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Integrated Mental Practice training improves Functional mobility in Chronic Stroke: A Pilot Study

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ABSTRACT

Background and Purpose of the Study: 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 effects of combining mental practice with physical practice on functional mobility in Chronic stroke subjects. **Methodology:** Quasi Experimental Study design of 12 chronic hemi paretic subjects who can able to ambulate 10 m and good imagery ability in KVIQ-20 e" 60 and Time dependent motor imagery screening test were recruited for the study. All Subjects underwent task orientated training for lower extremity 45 min per day and mental practice program for15 minutes for 3 weeks. **Results:** All the 12 subjects improved in Functional Gait Assessment from median score of 20 to 26 and in Timed Up and Go test from mean score of 56.5 to 45 seconds with the pvalue <.05. **Discussion:** This improvement can be explained by the principles of motor learning which is divided into 3 stages: cognitive, associative and autonomous stages. The cognitive stage is primarily declarative knowledge and must be interpreted through problem-solving. Participants used comparative information for feedback while comparing their task with that of a normal young adult through a five-stage protocol which includes progressive relaxation, external imagery (analysis of task sequences), problem identification, internal imagery and mental rehearsal. Another theoretical hypothesis is that role of mirror neuron system in humans which facilitates the motor learning. **Conclusion:** Motor imagery with mental practice provides additional benefits to regular physiotherapy to improve functional mobility in chronic stroke.

Key Words: Chronic Stroke, Motor imagery, Mental Practice, Mobility.

INTRODUCTION

Stroke as defined by World Health Organization is an "acute neurological dysfunction of vascular origin with sudden or at least rapid occurrence of symptoms and signs corresponding to involvement of focal areas in the brain"; further, the symptoms should last 24 hours or longer [1]. It is one of the foremost causes of morbidity and mortality and poses a major socio-economic problem in

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young patients, especially in developing countries [2]. The age adjusted prevalence of stroke in India ranges from 44-842/100,000 population with a male preponderance. In Karnataka the total prevalence rate is 165 people in rural and 135 people in urban out of one lakh [3].

Stroke is among the most common neurological disorders and impacts on all domains in the International Classification of Functioning, Disability and Health (ICF). Most individuals after a stroke will recover to some extent after the insulthowever;more than 50% of stroke survivors have residual motor deficits. Principal among them is hemi paretic gait that limits mobility and increases the risk of falls,promoting sedentary life style [4].

While majority of stroke survivors will regain some ability to walk, 40% will require assistance with walking and those of independent, 60% will be limited in community ambulation and having continuing problem with mobility [5]. This reduced levels of community ambulation and community participation results in decreased satisfaction with levels of outdoor mobility, community reintegration, and perceived difficulty in outdoor locomotion [6]. These observations reflect the importance of therapeutic strategies to improve functional walking ability in order to increase participation and quality of life after stroke.

Motor imagery refers to the active process by whichhumans experience sensations with or without externalstimuli. It is an active process during which a specificaction is reproduced within working memory without anyreal movements. Mental practice with motor imagery - based intervention has close relationship between cognitive brain mechanisms and the enhancement of neural activity in specific brain areas which activates neuronal circuits involved in the production of movements. There are evidences for Motor imagery training in enhancing motor learning, neural reorganization and cortical activation in stroke patients [7-12].

Motor imagery with Mentalpractice provides additional, available benefits to regular physiotherapyto improve upper extremityfunction in patients with stroke. However efficacy of Mental practice training involving lower extremity mobility tasks are limited in literature [13]. The aim of the present study is to investigate the effects of combining mental practice with physical practice on functional mobility in ambulant chronic stroke subjects.

MATERIALS AND METHODS

Subjects

Participants are stroke subjects who were admitted for a comprehensive rehabilitation program in Kasturba Medical College and Hospital, Mangalore, Manipal University, Karnataka. The clinical diagnose of Stroke was confirmed by the consultant appointed at the hospital on the basis of neurological examination and Computed Tomography or Magnetic Resonance Imaging. Subjects were included if they met the following 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 independently, with or without unilateral assistive device/ support d) Mini –Mental state examination score ≤ 24 e) Kinesthetic and visual imagery score (KVIQ-20) ≤ 60[14] f) Able to do Time dependent motor imagery screening test [14]. Subjects were excluded from the study if they were a) CNS diseases like Parkinson's, major head injury, Neuro psychiatric diseases b) Cerebellar or Brain stem stroke c) Unilateral hemi neglect d) Walking limited due to Dizziness or Vertigo, severe visual defect, Peripheral Vascular Diseases and other co morbid conditions e) Major orthopedic surgical procedures in lower extremities f)Those that are participated mental practice program related to physical activity within previous three months.

Design

The design of this study was a single-blinded quasi-experimental study.

Procedure

This study was approved by institutional ethical committee board Kasturba Medical College,Mangalore. Subjects signed an informed consent form after they receive information about the study purpose,and procedure,possible benefits and risks. Aftersigning, theparticipants were screened to ensure they meet the inclusion/exclusion criteria.

Intervention

Twelve subjects who participated in the study underwent task orientated training for lower extremity 45-60 min per day for 3 weeks. Allthe sessions, delivered one-on-one by qualified trained physical therapist.Task-orientedexercises[15] are [1] stepping forward, backward, and sidewayson the exercise step; [2] stepping over blocks of variousheights; [3] standing up from a chair, walking four steps forward, performing a bilateral stool touch and walkingbackwards to the chair; [4] standing up from a chair, walking four steps forward, turning to the right, steppingover the exercise step, turning to the right again andwalking forwards to the chair (repeat the exercise circuitin opposite direction); [5] from a sitting position on a65-cm Swiss ball, performing a range of motion andbalance exercises (forward and backward rolling of thearms; bending the trunk forward and side to side); [6] performing double-legged stance for 10 s; [7] performingtandem stance for 10 s; [8] rising from a chair without theuse of the arms; [9] walking forward and backward with atandem walking pattern (toes of one foot touching theheel of the foot in front); and [10] performing single legged stance for 10s.Adequate rest periods were given to the participants during the training programme to overcome fatigue.

Mental practice program started with familiarization period for first week followed by training of mobility tasks for next 2 weeks with each session lasting 15 minutes. In all the sessions mental practice will be trained first to overcome subject's fatigue and it will be practiced in a non distractible environment with subjects in supine or semi reclined position.

First six mental practice sessions will be of training simple tasks and next six practice sessions willbe of training complex tasks. 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) Total duration: 15 minutes [16].

All the outcome measurements were collected by blinded independent observer before and after 3 weeks of intervention period.

Instruments used for outcome measures

The Functional Gait Assessment is a 10-item test that contains 7 of the 8 items (exceptwalking around obstacles) from the DGI and 3 additional tasks, including walking with a narrow base of support, walking with theeyes closed, and ambulating backward. The total score ranges from0 to 30 [17].

The Timed up& Go (TUG) test is a simple and quickfunctional mobility test that requires a subject to stand up, walk 3m, turn, walk back, and sit down. The time from the point at which their spine left the back of the chair until they returned the same position was recorded by stopwatch [18].

Data Analysis

All statistical analyses performed using SPSS version 14.0 descriptive statistics were generated for each dependent variable. Mann-Whitney U test andone sample t test to pre-post treatment effect.

Results

Table 1. Demographiccharacteristic of subjects

Variable	Characteristics
Gender	
Male/Female	10/2
Age,Years -Mean(SD)	49.34(4.89)
Post Stroke duration,months - Mean(SD)	12.44(3.26)
Aeitology	
Ischemic/Haemorrhagic	4/8
Paretic side	
Right/Left	7/5
Brunnstorm recovery stage	
Stage 3	9
Stage 4	3

Table 2. Median Pre-Post FGA and mean Timed Up and Go Test scores

Variable	Pre	Post	p-value
FGA	20	26	<.05*
TGTin seconds	56.5(5.5)	45(3.5)	<.05*

*Statistical significance

Fig. 1. Graphical Representation of Pre-Post Functional Gait Assessment

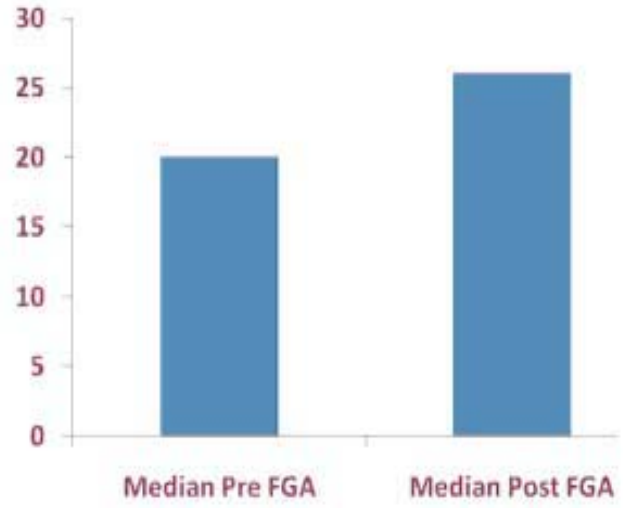
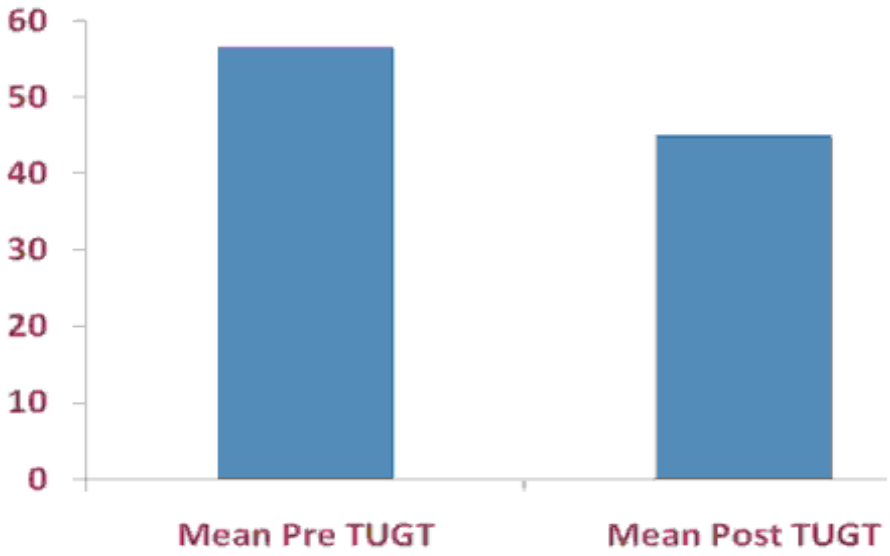


Fig. 2. Graphical Representation of Pre-Post Timed Up and Go Test



DISCUSSION

The results of this study showed that combined mental practice with physical practice improves functional mobility in chronic stroke subjects. The improvement of functional mobility performanceillustrated in this study can be explainedby the principles of motorlearning. Motor learning is divided into threestages: cognitive, associate and autonomousstages. The cognitive stage is primarily declarativeknowledge and must be interpreted throughproblem-solving. The subjects used comparativeinformation for feedback while comparing theirtask with that of a normal young adult through afive-stage protocol which includes progressive relaxation, external imagery (analysis of tasksequences), problem identification, internal imageryand mental rehearsal. This protocol was developedbased on the 'active relaxation, imagery andmental rehearsal' strategy, which is commonlyused in studies of motor imagery practice forsports Therefore, motor imagerytraining would be an effective intervention toimprove functional mobility by facilitating the cognitivecomponent of motor learning [19-20]. Another theoretical hypothesis is that role of mirror neuron system in humans whichfacilitates the motor learning [21].

CONCLUSION

Motor imagery practice provides additional benefits to regular physiotherapy toimprove functional mobility in chronic stroke.

Clinical Significance

Motor imagery practice is also a cost-effective and relativelysafe motor rehabilitation intervention forindividuals with stroke

Limitations

The improvement may be as a result of combined physical practice with mental practice. Subject's imagery ability will influence the results. Further a high quality randomized controlled studies needed to find the effects of mental practice in Stroke rehabilitation.

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