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Review article *Medical research*

A study to find the effect of mental imagery training for promoting relearning in post stroke subjects

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ABSTRACT

Objectives

To find the effect of mental imagery training for promoting relearning in post stroke subjects.

Study design

Experimental study design.

Subjects

Subject with post unilateral stroke patient

Intervention

Giving of mental imagery training for total 3 weeks with 1 hour session each week. Patients trained to perform 3 sets of daily tests and five task in each session.

Outcome measures

Daily living activities

Results

Mann Whitney "u" test is used.

Conclusion

Cortical re organisation and functional improvement can be seen in mental practice.

Keywords: Fugl Meyer motor assessment, 7 points Likert scale, Conventional Physiotherapy, Mental imagery training.

INTRODUCTION

Stroke is defined as a clinical syndrome characterized by rapidly developing signs of focal or global disturbance of cerebral functions, lasting for more than 24 h or leading to death, with no apparent causes other than vascular origin. It is the leading cause of long term disability in adults [1].

This study aims to evaluate a new therapy for improving arm function in acute stroke patients based on mental practice theories and functional task oriented training and to study the predictors for a positive treatment results. movement imagery has emerged, targeting the cognitive processes associated with enhanced motor performance and specific skilled movement in healthy persons [11] Humans have the ability to generate mental

correlates of perceptual and motor events without external stimuli. This cognitive operation can be performed in different modalities such as visual, auditory, tactile, kinesthetic, olfactory, and gustatory or any combination of these senses. Movement of an object or a person. For instance mental rotation is a form of movement imagery in which subjects have to rotate a geometric figure mentally in order to identify its shape. [9]

Use of mental practice in physical rehabilitation as a cost efficient means to promote recovery after damage to the central nervous system. Regularly applying this technique in training and completion is called mental practice combining mental practice training principles with active movement training appears more beneficial than mental practice training alone [11]. Mental imagery is a process in which a function, a behavior performance is rehearsed mentally, as if the person is actually performing it. It is believed to enhance relearning by involving the patient in actively gathering perceptual information from memory and undergoing the experience of seeing the performance of the behavior with the mind's eye This process demands perception and executive function, which in the case of motor imagery, is mediated by the activation of the parietal, frontal, and prefrontal regions. Functional imaging studies reveal a partial overlapping of brain activation between imaging and actually performing a task, for example, the contra lateral superior parietal lobe is activated when imaging finger movements. Mental imagery has also been applied to stroke rehabilitation, to promote upper extremity motor function and to improve the condition of neglected[8]. We hypothesized that; Mental imagery is better able to improve task performance for people with stroke than is functional retraining.

Motor imagery is the ability to imagine performing a movement without executing it." Motor imagery 'encompasses a range of computational processes, which can be arranged hierarchically. High level processes include memory for targets of movement and attention to spatial locations. Low -level pro commands necessary to make a desired movement. The inverse kinematics problem is the mapping of desired movement path to the sequence of muscle torques. Several of the regions activated during actual movement are activated during motor imagery. However, it is not know what computations these areas are performing during motor imagery. Brain activity during a motor imagery task could result from motor simulation. Somatotopic organization provides one means to distinguish between the two high -level representations of plans for actions or targets of movement do not have to be somatotopically organized. Thus if a motor imagery task leads to motor simulation activity during that task should be somatotopically organized. Indirect evidence comes from electroencephalographic studies, which have measured the surface electrical activity during imagined left and right hand movements, and found evidence for lateral organization [12].

Mental practice or motor imagery refers to use of vasomotor imagery or mental imagery with the purpose of improving motor behavior. Vasomotor imagery requires the use of one's imagination to stimulate an action.

REVIEW OF LITERATURE

Dickstein R, Deutsch je et al (2007)

Motor imagery (mi) is the mental representation of movement without anybody movement. [42]

Cleusa P Ferri et al (2011)

The authors investigated the prevalence of self reported stroke, stroke related disability, dependence and care giver status in Latin America (LA) China and India. The prevalence of self reported stroke ranged between 6% and 9% across most LA sites and urban China but was much lower in urban India (19%) and in rural sites in India (1.1%) china (1.6%) and Peru (2.7%). The proportion of stroke survivors needing care rural India (73%) [15].

Donnan Gab et al (2008)

Stroke is the second most common cause of death and major cause of disability worldwide. Because of the aging population, the burden will increase greatly during the next 20 years especially in developing countries. Advances have occurred in the prevention and treatment of stoke during the past decade [2].

Magdalena Ietswart et al (2011)

This study evaluated the therapeutic benefit of mental practice with motor imagery in stroke patients with persistent upper limb motor weakness.

There is evidence to suggest that mental rehearsal of movement can produce effects normally attributed to practicing the actual movements [30].

Sjoerd De Vries et al (2011)

Conducted a study whether motor imagery ability recovers in stroke patients and to see what the relationship is between different types of imagery and motor functioning after stroke. Implicate motor imagery ability and visual motor imagery ability improved significantly at 6 weeks compared to 3 weeks post stroke. [45]

Dawn m. Nilsen et al_2009

A study was done to evaluate whether mental practice is an effective intervention to improve upper-limb recovery after stroke. However result Suggest that mental practice combined with physical practice improves upper-limb recovery. [16]

Karen P.Y. Liu. Et al (2009)

To study the efficiency of mental imagery for promoting generalization of the task skills learned in a training environment to trained and untrained tasks carried out in a novel Environment. And this study showed significant better performances on 4 of 5 trained task. Mental imagery intervention was useful for improving patients ability on performing the task which they did not previously trained on and in places different from the training environment. [25]

Ludmina Svetlana M Calyan, et al. (2009)

Mental practice with motor imagery entails an individual to symbolically rehearse a physical activity with working memory in the absence of overall body movement. It has been proven to be useful in sports training and other skills training. Mental practice with motor imagery may serve as an avenue for patients to continue their skills training even when they are already physically exhausted, or when supervised therapy sessions have finished. [27]

Nicolas Gueugneau, MS et al (2009)

Mental practice through motor imagery improves subsequent motor performance and thus mental training is considered to be a potential tool in neuromotor rehabilitation. [35]

Andrea Zimmermann Schlatler et al (2008)

Conducted a study on evaluation of how motor imagery with conventional therapy vs conventional therapy only in their effects on clinically relevant outcomes during rehabilitation of persons with stroke. Two different motor imagery techniques were used .This study found significant effects of motor imagery in the fugl Meyer stroke assessment. [13]

DESIGN AND METHODOLOGY

Study design

Experimental study design

Study setting

The study was conducted in the Department of physiotherapy, Jaya College of physiotherapy, Chennai.

Sample size

A Total of 30 subjects fulfilled the inclusion criteria are randomly assigned as
Group A (n= 15; 11 Male, 4 Female) received mental imagery training with conventional physiotherapy.
Group B (n=15; 11 Male, 4 Female) received conventional physiotherapy alone.

Study duration

Total duration of 3 weeks was adopted in this study.

Treatment duration

- 3 weeks with 5 one hour sessions each week was adopted in this study.
- The subjects in both the groups received treatment for a period of 3 weeks.

METHODOLOGY

A total of 42 subjects referred for OP department of Jaya College of physiotherapy, Chennai with unilateral stroke. The subjects were clinically diagnosed as ischemic middle cerebral artery infarction and they are selected based on the inclusion and exclusion criteria. In which 34 patients fulfilled the inclusion criteria and on that 4 subjects were excluded as they were not willing to participate in this study. The purpose of the study was explained to all subjects and consent from each subject was taken. All subjects were assessed using

a special Performa. Subjects were randomly assigned into either (Group A) or (Group B).

Procedure

- Subjects are randomly assigned into two groups. Group A (experimental group) received Mental imagery training with conventional physiotherapy Group B (control group) received conventional physiotherapy for the period of 3 weeks.
- Total of 30 subjects were selected for the study with clinically diagnosed unilateral stroke. Simple random technique was used in the allocation of subject into Group A& Group B.
- **Group A:** 15 subjects were allocated in the Group A (experimental group)
- **Group B:** 15 subjects were allocated in the Group B (control group)

PROCEDURE

After initial neurological examinations, the subjects who meet study criteria, and agreed to participate were assigned into experimental and control groups. Informed consent form was taken from the subjects prior to the treatment.

The subjects in the experimental group were provided training in the mental imagery program and also training in the functional retraining. The patients received training for a total of 3 weeks with five 1 hour sessions each week, Apart from this the patient received general conventional physiotherapy treatment.

The therapist attended a two hour briefing session and the clinical program and the session covered the theoretical background and administration of standardized technique used in either the mental imagery or the functional retraining program During this three weeks, patients were trained to perform 3 sets of daily tasks and five tasks in each sets .The difficult level of each set of task was organized in ascending order .The training for the easiest task set was covered in the first week. The training for the most difficult set was covered in the third week. Patients received one hour conventional physiotherapy sessions for training in walking and for general muscle strengthening 5 days a week at a different time of a day to minimize the fatigue.

In the mental imagery program, patients were trained in the technique of mental imagery to practice specific tasks. In the first week, the focus was on analyzing task sequence to facilitate the motor planning and problem identification process using computer generated pictures and movies. In the second week, patient identified their own problems for rectification through the use of mental imagery picture cards depicting the task sequence were used if the patients needed help in recalling the steps. In the third week, the focus was on the practicing the rectified task performance using mental imagery and actual practice.

Each step was presented as a picture, with verbal explanation of physical and mental demands of the particular steps.

The five most difficult task trained in the third week were read ministered to the patients at the one month follow up. Five new tasks that are trained in the third week program and had a similar difficulty level to those in the last task set were administer to the patients at the end of third week.

The subjects in the controlled group were given one hour routine physiotherapy which includes stretching of the affected limb muscles, walking, general strengthening exercise and active assisted and active exercises five days per week for 3 weeks. Fugl Meyer motor assessment scale and 7-point Likert scale were administered to assess the recovery of affected extremity for the group before intervention and after intervention.

DATA ANALYSIS & STATISTICS

The data analysis was computed with SPSS. The outcome measures used are upper extremity and lower extremity sessions of Fugl Meyer motor assessment scale and 7 point likert scale. Wlicoxson signed ranks test is used to test the significant difference in the outcome of Fugl Meyer scale and 7 point likert scale within the groups. MannWhitney:"u" test is used to test the significant difference in the outcome measures between the experimental and control group. The level of significance is fixed as 5% fix the present study.

Table - 1

No. of Subject	**N=30**	
Age (Mean)	55.7	
Side Involved	Right : 13	Left: 17
Sex Male	22	
Female	8	

Table – 2

Comparing the pre and post test means of fugl Meyer motor scores in the experimental group.

FMS SCORE	**N**	**Mean**	**Z value**	**P value**
Pre test score	15	43.33		
Post test score	15	82.86	101.69	90.05

From the above table, P-value shows the significant difference between pre and post test means of fugl Meyer scale in experimental group.

Comparing the pre and post test means of Fugl Meyer motor assessment scale scores in the control group.

FMS SCORE	**N**	**Mean**	**Z value**	**P value**
Pre test score	15	43.46	52.2098	0.05
Post test score	15	62.66		

From the above table, P-value shows the significance differences between the pre and post test means of Fugal Mayer scale in the control group.

Comparing the post test means of Fugl Meyer Assessment scale scores between the control group and experimental group.

FMS SCORE	**N**	**Mean**	**Z value**	**P value**
Pre test score	15	82.86	37.998	0.05
Post test score	15	62.66		

From the above table, P value shows the significant difference between the post test means of experimental group and post test means of control group.

Comparing the pre and post test means of 7-Point Likert scale in experimental group for trained tasks.

FMS SCORE	**N**	**Mean**	**Z value**	**P value**
Pre test score	15	22.93	10.2059	0.05
Post test score	15	73.46		

From the above table P value shows the significant difference between pre and post test means of 7-Point Likert scale in experimental group for trained task.

Comparing the pre and post test means of 7-Point Likert scales scores in the control group for trained tasks.

FMS SCORE	**N**	**Mean**	**Z value**	**P value**
Pre test score	15	22.06	63.7215	0.05
Post test score	15	42.13		

From the above table, P value shows the significant difference between pre and post test means of 7-point Likert scale in the control group for trained tasks.

Comparing the post test mean of 7-Point Likert scale score for trained tasks between the control and experimental group.

FMS SCORE	N	Mean	Z value	P value
Pre test score	15	73.46	3.8717	0.05
Post test score	15	42.13		

From the above table, P value shows the significant difference between posttest means of experimental group post test mean of control group.

DISCUSSION

A sample of 30 subjects fulfilling the inclusion criteria have randomized into 2 groups of 15 each. All participants were clearly explained about the treatment procedure.

- Group A underwent mental imagery training for 3 weeks
- Group B underwent conventional physiotherapy for 3 weeks

In the mental imagery program, patients were trained in the technique of mental imagery to practice specific tasks. In the first week, the focus was on analyzing task sequence to facilitate the motor planning and problem identification process using computer generated pictures and movies. In the second week, patient identified their own problems for rectification through the use of mental imagery picture cards depicting the task sequence were used if the patients needed help in recalling the steps. In the third week, the focus was on the practicing the rectified task performance using mental imagery and actual practice.

FUGL MEYER MOTOR SCALE: MOTOR IMAGERY TRAINING

(Experimental Group)

In present study when we compare the pre and post test means of Fugl Meyer motor scores in experimental group the results reveals that .the mean of pre test score is 43.33 and mean of post test score is 82.8667 and t value is 2.1448 p value is 0.00<0.05 from the above table p value shows the significant difference between pre and post test means of Fugl Meyer scale in experimental group.

The previous study done by Malouin et al 2004 observed that the strongest relationship was manifested in the visual spatial domain. They followed by verbal and kinesthetic domains and the describe motor imagery as dynamic state during which the representation of specific action is internally reactivated. [31]

A study done by Magdalena Ietswaart, etal, 2011 to evaluate the therapeutic benefit of mental practice with motor imagery in stroke patients with persistent upper limb motor weakness. There is evidence to suggest that mental rehearsal of movement can produce effects normally attributed to practicing the actual movements. Imaging hand movements could stimulate restitution and redistribution of brain activity, which accompanies recovery of hand function, thus resulting in a reduced motor deficit. [30]

FUGL MEYER MOTOR SCALE

(Conventional Group)

In present study when we compare the pre and post test means of Fugl Meyer motor scores in conventional group the results reveals that the mean of pre test score is 43.4667 and mean of post test score is 62.6667 and t value is 2.1448 p value is 0.00<0.05 from the above table p value shows the significant difference between pre and post test means of Fugl Meyer scale in conventional group.

A study done by Page, Levial P, Sisto SA, in 2001 the patient was 56-years old man with stable motor deficits, including ULH; on his dominant side resulting from a right parietal infarct that occurred 5 months previously. He received physical therapy for an hour 3 times a week for 6 weeks. In addition, 2 times a week the patient listened to an audio tape instructing him to imagine himself functionally using the affected limb.[47]

The patient exhibited reduction in impairment (Fugl-Meyer scale) and improvement in arm

function, and suggested, mental practice may be added to complement physical therapy to improve motor function after stroke.

FUGL MEYER MOTOR SCALE

(Comparison between experimental group and conventional group)

When we compare the post test means of Fugl Meyer motor scores between experimental and conventional group revels that post test mean of experimental group is 82.8667 and post test mean of conventional group is 62.6667 and t value is 2.1314 p values is 0.05. From the above results p value shows the significant difference between the post test means of experimental group thanpost test means of conventional group.

Mental imagery is a process in which a function, a behavior performance is rehearsed mentally, as if the person is actually performing it. It is believed to enhance relearning by involving the patient in actively gathering perceptual information from memory and undergoing the experience of seeing the performance of the behavior with the mind's eye This process demands perception and executive function, which in the case of motor imagery, is mediated by the activation of the parietal, frontal, and prefrontal regions. Functional imaging studies reveal a partial overlapping of brain activation between imaging and actually performing a task, for example, the contra lateral superior parietal lobe is activated when imaging finger movements. Mental imagery has also been applied to stroke rehabilitation, to promote upper extremity motor function and to improve the condition of neglected[14]. We hypothesized that; mental imagery is better able to improve task performance for people with stroke than is functional retraining.

Study done by Francine malouin et al to examine the relationship between working memory and motor improvement obtained after training session combining mental and physical practice. The results reveals that the affected leg was improved after training ($p<0.01$) these results suggest that mental imagery is effective in improving motor performance.[4]

POINT LIKERT SCALE

(Experimental group)

In present study when we compare the pre and post test means of 7 point Likert scale: in experimental group the results reveals the mean of pre test score is 22.93 and mean post test score is 73.46 and t value is 2.1448 p value is 0.00<0.05 from the above table p value shows the significant difference between pre and post test means 7 point Likert scale: in experimental group.

The study done by Andrew J Butler et al states that the cortical changes observed after undergoing task specific, repetitive physical practice coupled with mental practice with motor imagery could be similar or even greater leading to greater amount of cortical reorganization and improved functional outcome [14]

POINT LIKERT SCALE

(Conventional group)

In present study when we compare the pre and post test means of 7 point Likert scale: In conventional group the results reveals the mean of pre test score is 22.06 and mean post test score is 42.13and t value is 2.1448 and p value is 0.00<0.05 from the above table p value shows the significant difference between pre and post test means 7 point Likert scale: in experimental group

A study done by Stephen J. PhD, 2005 supported that participants in Mental Imagery Training protocol may increase a stroke patients use of his/her more affected limb. [46]

POINT LIKERT SCALE

(Comparison between experimental group and conventional group)

When we compare the post test means of 7 point Likert scale between experimental and conventional group revels that post test mean of experimental group is 73.46 and post test mean of conventional group is 42.13 and t value is 3.8717p value is 0.05 .from the above results p value shows the significant difference between the post test means of experimental group and post test means of conventional group.

The study done by MargaTpper Bert Otenetal results suggest that that mental practice could be

most effectively introduced in the rehabilitation process after stroke

The study done by Chetwyn C Chan et al the result of the study revealed that patients who were trained in the mental imagery technique appeared to reach a higher level of performance than control group.

Many neural mechanisms are activated during motor imagery, as reveled by a sharp increase in tedious reflex in limb imagined to move and by vegetative changes which correlate with the level of mental effort. At the cortical level, a specific pattern of activation ,that closely resembles that of action execution, is observed in areas deviated to motor control .this activation might be the substrate for the effects of mental training. Hierarchical model of the organization of action is proposed this model implies a short term memory storage of copy of the various representational steps .these memories are erased when an action corresponding to the represented goal take place .By Contrast if the action is incompletely or not executed the whole system remains activated, and the content of the representation is rehearsed .This mechanism would be the substrate for consciousness to this content during motor imagery and mental training.

CONCLUSION

From the above study it shows that cortical re organization and functional improvement can be seen following mental practice with motor imagery. Neuronal network involved in movement execution also active during mental practice .thus mental imagery training can be added in stroke rehabilitation, for improvement of valued activities of daily living.

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