

# A Comparative Study to Analyze the Effectiveness of Repetitive Facilitation Exercises (RFE) and Mirror Therapy (MT) to Improve the Upper Limb Motor Function for Sub - Acute Stroke Hemiparesis

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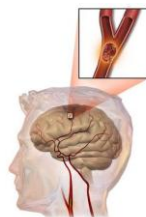
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**Abstract:** ***Background:** Stroke or Cerebrovascular accident [CVA] is a neurovascular disease commonly results from occlusion of the lumina of the cerebral vessels by a thrombus or embolus. **Purpose:** To analyse the effectiveness of Repetitive Facilitation Exercises and Mirror therapy to improve the upper limb functional ability in post stroke subacute hemiparetic patients. **Objective of the study:** This study is to compare the effectiveness of repetitive functional exercises (RFE) and Mirror Therapy (MT) on upper limb functional ability in patients with sub - acute stroke hemiparesis. **Methodology:** 30 patients with Subacute stroke hemiparesis were included in this study. They were grouped into A & B after the upper limb functional level testing with Wolf motor Function Test (WMFT). Group A received RFE with designed facilitation exercises and Group B received MT. The duration of each session for RFE was approximately 40 minutes for 3 days and MT was approximately for duration of 30 minutes for 3 days. The exercise program for Group A [RFE] and Group B [MT] was given for 6 weeks. The study duration was 6 months. The subject was evaluated, based on pre and post test scores. **Outcome measures:** - The outcome result was measured by using Wolf Motor Function Test [WMFT]. **Results:** The study revealed that Repetitive facilitation exercises exhibited statistically significant improvement in Barthel Index and Wolf Motor Function Test (WMFT) compared to Mirror Therapy exercise group. When comparing the pre and post test scores. **Conclusions:** It is concluded from the study that the Repetitive Facilitation exercises (RFE) on the upper limb muscles provide greater improvement in upper limb functional ability than the Mirror Therapy interventions.*

**Keywords:** Stroke, upper limb motor function, RFE, Mirror Therapy, ADL, Barthel Index, WMFT

## 1. Introduction

Stroke or Cerebrovascular accident [CVA] is a global epidemic neurovascular disease commonly results from occlusion of the lumina of the cerebral vessels by a thrombus or embolus. As per WHO definition Stroke is defined as "rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, no apparent cause other than that of vascular origin. The paretic upper limb is a common and undesirable consequence of stroke that increases activity limitation Stroke is broadly classified into two types: ischemic and hemorrhagic. Stroke has become the fifth leading cause of death in 2016 from 12th cause in 1996 and claims 119 - 145 lives in every 100, 000 population, which is almost a 100 percent increase. Every year, 1.8 million people suffer stroke in India, also contributed to 41% of deaths and 72% of disability adjusted life years amongst the non - communicable diseases (ICMR 2004).



After stroke, physiotherapy can promote brain reorganization and motor recovery with numerous physiotherapy interventions.

**The repetitive facilitation exercise (RFEs)** using novel facilitation methods for the upper limb and finger, give sufficient physical stimulation, such as by the stretch reflex or skin muscle reflex that is elicited immediately before or at the same time as when the patient makes an effort to move his hemiplegic hand or finger, in order to elevate the level of excitation of the corresponding injured descending motor tracts and it allows the patient to initiate movements of the hemiplegic hand or finger in response to his intension of functional recovery of the hemiplegic upper limb and hand might depend on the repetition of voluntary movements elicited by the RFE, especially when they are influenced by a synergistic pattern.

**Mirror therapy** is a relatively new therapeutic intervention which is simple, inexpensive and most importantly patient directed treatment that focuses on moving the unaffected limb. Mirror therapy was first introduced by Ramachandran and Roger Ramachandran to treat phantom limb pain after amputation. Mirror therapy functions through a process known as mirror visual feedback wherein the movement of one limb is perceived as movement from the other limb.

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The principle of mirror therapy (MT) is use of a mirror to create a **reflective illusion** of an affected limb in order to trick the brain into thinking movement has occurred without pain. It involves placing the affected limb behind a mirror, which is sighted to the reflection of the opposing limb, appears in placing of the hidden limb

### Outcome Measurement Tools

#### Barthel Index:

The Barthel Index (BI) was developed in 1955 as a simple index of independence to score the ability of a patient with a neuromuscular or musculoskeletal disorder to care self, and by repeating the test periodically, to assess improvement. The Barthel Index (BI) measures the extent to which somebody can function independently and has mobility in their activities of daily living (ADL) i. e. feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation and stair climbing. The index also indicates the need for assistance in care. The BI is a widely used measure of functional disability. The index was developed for use in rehabilitation patients with stroke and other neuromuscular or musculoskeletal disorders, but may also be used for oncology patients.

#### The Wolf Motor Function Test (WMFT):

The Wolf Motor Function Test (WMFT) quantifies upper extremity (UE) motor ability through timed and functional tasks. It is a quantitative index of upper extremity motor ability examination through the use of timed and functional tasks. The WMFT has been used for assessing the motor status of higher functioning chronic patients with stroke and traumatic brain injury solely for upper extremity motor deficiency. The original version of the WMFT was developed by Wolf, Lecraw, Barton, and Jann in 1989 to examine the effects of constraint - induced movement therapy in clients with mild to moderate stroke and traumatic brain injury.

## 2. Materials and Methodology

- **Study design:** It is a prospective randomized experimental study without any control group.
- **Study Setting:** The study was conducted in the outpatient department of Cherraan's College of Physiotherapy, Coimbatore, Tamilnadu.
- **Study Population:** Sub acute stroke hemiparesis were selected for this study.
- **Sample Size:** 30 subjects were selected in this study and divided into 15 in each groups.
- **Sampling Method:** Conventional sampling method
- **Study Duration:** The study was conducted for a period of 6 months
- **Treatment Duration:** The treatment duration of this study was conducted for a period of 6 Weeks.
- **Inclusion Criteria:** 40 - 60 years old, both male and female with hemiparetic upper extremity weakness.
- **Exclusion Criteria:** Subjects with patient having history of trauma, surgery, any orthopedic deformity
- & acute infections

### Outcome measurement tools:

- **Barthel Index:** The Barthel Index is a scale that measures disability or dependence in activities of daily living (ADL) in stroke patients.
- **The Wolf Motor Function Test:** The Wolf Motor Function Test (WMFT) assesses motor function in adults with hemiplegia due to stroke or traumatic brain injury.

## 3. Procedure

#### Group A (n= 15): Repetitive facilitation Exercises:

The RFE, the therapist use muscle spindle stretching program and skin generated reflex to assist patients effort and move affected joint after doing pre test of the patients with Barthel index and wolf motor function test the patients are grouped as group A where they are treated with RFE program. The duration of RFE program is per session 40 minutes. The RFE was done 3 session per week for 6 weeks. The eight new facilitation for the hemiplegic upper limb and fingers were applied as below.

- 1) **Shoulder flexion with 90° elbow flexion in the supine position.** The patients were instructed to 'Flex' the patient attempted to flex the hemiplegic shoulder. To facilitate shoulder flexion anterior part of the deltoid muscle tapped with fingers and then pushed on the humeral head to avoid impingement in the shoulder.
- 2) **Shoulder horizontal extension/flexion with elbow flexion in the supine position.** The patients were instructed to 'Extend' or 'Flex' the patient attempted to extend or flex his shoulder, respectively. To facilitate shoulder horizontal extension/flexion, rapid stretching and rubbing of the deltoid muscle were applied.
- 3) **Shoulder flexion/adduction/external rotation with flexion of the elbow** and forearm supination accompanied by wrist flexion, finger flexion and shoulder extension/abduction/ internal rotation while extending the elbow and pronating the forearm accompanied by wrist dorsiflexion and finger extension in the supine position (two middle columns; modied PNF). The patients were instructed to 'Hold therapist hand and carry it to the top of their head', the patient attempted to perform this movement, which involves shoulder flexion/ adduction/external rotation. When the patients instructed to, 'Extend your fingers and push therapist hand to the side of your torso', the patient attempted to perform this movement, which involves shoulder extension/abduction/ internal rotation. To facilitate the movements, tapping, rubbing and rapid stretching of the muscles were applied by the therapist.
- 4) **Shoulder flexion/abduction/external rotation with elbow extension** accompanied by wrist dorsiflexion and finger extension (modied PNF). When the patient instructed to, 'Raise your hand over your head as if you were wiping your face with your forearm', the patient attempted to perform the movement, which involves shoulder flexion/abduction/external rotation. The patient's upper limb was hold in a posture of shoulder extension/ adduction/ internal rotation, elbow extension and forearm pronation. The therapist then quickly pulled the patient's upper limb to achieve shoulder extension/adduction/ internal rotation and tapped and rubbed the inside of the deltoid muscle using his fingers

to elicit shoulder flexion, while his thumb provided resistance to facilitate the shoulder external rotation.

- 5) **Forearm supination/pronation with 90° elbow flexion in the sitting position** (right column). When the therapist said ‘Turn your hand (palm) upward’, the patient attempted to perform forearm supination and when the therapist said, ‘Turn your hand (palm) downward’, the patient attempted to perform forearm pronation. To facilitate the movements, tapping, rubbing and rapid stretching of the muscles were applied by the therapist.
- 6) **Wrist dorsiflexion and forearm pronation with extension of the fingers in the supine position.** The patients instructed to ‘Turn forearm as if fanning wind to face with the back of hand’ or ‘Turn forearm and hand as if fanning wind to face with the back of your hand’, the patient attempted to perform wrist dorsiflexion and forearm pronation. The therapist held the abductor pollicis brevis in his hand and held fingers two - to - five in the wrist flexion position using the second and third fingers of his other hand. To facilitate forearm pronation and wrist extension with finger extension, holding the abductor pollicis brevis, fingers pulled quickly, forearm supinated and tapped the ulnar side of the dorsal hand using the thumb.
- 7) **Finger extension with wrist flexion in the supine position.** When the therapist said ‘Extend’, the patient attempted to extend his finger. This exercise was performed by each of the five fingers of the hemiplegic hand (right, and upper and middle rows). To facilitate isolated volar abduction of the thumb, taping, rubbing and rapid stretching of the muscles were applied by the therapist.
- 8) **Finger extension /flexion with wrist flexion in sitting position:** when the therapist said ‘ flex your fingers’ the patient attempts to flex his finger and therapist said’ extend your finger’ the patient attempts to extend his finger. To facilitate isolated finger flexion and extension tapping, rubbing, rapid stretching of the muscle and slight resistance against finger movement were applied by the therapist.



**Group B (n=15):**

**Mirror Therapy**

In mirror therapy after checking Barthel Index score and Wolf Motor Function Test (WMFT) scales, the patient was seated close to a table in which a mirror (33\*35 cm) was placed vertically. A 30 minute mirror box training session was performed. The Mirror therapy patients were treated in 3 sessions per week for 6 weeks duration. They seated on a chair close to a table on which a mirror box was placed vertically. The involved hand was placed behind the mirror and uninvolved in front of the mirror.

The patients were asked to perform forearm supination - pronation, wrist flexion - extension, finger flexion - extension, abduction, adduction, opposition movements on the paretic side while the patients looked into the mirror watching the image of their non - involved hand thereby the patients see the reaction of the hand movement projected over the involved hand. The patients were instructed to do the same movement with the paretic hand simultaneously. After completion of 6 weeks treatment protocol, posttest assessment was performed.

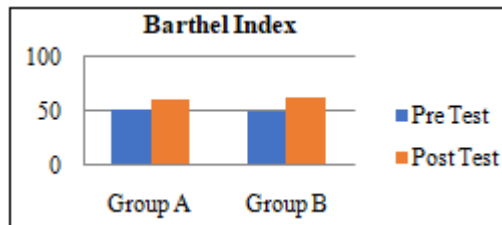


**4. Data Analysis and Interpretation**

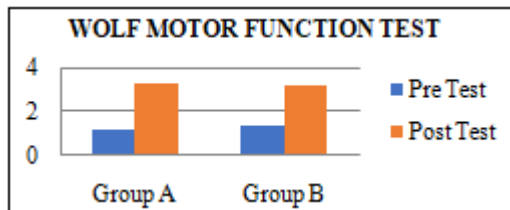
The statistical analysis used in this study was paired “t” test.

The improvement in the functional activity and participation was measured using activity motion scale and functional movement score before and after treatment. Paired “t” test was performed to analyze the level of significance of the study

Group	N	Pre test score		Post test score		MD	SD	‘t’ value
		Pre Test	Pretest mean	Post Test	Posttest mean			
A	15	770	51.3	985	61.7	10.4	3.72	14.92
B	15	750	50	950	63.3	13.33	3.68	14.03



Group	N	Pretest score		Posttest score		M D	SD	't' value
		Pre test	Pretest mean	Posttest	Posttest mean			
A	15	17.64	1.18	48.4	3.23	2.52	0.31	25.61
B	15	20.44	1.36	47.63	3.18	1.82	0.30	23.10



## 5. Results

Repetitive Facilitation Exercise is a new and effective facilitator techniques applied by physiotherapist in treating the Stroke paralysis patients. It facilitates movement strategy and helps to recover the upper limb function. Also Mirror therapy is applied in impaired hand functioning for Sub acute hemiparesis & they also help to restore normal functioning of upper extremity. MT helps to stimulate neuroplasticity of the different brain regions for movement, sensation, and pain. However, RFE technique aims to improve function, improve muscular recruitment & also increase proprioception stimulation enhancing static & dynamic neuro - muscular retraining by balancing the tissue length/tension relationship & motor control. The 30 subjects selected for this study at the age of 40 - 60 years includes male and female and excluding severe hand impairments or any permanent deformity. The treatment sessions were scheduled for 3 days in a week with 6 weeks programme. Before initiating the treatment the pre - test values of BI and WMFT - upper limb functional movement scale values were measured. The paired 't' test was used to analyse the pre - test and post - test values of Barthel Index of Group A (RFE) & Group B (MT) with WMFT of Group A (RFE) and Group B (MT). Based on the statistical analysis, the result of present study shows that there is a significant improvement in functional activity in affected upper extremity of Sub acute Stroke hemiparesis on both groups with significant increase in Group A treated with RFE. Hence, the result of this study was concluded that Repetitive facilitation exercise was effective than Mirror Therapy in improving Upper limb functional abilities of Sub acute Stroke Hemiparesis.

## 6. Discussion

Stroke incidence in India is higher (194 - 215 per 100, 000 populations) in rural areas as compared to the national average (119 - 145 per 100, 000 populations). Exclusive physiotherapy strategies have been developed to improve functional recovery in patients with a upper limb disabilities such as, Brain stimulation techniques, Bilateral training,

Brainstorm approach, Bobath approach, Constraint - induced movement therapy, Computerized arm training, Electromyography biofeedback, Electromyography - EMG initiated electrical stimulation, early and repetitive sensorimotor stimulation of the arm, functional electrical stimulation, Mental practice, Mirror therapy, Virtual reality, Robotics, and repetitive task training, trans cranial magnetic stimulation and thermal intervention for the hemiplegic upper limb to facilitate sensory and motor recovery. However, Repetitive facilitation exercises and Mirror Therapy are found to be effective and providing long term recovery and motor function gain to the patients. In our series of 30 patients with Subacute Stroke hemiparesis, RFE was found to be beneficial therapeutic technique to improve upper limb functional activities than mirror therapy program (Kazumi Kawahira - 2010) The present study shows that, the statistical analysis of the pre and post test score were calculated in two scales, which are activities of daily living (ADL) and functional movement scale for Group A & B. The both scale data analysis that the mean values of the Barthel Index scale was 14.33 (RFE - Group A) & 13.33 (MT - Group B) and standard deviation were 3.72 (Group A) & 3.68 (Group B) and  $p < 0.005$ . The mean values of Barthel Index outcome measurement 2.05 (RFE - Group A) & 1.81 (MT - Group B) and standard deviation were 0.31 (Group A) & 0.30 (Group B) and  $p < 0.005$ . This study showed that there is a significant change in Subacute Stroke Hemiparesis with their upper limb functional ability level. However, further scope of this study to analyze the effectiveness of RFE and MT to improve upper limb motor abilities in chronic stroke paralytic patients can be done.

## 7. Conclusion

Here we concluded in this study that the effectiveness of Repetitive Facilitation Exercises (RFE) was effective than Mirror Therapy (MT) in Sub acute Stroke Hemiparesis. The effectiveness of RFE and MT were assessed by pre and post test score and the analysis of the data showed that "there is a significant improvement in post test score" which shows increased upper limb functional ability of Sub acute Stroke Hemiparesis.

## 8. Limitation and Recommendation

- A large sample is required to make the study more Reliable.
- Time bound study.
- Only 40 - 50 years were selected.
- Only Sub acute Stroke Hemiparesis patients were selected.
- Young Stroke subjects can be studied.
- Large size of sample can be included.
- To make the result more valid a long - term study may be carried out.
- Similar study can be done with other conditions such as Stroke with hemiplegia, monoplegia and cerebral palsy patients.
- Further studies can be conducted by comparing any manual therapy and electrotherapy modalities like neuromuscular electrical stimulation.

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