 3	 8 4
Age in Years	58±4.5	62±5.2
Post stroke duration, months	15±2.5	12±4.8
Etiology Ischemic Hemorrhagic	 6 6	 9 3
Paretic side Right left	 5 7	 4 8
Brunnstrom recovery stage Stage 3 Stage 4	 2 10	 3 9
Functional Ambulation Category	3	3
Mean KIVQ-20 questionnaire	77±10.5	65±5.5

Table 2 shows the within group comparison of BBS, FGA and SIS 16 scores. All assessed outcome parameters improved significantly in both the groups after treatment with p value <.00.

Table 2: Pre-Post Results of Outcome Measures (Mean±SD) in Control and Experimental Group

Outcome Measures	Control Group			Experimental Group		
	Pre	Post	p value	Pre	Post	p value
BBS	38.80±5.26	42.10±5.17	.00**	36.80±4.90	46.70±3.46	.00**
FGA	20.70±1.70	23.10±1.79	.00**	19.40±1.89	24.60±1.26	.00**
SIS-16	51.10±5.58	58.30±4.83	.00**	52.40±6.07	64.60±7.26	.00**

****Highest Significant p<.00**

Between group comparisons of change score from pre-treatment to post-treatment BBS, FGA and SIS-16 are detailed in table 3. The change score of BBS, FGA and SIS 16 showed significantly more improvement in the experimental group than the control group with p value <.05.

Table 3: Mean±SD of Change Scores between Control and Experimental Group

Outcome measures	Control Group	Experimental Group	p value
BBS	3.30±1.88	7.90±1.96	.033*
FGA	2.40±1.17	5.20±1.61	.002*
SIS-16	7.20±3.99	12.20±5.58	.031*

***Significant p<.05**

Figure 1 Pre-Post BBS scores between the Control and Experimental Group

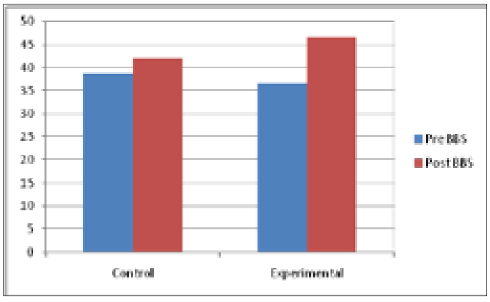


Figure 2 Pre-Post FGA scores between the Control and Experimental Group

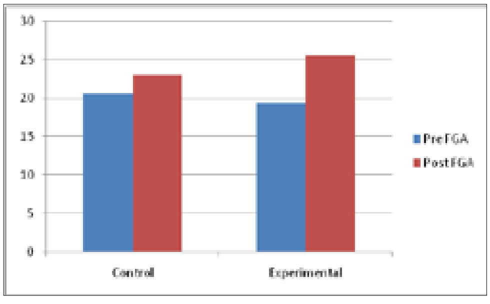
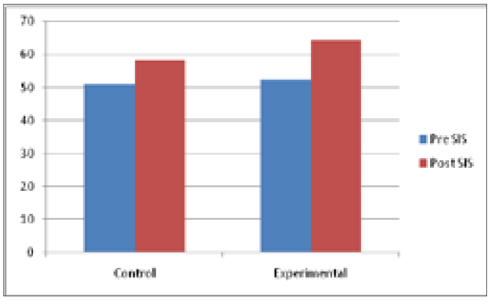


Figure 3 Pre-Post SIS-16 scores between the Control and Experimental Group



Discussion

The results of this pilot study revealed several significant findings. The results of this study showed that combined mental practice with physical practice improves functional mobility and quality of life in chronic stroke subjects which can be explained by clinical measures such as Berg Balance Scale, Functional Gait Assessment and Stroke Impact Scale-16 scores. All the outcome parameters were improved in both groups following 3 weeks of task orientated training. Compared to control group, the experimental group (physical practice with mental practice) showed significant improvement with p value <.05.

Compared to previous studies[41,42] the motor imagery used to train our subjects include performance of lower extremity mobility tasks in normal young adult as well as the knowledge of performance to provide perceptual feedback information about the subject's own lower extremity mobility task pattern to stroke subjects through the five-stage protocol mentioned in the procedure. To enhance the imagery during mental practice all the participants were provided with the audiotape feedback about the lower extremity mobility tasks. Our study results are more similar to Malouin et al[49] and Oh W D et al[50] where they concluded in their studies that added motor imagery training of lower extremity mobility tasks promotes relearning of rising, sitting tasks and also symmetrical use of knee extensors during sit-to-stand and stand-to-sit tasks in post stroke hemiparesis.

The improvement of functional mobility illustrated in this study could be explained by the principles of motor control and motor learning.[51] Motor learning is divided into three stages: cognitive, associate and autonomous stages. The cognitive stage is primarily declarative knowledge and must be interpreted through problem-solving. In our study stroke subjects used comparative information for feedback while comparing their lower extremity tasks with that of a normal young adult through a five-stage protocol, thus Lower extremity imagery training would be an effective intervention to improve functional mobility by facilitating the cognitive component of motor learning. Greater improvement of functional mobility in the experimental group can be explained by the transfer effect though lower extremity imagery training. The transfer of learning between tasks only occurs when two motor tasks are similar.[51, 52] further tasks trained in the Mental Practice are similar to daily life style situation which further improves their confidence in Community level integration which was reflected in Quality of life scores in SIS-16.

Limitations

In the present study lower extremity imagery training improves balance and mobility for those subjects who can ambulate 10m independently with or without support. Therefore, the results cannot be generalized to rehabilitation for patients with low-level functional ability as in acute stage. We also cannot mention patients who become fatigued easily, because fatigue level was not measured in this study. We expect that future studies incorporating brain-imaging technologies will provide more evidence of neural reorganization related to functional and biomechanical improvement following lower extremity imagery training. In addition, this study included a relatively small number of patients as Power of the Study was not estimated there is a need to conduct blinded, randomized controlled lower extremity imagery training experiments with larger numbers of subjects to improve internal and external validities.

Clinical message

Motor imagery practice is also a cost-effective and relatively safe motor rehabilitation intervention for individuals with stroke. Three weeks of added lower extermity motor imagery training with physical therapy (task oriented training) improves functional mobility and quality of life in ambulant stroke subjects.

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