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Effect of Graded Motor Imagery (GMI) in Improving Upper Extremity Functions for Patients with Acute and Subacute Stroke

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Background: Movement problems after stroke are one of the leading causes of permanent disability. Upper extremity rehabilitation is important for daily activities, but it is variable and Incomplete. Graded Motor imagery is a comprehensive program that has been proposed to activate cortical motor networks and improve cortical control in three domains: laterality training, imagined movements, and MVF. This study examines the effect of Graded motor imagery(GMI) on improving upper extremity functions in patients with acute and subacute stroke. **Objectives:** The study is aimed to find the effect of Graded Motor Imagery (GMI) in improving upper extremity functions for patients with Acute and subacute stroke. **Materials and methods:** The study is based on quasi – experimental study with 30 patients with acute and subacute stroke (15 in experimental group and 15 in control group) age group between 40 years and above.Fugl-Meyer assessment upper extremity (FMA-UE) is used to measure the upper extremity functions among the patients with acute and subacute stroke. **Result:** There is a significant improvement in upper extremity functions among patients with acute and subacute stroke. The data analyzed the pretest and post test score of both experimental and control group which shows a significant difference between groups. Since the p value is lesser than 0.05, alternate hypothesis is accepted. Hence, there is statistically significant difference in post test scores between Experimental and Control Group of the FMA-UE. This suggests that the intervention received by the experimental group had significant improvement when compared to the control group. **Conclusion:** From the findings of this study, it was concluded that Graded Motor Imagery (GMI)has proved its effect in improving upper extremity functions in patients with acute and subacute stroke.

Keywords: Graded Motor Imagery (GMI), upper extremity functions, stroke

Introduction:

Stroke presents a significant and increasing global health issue. Globally, stroke ranks as the foremost cause of acquired physical disability among adults, and it is the second highest cause of death in middle to high-income nations (1). A stroke is characterized by an abrupt rupture of the brain's blood vessels. Blood supply to the brain is directed by the two internal carotid arteries anteriorly and the two vertebral arteries posteriorly (Circle of Willis). An ischemic stroke is caused by a lack of blood and oxygen supply to the brain. A hemorrhagic stroke is caused by leakage or bleeding in the blood vessels (2).The period following a stroke Is frequently segmented into different phases. The Stroke Round Table Consortium suggested classifying the first 24 hours as the hyper-acute phase, the initial 7 days as the acute phase, the first 3 months as the early sub-acute phase, the months 4 to 6 as the late sub-acute phase, and beyond 6 months as the chronic phase. The reasoning for this classification is that recovery processes after a stroke are dependent on time (3).

Upper extremity impairments after a stroke are the cause of functional limitations in the use of the injured upper extremity after a stroke, so an understanding of the underlying impairments is necessary to provide treatment appropriately (4). Following a stroke, complications related to upper limbs' function are more frequent. These upper extremity complications cause problems with the movement and coordination of the arms, hands and fingers, making it difficult to do daily activities, such as eating, dressing, and washing. More than half of people who develop an upper extremity injury after a stroke continue to suffer months to years after the stroke. Improving upper extremity functions is an important part of recovery in stroke rehabilitation (5).During rehabilitation, physical, occupational, and speech therapists facilitate the execution of tasks that hold significance for patients, establish and revise attainable goals considering the boundaries of remaining reflexive and voluntary neural control, and promote a routine of daily skills practice that increases in intensity and complexity. Therapists might employ neuromuscular facilitation techniques to initiate the process of regaining motor skills, prior to progressing from basic to more intricate actions that make up goal-oriented behaviours (6).Occupational therapy interventions may consist of approaches designed to maintain or enhance the soft tissue characteristics of the upper limb. For instance, techniques that might be utilized to alleviate spasticity include stretching and static or dynamic splinting, whether used individually or in combination with medically administered botulinum toxin therapy (7) .

GMI is considered "backdoor" in neurological conditions like stroke to approach the motor system and rehabilitation after stroke at all stages of recovery because it does not depend on residual activity, but on constant access to movement. DeVries and Mulder proposed

the concept that stroke patients could also activate the patient's motor system "off-line" through motor imagery or observation of movements. The presence of mirror neurons is associated with this phenomenon. These are the neurons that fire when we perceive (observe and imagine) the action and perform the action. It is proven that prolonged passive movement therapy in stroke patients neither improves performance nor induces cortical plasticity. The gap between passive and active therapy can be filled by the implementation of GMI program. In contrast to active motor therapy and electrical therapy, Graded motor imagery typically does not rely on residual activity, but instead involves continuous stimulation. Importantly, in mammals, the primary motor cortex (M1) is directly involved in motor imagery represented by direct sensory recordings. In stroke patients, motor imagery can substitute for the movements performed to activate the motor network (7).

Conclusively, graded motor imagery is a comprehensive program intended to progressively stimulate cortical motor networks and enhance cortical organization in three phases: laterality training: The left/right discrimination (laterality) tasks are meant to evaluate how readily you can determine whether the image you are viewing is a left or right body part. The task is probably connected to the subconscious mental representation of an individual's body part and/or its movement (8). imagined hand movements:Motor imagery refers to a cognitive process where an individual performs a movement without physically performing it and without any muscle tension. This represents a dynamic state in which the representation of a particular motor action is activated internally, without any motor output (9) and MVF: A phenomenon where movement of one limb is perceived as movement of another limb(10). Hence the purpose of this study is to determine the effectiveness of GMI-GRADED MOTOR IMAGERY in improving upper extremity functions in patients with acute and subacute stroke.

Materials and Methods:

The Fugl-Meyer Assessment (FMA) is a stroke-specific, performance- based impairment index. It is designed to assess motor functioning, balance, sensation and joint functioning in patients with post-stroke hemiplegia. It is applied clinically and in research to determine disease severity, describe motor recovery, and to plan and assess treatment. The FMA-UE consists of 30 items assessing motor function and 3 items assessing reflex function. The score most applicable to task performance is given from "0, inability," "1, beginning ability," to "2, normal" (total score range, 0–66). Scoring is based on direct observation of p

Participation:

Patients with acute and subacute stroke were invited to participate in the study. The inclusion criteria were people with acute and subacute stroke aged from 40 years with MMSE score of greater than or equal to 24 and of Brunnstrom stage 3 and above. Participants were excluded if they hadOther neurological disorders affecting ADL or mood. Musculoskeletal disorders hindering routine activities of daily living, MMSE score of lesser than 24.The ethical committee authorized and provided the permission to conduct the study.

Protocol:

In this study patients were explained about the procedure and those who are willing for the therapy were selected using convenient sampling method. Following that, Screening test was conducted to find acute and subacute patients with normal cognition using MMSE. 30 patients were selected based on inclusion criteria and baseline pre-test measurement was done using Fugl-Meyer assessment upper extremity (FMA-UE). Out of these, 15 patients were allocated to the experimental group where they received Graded Motor Imagery and the remaining 15 patients were allocated to the control group where they received conventional occupational therapy. The duration of this study took 12 weeks (36 Sessions) where each session was 45 minutes and was given for 3 days a week. After the study was complete, post-test measurements using the outcome measures were assessed and analyzed using appropriate statistical method.

Intervention

Session 1 – 2: Introduction, Establishing rapport and General neurological assessment is done.

Session 3 – 4: Administration of scale. Pre test taken using Fugl-Meyer Assessment upper extremity FMA-UE scale for Control group.

Session 5 – 6: Administration of scale. Pre test taken using Fugl-Meyer Assessment upper extremity FMA-UE scale for experimental group.

Session 7 – 8: 20 mins of conventional occupational therapy (Task oriented activities – reaching, transferring, kicking ball, Weight bearing activities, passive ROM, strengthening activities). Explanation about the experimental intervention and purpose of activities was done. Laterality recognition activities – flashcards of left and right hand side of hands in different positions and angles was shown and asked to identify.

Session 9 – 12: 20 mins of conventional occupational therapy followed by laterality recognition activities – Identification of only one side, sorting left and right side in their respective sides, each session was graded by difficulty of pictures.

Session 13: 15 mins of conventional occupational therapy followed by 10 mins of laterality recognition activities then explicit motor imagery was introduced. Flashcards, videos along with commands of their daily activities was given and patient was asked to imagine the movements and senses. (eg: picture of opening a jar) Session 14 – 18 – 20 mins of laterality recognition activities was given then a Particular task from their daily activity was selected and graded by adding components by giving them vocal instructions about the situation they are imagining. Session 19 – Administration of mirror box. 20 mins of conventional occupational therapy was given. Choosing an appropriate motor exercise. Started with simple exercises like flexion and extension of fingers, wrist and elbows. Session 20 – 24 – Execution of motor exercise – Unilateral movements of the non – affected arm alone. Bilateral movements as good as possible. Guiding of the affected arm by the therapist.

Session 25: Mid term assessment was taken.

Session 26 – 30: Using functional task. After basic exercises functional tasks with objects is integrated to the program (cups, balls, wooden blocks). Simple functional movements (sliding of an object on the surface) are performed.

Session 31 – 33: Simple functional movements are repeated with gradual fading of Therapist assistance followed by complex functional movements such as grasping, carrying and placing of a cup.

Session 34 – 36: Post test was done to evaluate the progress for both control and experimental group.

Statistical Analysis:

The data was analyzed by the Wilcoxon signed rank test used to test the statistical difference between pretest and posttest of group A and B. Mann Whitney U test was applied for the comparison of post test score, which identifies whether their exists statistically difference in consideration of the treatment given. The level of P – 0.05 was measured to be statistically significant. The statistical analysis was performed using IBM SPSS version 24.0.

Results

The experimental group underwent Graded Motor Imagery along with conventional occupational therapy whereas the control group received only conventional occupational therapy. The results showed that there was a significant improvement in the experimental group than the control group after receiving Graded Motor Imagery. Thus, this study proved the effect of Graded Motor Imagery in improving upper extremity functions for

patients with acute and subacute stroke. The results of the present study indicated that Graded Motor Imagery can be a useful for stroke patients with poor upper extremity functions.

Table 1: Comparison of Pre-Test And Post-Test of Fugl-Meyer Assesment Upper Extremity (Fma-Ue) in Control Group

Test	Mean	S.D.	N	Z Value	p Value
Cntr1-Pre	17.2667	6.25033	15	-3.416	0.001
Cntr1-Post	23.1333	8.17546	15		

Since the p value of 0.001 is lesser than 0.05, alternate hypothesis is accepted. Hence, there is statistically significant difference between pre- test and post test scores in the Control Group of the FMA. This suggests that the intervention received by the control group had significant improvement.

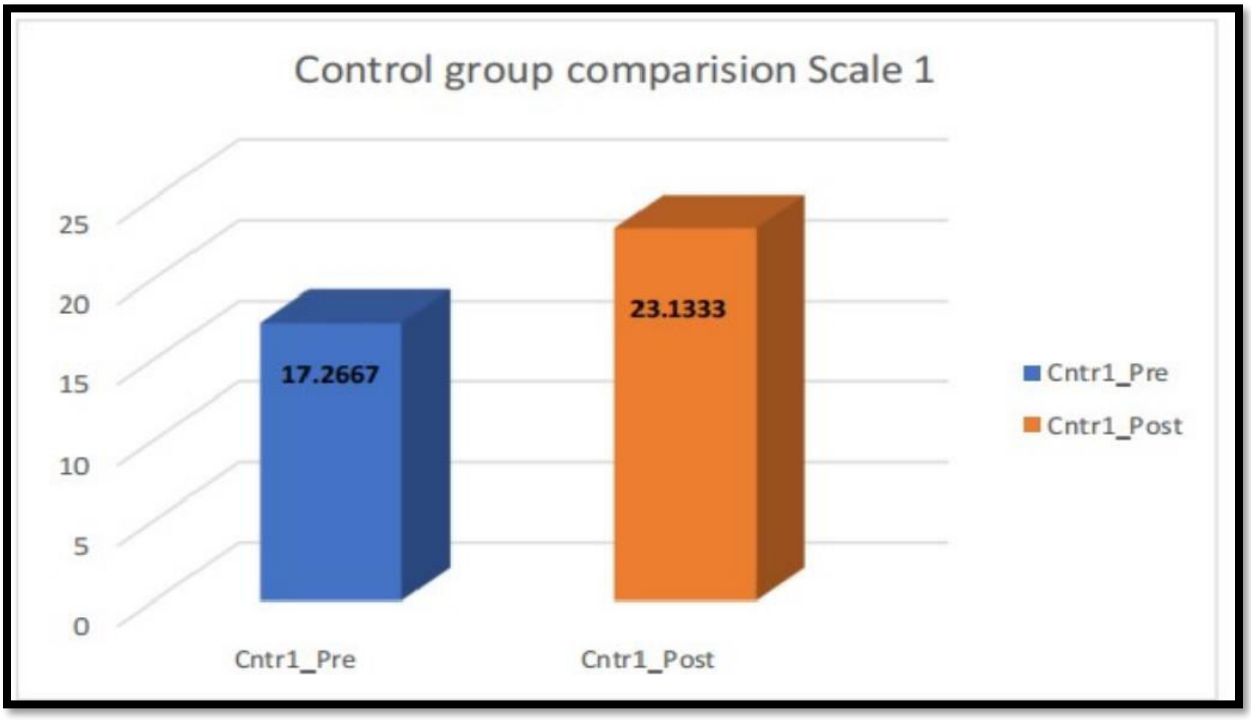
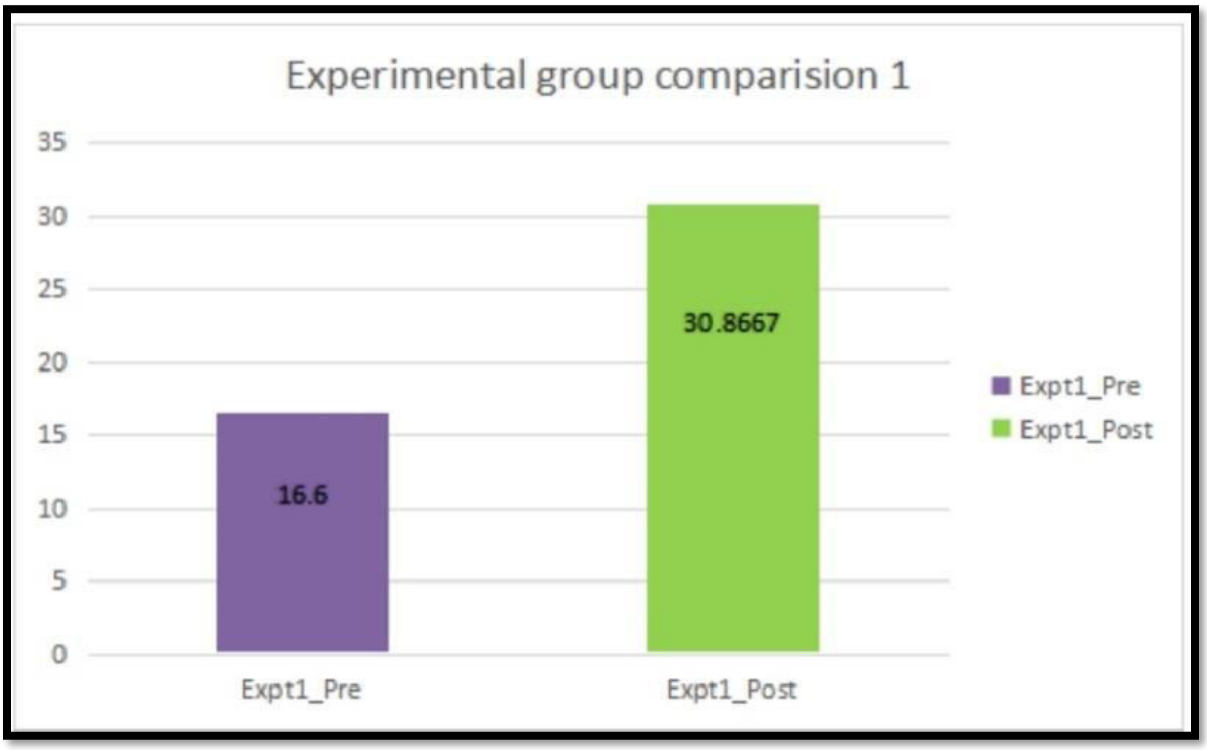


FIGURE 1: Comparison between pre-test and post-test of the control group

Table 2 : Comparison of Pre-Test And Post-Test of Fugl-Meyer Assessment Upper Extremity (Fma-Ue) Inexperimental Group

Test	Mean	S.D.	N	Z Value	p Value
Expt1-Pre	16.6	5.17963	15	-3.436	0.001
Expt1-Post	30.8667	5.69294	15		

Figure 2: Comparison between pre-test and post-test of the experimental group



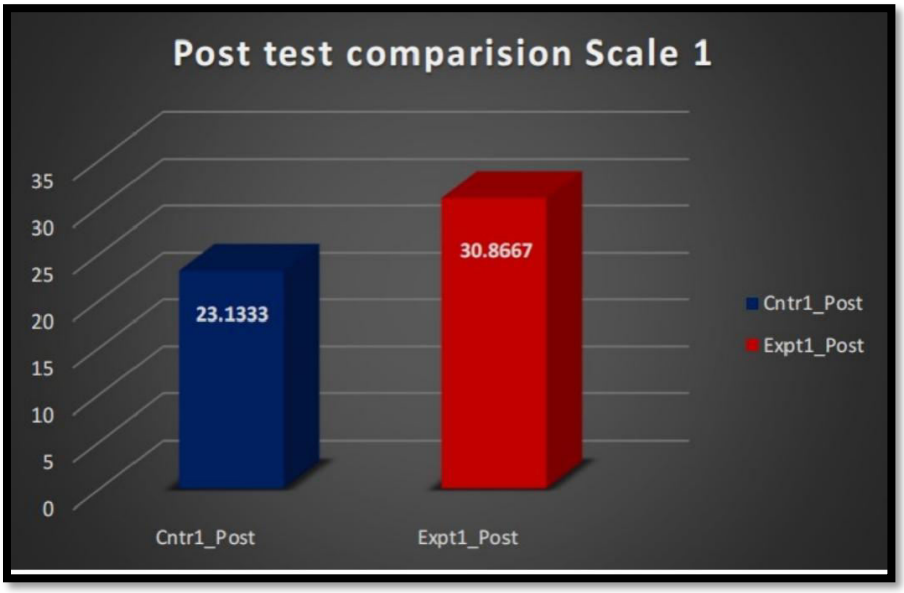
In the Experimental group, since the p value of 0.001 is less than 0.05, alternate hypothesis is accepted. Hence, there is statistically significant difference in Experimental Group between pre-test and post test scores of FMA. This suggests that the intervention received by the experimental group had significant improvement.

Since the p value of 0.002 is lesser than 0.05, alternate hypothesis is accepted. Hence, there is statistically significant difference in post test scores between Experimental and Control Group of the FMA. This suggests that the intervention received by the experimental group had more improvement when compared to the control group.

Table 3: Comparison of Post-Test Scores of Fugl-Meyer Assessment Upper Extremity (Fma Ue) in Control Group and Experimental Group

Group	Mean	S.D.	N	Z Value	p Value
Cntr1-Post	23.1333	8.17546	15	-3.007	0.002
Expt1-Post	30.8667	5.69294	15		

FIGURE 3: Comparison between post-test of control and experimental group



Discussion:

The present study aimed to assess the effect of Graded Motor Imagery in improving upper extremity functions for patients with acute and subacute stroke. A total of thirty stroke patients were selected based on the selection criteria described in the methodology and allocated to experimental and control group each of 15 samples using convenient sampling method. The study included both male and female patients. Screening test using MMSE was conducted to find patients with acute and subacute stroke with normal cognition of score greater than or equal to 24. The upper extremity functions level in both experimental group and control group was measured by Fugl-Meyer assessment upper extremity (FMA-UE). The experimental group alone underwent Graded Motor Imagery activities along with conventional Occupational Therapy interventions for a period of three months, 3 sessions per week with the duration of 40 mins per session, whereas the control group had not under gone any specific intervention except conventional occupational therapy. After a period of three months of intervention the post-test evaluation was done for both groups and the scores were calculated and results were analyzed. The effect of intervention was analysed by comparing the pre and post-test values of the experimental group. The results showed in table no. 4.1 and graph no. 4.1 (i.e.) the comparison of of Fugl-Meyer Assessment upper extremity FMA-UE scale between pre-test and post-test mean scores which is 17.2667 and 23.1333 and 'Z' value is -3.416 and 'p' value is 0.001 among the control group had statistically significant difference because of conventional occupational therapy intervention. The implication for occupational therapy was discussed in terms of improvement of upper extremity functions in stroke patients. The present study supported by Khader A. Alhmdavi. Et al., (2016). This was to validate the evidence within occupational therapy in improving upper extremity functions for stroke. In table no. 4.3 and graph no. 4.3 the results showed that Fugl-Meyer Assessment upper extremity FMA-UE scores between control group and experimental group in post- test. The mean value of control group is 23.1333 and mean value of experimental group is 30.8667 and 'Z' value is -3.007 and 'p' value is 0.002. This showed that there is statistically significant difference. This means that Graded Motor Imagery along with occupational therapy interventions results in a higher level improvement in upper extremity functions among persons with acute and subacute stroke than conventional occupational therapy as supported by previously published literature Khader A. Alhmdavi. Et al., (2016). The study's most clinically significant finding was that the participants were Enthusiastic and motivated to engage in the Graded Motor Imagery activities, furthermore there was significant improvement in the experimental group when compared with the control group in upper

extremity functions. Graded Motor Imagery appears promising as a rehabilitation technique for improving upper extremity functions among a variety of rehabilitation techniques. Although the findings from the studies are mostly positive for therapeutic and health benefits, more clinical trials are needed in order to assess Graded Motor Imagery as an effective therapeutic approach.

Conclusion:

The study was intended to study the effect of Graded Motor Imagery(GMI) in improving upper extremity functions for patients with acute and subacute stroke. The study was conducted for 36 sessions with an intervention period of 12 weeks. Thirty (30) samples were selected for this study, 15 samples in the control group, and 15 samples in the experimental group. Pre-test and Post-test were conducted in both groups. Pre and post-test were done for both groups using Fugl-Meyer Assessment upper extremity (FMA-UE). The experimental group underwent Graded Motor Imagery along with conventional occupational therapy whereas the control group received only conventional occupational therapy. The results showed that there was a significant improvement in the experimental group than the control group after receiving Graded Motor Imagery. Thus, this study proved the effect of Graded Motor Imagery in improving upper extremity functions for patients with acute and subacute stroke. The results of the present study indicated that Graded Motor Imagery can be a useful for stroke patients with poor upper extremity functions.

Conflict of Interest: The authors declare no conflict of interest

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Ethic Approval

This study was approved by the institution scientific review board (ISRB) of saveetha college of occupational therapy. (SCOT/ISRB/055/2023)

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