

Effectiveness of mirror therapy with conventional therapy versus conventional therapy alone to improve functional activity of upper extremity in chronic stroke patients: Comparative Study

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ABSTRACT

To study the effectiveness of mirror therapy with conventional therapy versus conventional therapy alone on upper limb activities in chronic stroke patients, thirty chronic stroke patients with upper limb involvement were randomly selected according to inclusion and exclusion criteria and were divided into two groups – Group A and Group B. Both the groups were assessed for the upper limb functional status using Fugl Meyer assessment – upper extremity and upper limb motor assessment using Motor assessment scale – upper limb. These parameters were assessed before the start of the program as pre-test values and at the end of 12 week as post-test values. Group A received mirror therapy with conventional therapy and Group B conventional therapy alone. The mean age of group A was 59.20 years and group B was 59.80 years. The statistical analysis correlates the study by proposing that groups taken for study either group A and B showed significant effect in improvement in upper limb functions of chronic stroke patients. The group A had higher significance when compared to group B. The mean improvement in upper limb function scores of FMA-UE was 29.20 and 16.53 in group A and B, respectively. The mean improvement in motor assessment measured by MAS-UL was 14.73 and 10.07 in group A and B, respectively. It was resulted that mirror therapy with conventional therapy had a superior effect over conventional therapy alone. This study concluded that mirror therapy with conventional therapy had effective technique in improving upper limb functions in chronic stroke patients.

KEY WORDS: Stroke, upper limb function, Mirror therapy, Conventional therapy

INTRODUCTION

Stroke is one of the major cause of death and disability in adults worldwide.¹ The majority of survivors show some degree of recovery but more than 50% still present with some sensory and motor deficits and only 30% of these patients can return to work during the first year post-stroke.² Stroke affects postural and functional movements, paresis is present in hemibody or one side of upper and lower limbs. More than 80% of survivors have paresis of upper limb and 30 to 60% of these patients cannot use the paretic upper limb which compromises their independent and quality life.^{3,4}

A stroke is the disturbance in blood supply, when blood vessel ruptured or blocked by a clot, which cuts off the oxygen supply and nutrients to the brain, causing damage to the brain tissue. Stroke is a clinical syndrome divided into two broad classifications such as ischemic stroke which is caused by sudden occlusion of arteries supplying the brain, either due to a thrombus at the site of occlusion or formed in another part of the circulation. It accounts for 50% to 85% of all strokes worldwide. A haemorrhagic stroke occurs due to injury to a blood vessel wall and formation of clot. It accounts for 15% of all strokes worldwide.⁵

Stroke is due to upper motor neuron lesion and is characterized by the motor paralysis or paresis, perceptual problems, altered balance, cranial nerve problems, reflex sympathetic dystrophy, shoulder subluxation, gait problems and spasticity.⁶

Stroke was the second most frequent cause of death after heart diseases, accounting for 6.4 million deaths, in which ischemic stroke resulted in 3.3 million deaths and hemorrhagic stroke resulted in 3.2 million deaths. Almost half of the stroke patients live less than one year and two thirds of strokes occurred in those over 65 years old. Worldwide stroke is the fourth leading cause of disability. According to the WHO, each year 15 million people worldwide suffer from stroke. In that nearly 5 million people die and another 5 million people are left permanently disabled. It forecasts that disability-adjusted life years lost to stroke, will rise from 38 million in 1990 to 61 million in 2020. The prevalence of new or recurrent stroke is nearly 750,000 in each year and above 4 million is living with the residual effects of stroke which includes paralysis and disability.⁷

In India, stroke is one of the leading causes of death and disability. The prevalence rate ranges from 84-262/100,000 in rural areas and 334-424/100,000 in urban areas. Stroke signified 1.2% of total deaths in India.⁸

Stroke risk increases with various risk factors such as age, sex, race, family history, hypertension, extreme alcohol consumption, smoking, tobacco, lack of physical exercise, obesity, high blood cholesterol level, diabetes mellitus, earlier TIA and heart diseases. The aged population has less chance of recovering from paralysis and disability; males are more at risk than females and ratio in India is 7:1. The prevalence of stroke among men may be due to smoking and drinking as well as higher among menopausal women in India.^{9,10}

The stroke cause sudden death depends on the site and severity of brain injury. The common symptoms are sudden weakness or numbness, confusion, aphasia, dysphasia, dysarthria, vision changes, altered motor function and unconsciousness. In worldwide, almost 85% of stroke survivors experience upper extremity hemiparesis immediately after stroke and between 55% and 75% of survivors continue to experience upper extremity functional limitations and diminished quality of life. Treatment to recover from lost function is called stroke rehabilitation and ideally takes place in a stroke rehabilitation units through the interdisciplinary team.¹¹

At least 85% of stroke patients experience hemiplegia and upper extremity function of at least 69% of patients is damaged. Hemiplegia damage to the upper extremity functions has critical effects on the ability to perform independent activities of daily living. Rehabilitation programs are different in worldwide that most commonly, certain types like inpatient rehabilitation centres with acute care facilities, outpatient & home rehabilitation. In those rehabilitation programs they practice mobility, communication, ADLs and normal bowel and bladder patterns.^{12,13}

While it is clear that a decreased motor capacity of the paretic arm influences the use of both extremities, the exact changes in upper limb use following stroke are not yet fully understood. Regarding the paretic upper-extremity, many studies have shown that there is no 1-on-1 relationship between motor impairment and functional use.¹⁴ This may be related to the phenomenon of learned non-use, which describes how patients will have 'learned' not to use the paretic side to its full capacity. Brain injury causes structural damage to motor pathways as well as

depression of neural excitability near the lesion. Decreasing activity of the upper-extremity leads to a further reduction in excitability and as such starts a vicious circle of decreasing excitability and decreasing activity.^{15,16}

Traditional rehabilitation programs for improving functional use of the arm, commonly used are compensatory strategies, splinting, task oriented practice strategies, constraint induced movement therapy, electro-myography (EMG) biofeedback, acupuncture, strengthening exercises and various approaches like neuro-developmental therapy (NDT), proprioceptive neuro-muscular facilitation (PNF), Rood's approach, Brunnstrom approach, Vojta approach. There are now multiple approaches, many relating to brain plasticity, including: (a) Use of a body part enhances its function, for example, by constraint-induced movement therapy, neuromuscular electrical stimulation (NMES), Robot aided movement therapy and virtual reality. (b) The ipsilateral hemisphere can contribute to motor control; bilateral, symmetrical arm movement training may help on this basis. (c) Sensory stimulation enhances plasticity. It can be given through transcutaneous electrical stimulation or acupuncture. (d) Reduction of inhibition enhances plasticity. This has been demonstrated to be useful for rehabilitation utilizing transient deafferentation. (e) Many pharmacological agents can induce plasticity.^{14,15,16,17}

Mirror therapy is a simple non-invasive technique for the treatment of hemiparesis after stroke. Visual feedback is supposed to be used to match and recalibrate proprioceptive sensory informations or input that may be impaired to stroke.¹¹

Mirror therapy is relatively new therapeutic intervention for stroke patients. It is a simple, inexpensive and, most importantly, patient directed treatment that may improve upper-extremity function. It involves performing movements of unimpaired limb while watching its mirror reflection superimposed over the (unseen) impaired limb (motor imagery). It creates a visual illusion of enhanced movement capability of the impaired limb.¹⁸

Mirror therapy is an example of a priming technique designed by Ramachandran et al., mirror therapy was originally developed to diminish phantom limb pain in amputees. In 1999, Altschuler et al. introduced mirror therapy for improving motor function of the arm and hand following stroke and showed that motor performance of chronic stroke patients improved. Although several additional studies were small and often not well controlled, recent, high-quality, randomized controlled trials have also reported mirror therapy to improve motor function in patients with

subacute and chronic stroke. However, despite the encouraging clinical results, little is known about the underlying mechanisms of mirror therapy.¹⁹

While the influence of mirror therapy at the level of brain organization and plasticity is not well-established, on the other end of the spectrum, i.e. at the level of translation of functional improvement towards daily life improvement, we also still have a lot to learn. It is important to realize that motor recovery following stroke does not stop at the level of motor function, but that improvements have to translate to improved actual use of extremity in daily life in order to be beneficial to the patients.²⁰

Presumably, different working mechanisms are behind the effects of mirror therapy on pain and motor symptoms. For the latter category, the focus of the current study, a number of mechanisms have been proposed. Ramachandran²¹ originally hypothesized that paralysis following stroke might have a 'learnt' component, which could possibly be 'unlearnt' by means of the mirror illusion.

Previous research has shown that mirror therapy can improve the motor function of acute and sub-acute stroke patients with mild to moderate impairment. Moreover, interventions involving stroke survivors with upper limb paresis have been shown to provide limited motor improvement in the acute or sub-acute phase. However, no previous research has described the effects of mirror therapy in chronic stroke patients with impaired upper limb function. Therefore, present study was conducted to evaluate the comparative effectiveness of mirror therapy with conventional therapy and conventional therapy alone on functional activities of upper extremity in chronic stroke patients.

METHODOLOGY

Comparative study in which 30 chronic stroke patients with of upper limb functional involvement were selected with simple randomization on the basis of inclusion and exclusion criteria and duration of the study was 12 weeks , in which treatment was given for Six days for 1 hours

i. INCLUSION CRITERIA:

- ❖ Patients with chronic stroke duration between 6 months to 2 years.
- ❖ Age group: 40-75years.
- ❖ Only male patients.

- ❖ Patients with right or left upper extremity hemiparesis.
- ❖ Patients who have 10 degree active wrist extension, 10 degree active thumb abduction and 10 degree active extension of any two digits of affected hand.

ii. EXCLUSION CRITERIA:

- ❖ Post stroke hemiparesis patients with cognitive disturbances.
- ❖ Chronic spastic hemiplegic patients.
- ❖ Age above 75 years and below 40 years.
- ❖ Hemiplegia or hemiparesis due to head injury.
- ❖ Any musculoskeletal condition of upper limb.
- ❖ Psychosomatic patients.
- ❖ Visual and hearing problem

2. OUTCOME MEASURES:

1. Fugl Meyer Assessment – Upper Extremity (FMA-UE)

2. Motor Assessment Scale – Upper Limb (MAS-UL)

3. DATA COLLECTION AND ANALYSIS

The pre, mid and Post test data was collected with regard to parameters under study were tabulated and statistically analyzed using paired and unpaired ‘t’ test for interpretation of the results. The differences in the means was compared by Least Significant Differences (LSD) at 5 per cent level ($P < 0.05$).

PROCEDURE

Thirty chronic stroke patients was randomly selected according to inclusion and exclusion criteria and divided into two groups – Group A: experimental group and Group B: control group. The nature and duration of the study was explained to all the participants and written consent will be obtained from each participant. The demographic and clinical data were collected from each participant. Pre-test level of upper extremity function was assessed through Fugl meyer assessment scale – Upper extremity and Motor Assessment Scale – Upper Limb with observation checklist, among interventional group on first day of the study. Mirror therapy and conventional therapy was demonstrated to group A and conventional therapy was

demonstrated to group B. Participants of both the groups were practiced the techniques six days per week for twelve weeks. Post-test data was collected at the end of 12th week.

INTERVENTION:

In present study, Group A treated with mirror therapy with conventional therapy and Group B treated with conventional therapy. Participants of both the groups were received the selected treatment for 12 weeks.

TREATMENT PARAMETERS:

Duration of treatment: One hours per day

Frequency of treatment: Six days per week.

TECHNIQUES:

Group A: Mirror therapy with conventional therapy

The group A ie. Experimental group was treated with mirror therapy with conventional therapy.

1. Mirror therapy²⁴:

Patient should be in front of mirror for two hours and practiced the following exercises by affected upper extremity:

i. Range of motion exercises:

- Flexion and extension of shoulder
- Abduction and adduction of shoulder
- External and internal rotation of shoulder
- Flexion and extension of the elbow
- Supination and pronation of forearm
- Flexion and extension of the wrist
- Ulnar and radial deviation of the wrist
- Circumduction of the wrist
- Flexion and extension of thumb and fingers

- Abduction and adduction of thumb and fingers



Plate 1: Upper limb activities in front of mirror

ii. Task or Activities²⁵:

- Squeeze and release the fist
- Open and close the hand
- Tap the fingers on the table
- Touch each finger to the thumb one by one
- With the hand closed, try to lift each finger and thumb
- Handle objects using different types of grips, for example, make small balls of theraplast or modeling clay with the fingers, turn a cylindrical object in the hand (complex rotation), pick up beads or paper clips, put clothes pegs on the lip of a mug, insert pegs in a board, etc.
- Grasp and release objects with different textures (balls, sponges, etc.)
- Pick up and move various objects (balls, sticks, cubes, mug, glass, etc.) in different directions, for example, move an object following a sequence of movements forming a square or an 'X', put a ball in a glass and take it out, lift a glass, lift a rectangular object, place beads or pegs in a container with a small opening, insert pegs in holes in a piece of wood, transfer grains of rice from one pot to another, manipulate rings, etc.
- Turn over playing cards
- Color, connect the dots to make a drawing, copy shapes on a piece of paper
- Handle utensils

- Wipe, clean and dust the table with cloths with different textures (scouring pad, soft sponge, silk cloth, etc.)



Plate 2: Hand functions in front of mirror

2. Conventional Therapy:

i. Range of motion exercises²⁶:

- Flexion and extension of shoulder
- Abduction and adduction of shoulder
- External and internal rotation of shoulder
- Flexion and extension of the elbow
- Supination and pronation of forearm
- Flexion and extension of the wrist
- Ulnar and radial deviation of the wrist
- Circumduction of the wrist
- Flexion and extension of thumb and fingers
- Abduction and adduction of thumb and fingers



Plate 3: Range of motion exercise of upper limb

ii. Stretching Exercises²⁶:

- Stretching of shoulder and arm muscles
- Stretching of forearm, wrist and hand muscles.



Plate 4: Stretching of upper limb muscles

iii. Strengthening Exercises²⁴:

- Strengthening of shoulder and arm muscles
- Strengthening of forearm, wrist and hand muscles

iv. Cryotherapy²⁷:

- Cryotherapy to reduce spasticity of shoulder, arm, forearm, wrist and hand muscles.

Group B: Conventional therapy

The group B ie. control group was treated with Conventional therapy. The following exercises were given as conventional therapy:

i. Range of motion exercises²⁶:

- Flexion and extension of shoulder
- Abduction and adduction of shoulder
- External and internal rotation of shoulder
- Flexion and extension of the elbow
- Supination and pronation of forearm
- Flexion and extension of the wrist
- Ulnar and radial deviation of the wrist
- Circumduction of the wrist

- Flexion and extension of thumb and fingers
- Abduction and adduction of thumb and fingers

ii. Cryotherapy²⁷:

- Cryotherapy to reduce spasticity of shoulder, arm, forearm, wrist and hand muscles.

iii. Stretching Exercises²⁶:

- Stretching of shoulder and arm muscles
- Stretching of forearm, wrist and hand muscles.

DATA ANALYSIS

In present study, the two groups were compared for the significant difference to Effectiveness of mirror therapy with conventional therapy and conventional therapy alone to improve functional activity of upper extremity in chronic stroke patients. The statistical tools used for analysis were paired and unpaired “t” test. The differences between pre - test and post – test values were found. The data was collected at beginning, at six week and at the end of twelve weeks. The mean difference of FMA-UE and MAS-UL of group A were compared with group B and the actual pattern of variation were observed. With the ‘t’ value from the pre-test and post-test, the accurate level of significance was analyzed and interpreted. An alpha level of $p < 0.05$ was the level of significance for the test. Paired ‘t’ test was performed to analyze the efficacy of treatment within the groups and unpaired ‘t’ test was performed to analyze the efficacy of treatment between both groups.

Arithmetic Mean³⁰:

The mean of the value was calculated using the formula given below:

$$\bar{X} = \frac{\sum x}{N}$$

Where,

X = Arithmetic Mean

$\sum x$ = Sum of all variables

N = Total number of variables

PAIRED ‘t’ TEST WITHIN GROUP^{30,31}:

The paired ‘t’ test was used to find out the significance within the same group with the values of parameters considered for the study.

The formula to find the value of ‘t’ using paired ‘t’ test:

$$t = \frac{[M1-M2]}{SEMd}$$

Where,

$$M1 = \text{Mean 1}$$

$$M2 = \text{Mean 2}$$

$$SEMd = \text{Standard Error of Mean difference}$$

$$SEMd = \sqrt{SEM1^2 + SEM2^2 - 2r SEM1 SEM2}$$

r = correlation between Group A and Group B

$$df = N - 1$$

UNPAIRED ‘t’ TEST BETWEEN GROUP^{30,31}:

The ‘t’ test was used to find out the significance between the groups and it gives the valuable information regarding this study.

The formula to find the value of ‘t’ using unpaired ‘t’ test for Group A v/s Group B:

$$t = \frac{[M1-M2]}{SEMd}$$

Where,

$$M1 = \text{Mean 1}$$

$$M2 = \text{Mean 2}$$

$$SEMd = \text{Standard Error of Mean difference}$$

$$SEMd = \sqrt{SEM1^2 + SEM2^2}$$

$$SEM1 = \frac{\sigma_1}{\sqrt{N_1}}$$

$$SEM2 = \frac{\sigma_2}{\sqrt{N_2}}$$

$$df = N_1 + N_2 - 2$$

Where,

- σ = Standard Deviation
- SEM = Standard Error of Mean
- SEMd = Standard Error of Mean difference
- M = Mean

RESULT AND DATA INTERPRETATION

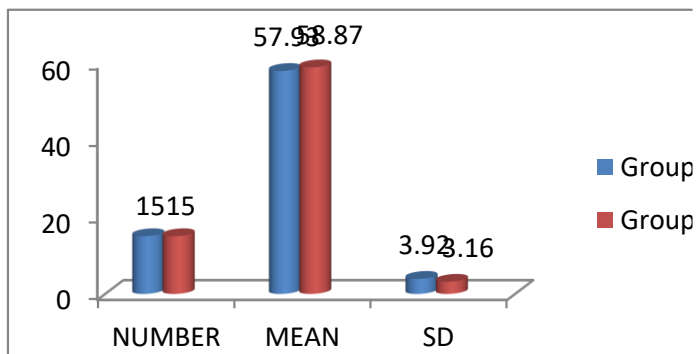
The present study was carried out to compare effectiveness of mirror therapy with conventional therapy versus conventional therapy alone to improve functional activity of upper extremity in chronic stroke patients. The level of upper limb functions and motor assessment was assessed by Fugl Meyer Assessment – Upper Extremity and Motor Assessment Scale – Upper Limb, respectively.

1. DESCRIPTIVE PRESENTATION OF AGE IN GROUPS:

TABLE:1

GROUPS	NUMBER	AGE IN YEARS	
		MEAN±SEM	SD
Group A	15	59.20±2.18	8.436
Group B	15	59.80±2.02	7.830
Total	30	59.50±1.46	8.003

GRAPH: 1



INTERPRETATION:

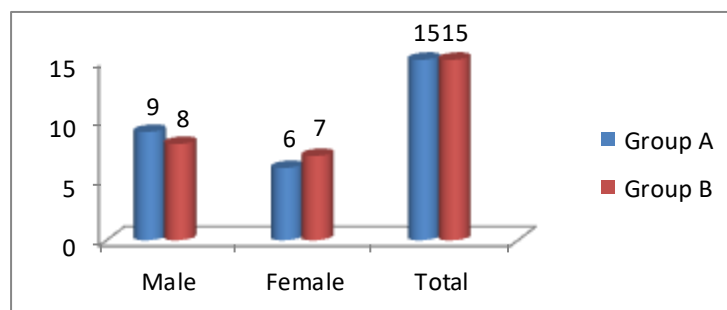
Above table shows that group A had a mean age of 59.20 years and group B had a mean age of 59.80 years. The mean age of total 30 patients was 59.50 years.

2. GENDER DISTRIBUTION IN GROUPS:

TABLE: 2

Gender	GROUP A		GROUP B		TOTAL
	NUMBER	%	NUMBER	%	
Male	9	60.00%	8	53.33%	17
Female	6	40.00%	7	46.67%	13
Total	15	100.00%	15	100.00%	30

GRAPH: 2



INTERPRETATION:

Above table shows that group A had 9 (60%) male and 6 (40%) female patients, out of 15 patients, there are 8 (45.5%) male and 7 (54.5%) female patients, out of total 15 patients in group B.

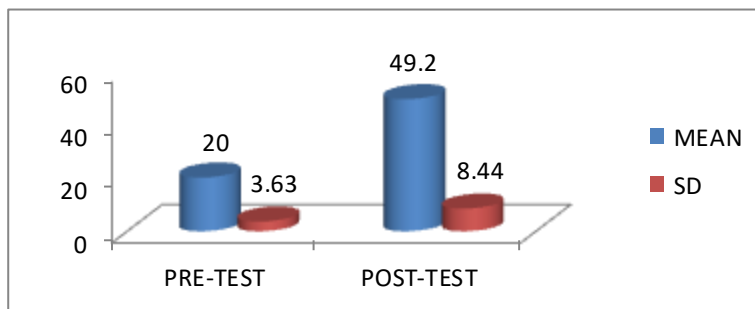
3. ANALYSIS OF PRE-TEST AND POST-TEST VALUES OF FUGL MEYER ASSESSMENT – UPPER EXTREMITY (FMA-UE) WITHIN GROUP A:

TABLE: 3

	Mean	N	SD	Std. Error Mean	R	Mean Diff	T	P
Pre-test	20.00	15	3.63	0.94	0.9202	29.2	21.361	<0.0001*
Post-test	49.20	15	8.44	2.18				

* Significant difference (P<0.05)

GRAPH: 3



INTERPRETATION:

The above table shows the mean of pre-test and post – test values were 20.00 and 49.20, respectively. The mean improvement in motor arm function of Group A was 29.2. The ‘t’ value 21.361 and ‘P’ value <0.0001 for upper extremity motor function scores using FMA-UE within Group A analysis. When compared to table value, the above ‘P’ value is lesser at P<0.05, which is highly significant. The result of the study indicates that Group A treated with Mirror Therapy (MT) with Conventional Therapy (CT) had significant improvement in upper extremity motor functions within Group A.

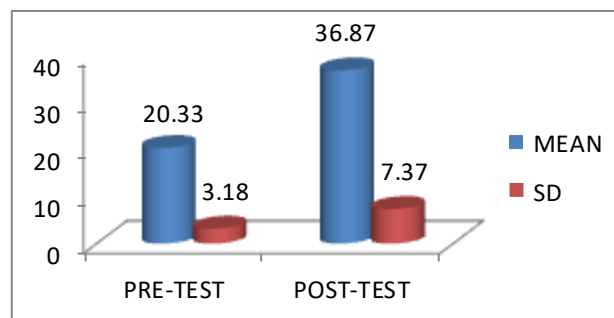
4. ANALYSIS OF PRE-TEST AND POST-TEST VALUES OF FUGL MEYER ASSESSMENT – UPPER EXTREMITY (FMA-UE) WITHIN GROUP B:

TABLE: 4

	Mean	N	SD	Std. Error Mean	R	Mean Diff	T	P
Pre-test	20.33	15	3.18	0.82	0.8321	16.53	12.703	<0.0001*
Post-test	36.87	15	7.37	1.90				

* Significant difference (P<0.05)

GRAPH: 4



INTERPRETATION:

The above table shows the mean of pre-test and post – test values were 20.33 and 36.87, respectively. The mean improvement in upper extremity motor function score of Group B was 16.53. The ‘t’ value 12.703 and ‘P’ value <0.0001 for upper extremity motor function scores using FMA-UE within Group B analysis. When compared to table value, the above ‘P’ value is lesser at P<0.05, which is highly significant. The result of the study indicates that Group B treated with Conventional Therapy (CT) alone had significant improvement in upper limb motor function within Group B.

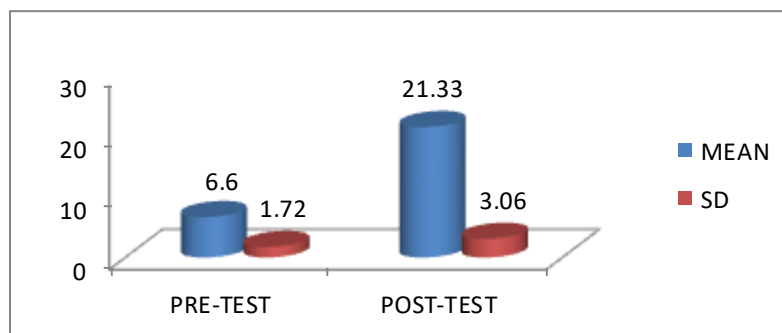
5. ANALYSIS OF PRE-TEST AND POST-TEST VALUES OF MOTOR ASSESSMENT SCALE – UPPER LIMB (MAS-UL) FOR SIGNIFICANCE WITHIN GROUP A:

TABLE: 5

	Mean	N	SD	Std. Error Mean	R	Mean Diff	T	P
Pre-test	6.60	15	1.72	0.45	0.677	14.73	25.00	<0.0001*
Post-test	21.33	15	3.06	0.79				

* Significant difference (P<0.05)

GRAPH: 5



INTERPRETATION:

The above table shows the mean of pre-test and post – test values of motor assessment score were 6.60 and 21.33, respectively. The mean improvement in motor assessment of Group A was 14.73. The ‘t’ value 25.00 and ‘P’ value< 0.0001 for motor assessment scores using MAS-UL within Group A analysis. When compared to table value, the above ‘P’ value is lesser at P<0.05, which is significant. The result of the study indicates that Group A treated with Mirror Therapy with Conventional Therapy had significant improvement in motor assessment score of upper limb within Group A.

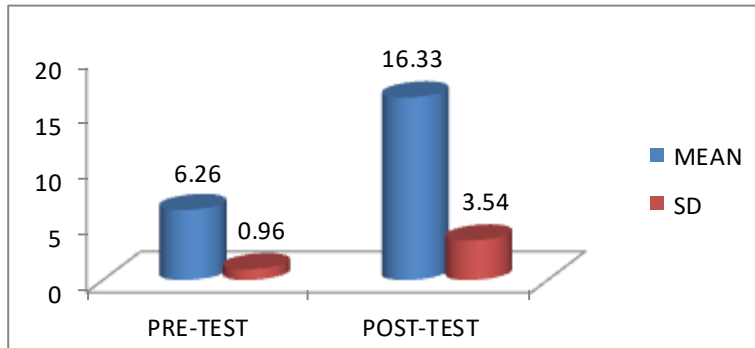
6. ANALYSIS OF PRE-TEST AND POST-TEST VALUES OF MOTOR ASSESSMENT SCALE – UPPER LIMB (MAS-UL) FOR SIGNIFICANCE WITHIN GROUP B:

TABLE: 6

	Mean	N	SD	Std. Error Mean	R	Mean Diff	T	P
Pre-test	6.26	15	0.96	0.25	0.812	10.07	13.85	<0.0001*
Post-test	16.33	15	3.54	0.91				

* Significant difference (P<0.05)

GRAPH: 6



INTERPRETATION:

The above table shows the mean of pre-test and post – test values of upper limb motor assessment score were 6.26 and 16.33, respectively. The mean improvement in motor assessment of Group B was 10.07. The ‘t’ value 14.515 and ‘P’ value 0.0067 for upper limb motor assessment scores using MAS-UL within Group B analysis. When compared to table value, the above ‘P’ value is lesser at P<0.05, which is highly significant. It indicates that Group B treated with conventional therapy had significant improvement in upper limb motor assessment within Group B.

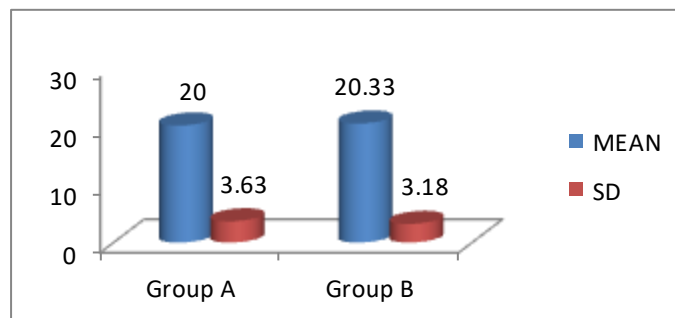
7. ANALYSIS OF PRE-TEST VALUES OF UPPER LIMB FUNCTION SCORES USING FUGL MEYER ASSESSMENT – UPPER EXTREMITY (FMA-UE) BETWEEN GROUPS:

TABLE: 7

Group	Mean	N	SD	Std. Error Mean	Mean Diff	t	P
A	20.00	15	3.63	0.94	0.33	0.2678	0.7909 ^{NS}
B	20.33	15	3.18	0.82			

^{NS} Non-significant difference (P<0.05)

GRAPH: 7



INTERPRETATION:

The above table shows the mean of pre-test values of upper extremity function scores were 20.00 and 20.33 in Group A and Group B, respectively. The mean difference in upper extremity functional scores between groups was 0.33. The 't' value 0.2678 and 'P' value 0.7909 for upper extremity functional scores between Group A and Group B analysis. When compared the table value, the above 'P' value is greater at P<0.05, which is non-significant. It indicates the homogeneity in pre test values of both the groups.

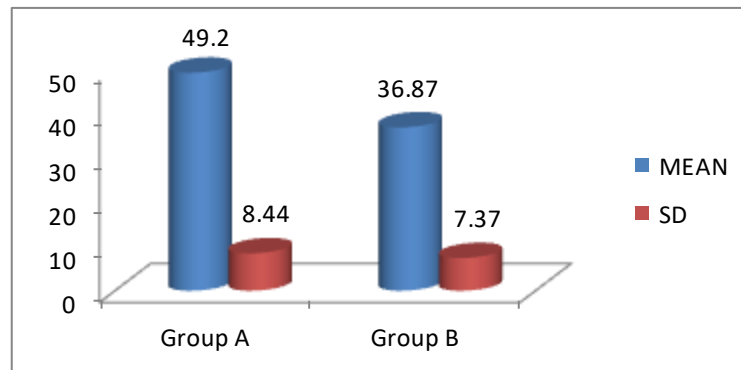
8. ANALYSIS OF POST-TEST VALUES OF UPPER EXTREMITY FUNCTION SCORES USING FUGL MEYER ASSESSMENT – UPPER EXTREMITY (FMA-UE) BETWEEN GROUPS:

TABLE: 8

Group	Mean	N	SD	Std. Error Mean	Mean Diff	t	P
A	49.20	15	8.44	2.18	12.33	4.265	0.0002**
B	36.87	15	7.37	1.90			

*Significant difference (P<0.05)

GRAPH: 8



INTERPRETATION:

The above table shows the mean of post-test values of upper extremity functional scores were 49.20 and 36.87 in Group A and Group B, respectively. The mean difference in upper extremity functional scores between groups was 12.33. The ‘t’ value 4.265 and ‘P’ value 0.0002 for motor arm upper extremity functional scores between Group A and Group B analysis. When compared the table value, the above ‘P’ value is lesser at P<0.05, which is significant. It indicates that both the techniques were effective in improving functional activities of upper limb in chronic stroke patients but Group A treated with Mirror Therapy with Conventional Therapy has superior effect than Group B treated with Conventional Therapy alone in upper limb activities of chronic stroke patients.

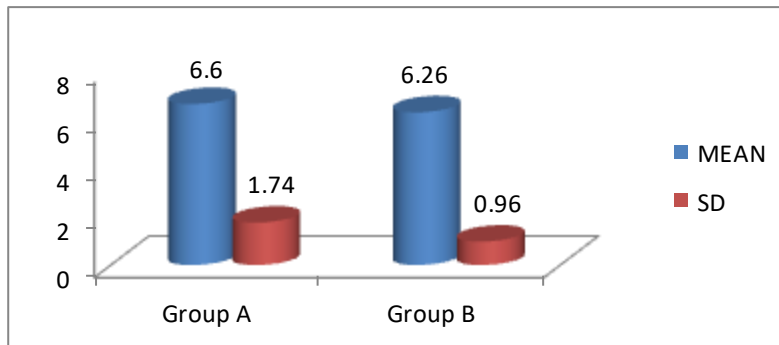
5.9: ANALYSIS OF PRE TEST VALUES OF UPPER LIMB MOTOR ASSESSMENT SCORES USING MOTOR ASSESSMENT SCALE – UPPER LIMB (MAS-UL) BETWEEN GROUPS:

TABLE: 9:

Group	Mean	N	SD	Std. Error Mean	Mean Diff	t	P
A	6.60	15	1.72	0.45	0.34	.6541	0.5184 ^{NS}
B	6.26	15	0.96	0.25			

*Significant difference (P<0.05)

GRAPH: 9



INTERPRETATION:

The above table shows the mean of pre-test values of upper limb assessment scores were 6.60 and 6.26 in Group A and Group B, respectively. The mean difference in upper limb assessment scores between groups was 0.34. The ‘t’ value 0.6541 and ‘P’ value 0.5184 for upper limb assessment scores between Group A and Group B analysis. When compared the table value, the above ‘P’ value is greater at P<0.05, which is non-significant. The result of the study indicates the homogeneity in pre test values of both the groups ie. Group A treated with mirror therapy with conventional therapy and Group B treated with conventional therapy alone showed insignificant effect in pre-test values with each other.

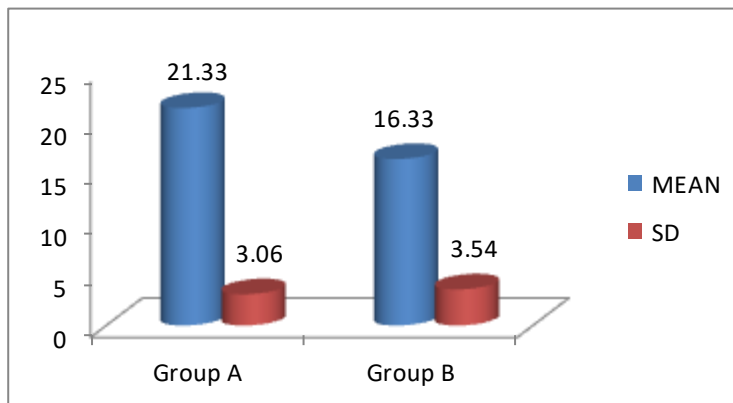
10. ANALYSIS OF POST - TEST VALUES OF UPPER LIMB MOTOR ASSESSMENT SCORES USING MOTOR ASSESSMENT SCALE – UPPER LIMB (MAS-UL) BETWEEN GROUPS:

TABLE 10:

Group	Mean	N	SD	Std. Error Mean	Mean Diff	t	P
A	21.33	15	3.06	0.79	5.00	4.138	0.0003*
B	16.33	15	3.54	0.91			

*Significant difference (P<0.05)

GRAPH: 10



INTERPRETATION:

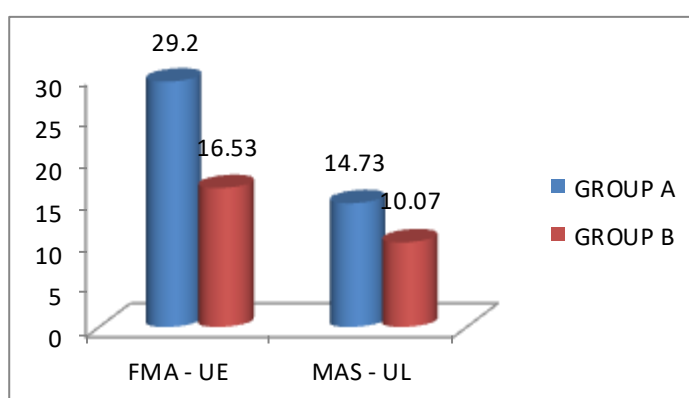
The above table shows the mean of post-test values of upper limb assessment scores were 21.33 and 16.33 in Group A and Group B, respectively. The mean difference in upper limb assessment scores between groups was 5.00. The ‘t’ value 4.138 and ‘P’ value 0.0003 for upper limb assessment scores between Group A and Group B analysis. When compared the table value, the above ‘P’ value is lesser at P<0.05, which is significant. The result of the study indicates that both the techniques were effective in upper limb motor assessment in chronic stroke patients but Group A treated with Group A treated with mirror therapy with conventional therapy has superior effect than Group B treated with conventional therapy alone in upper limb motor assessment of chronic stroke patients.

11. MEAN IMPROVEMENT IN ALL THE PARAMETERS BETWEEN GROUP A AND GROUP B:

TABLE: 11

	Group	N	Mean		Group	N	Mean
FMA-UE	A	15	29.20	MAS-UL	A	15	14.73
	B	15	16.53		B	15	10.07

GRAPH: 11



INTERPRETATION:

The above table shows the mean improvement in upper limb functional scores of FMA-UE was 29.20 in Group A and 16.53 in Group B. It was resulted that Group A treated with mirror therapy with conventional therapy had a superior effect in upper limb function scores over Group B treated with conventional therapy in upper limb function of chronic stroke patients. The above table shows the mean improvement in upper limb assessment scores of motor assessment scale – upper limb was 14.73 in Group A and 10.07 in Group B. It was resulted that Group A treated with mirror therapy with conventional therapy had a superior effect in upper limb function scores over Group B treated with conventional therapy in upper limb function of chronic stroke patients. Thus, the above study resulted that Group A treated with mirror therapy with conventional therapy had a superior effect in upper limb functions of chronic stroke patients.

DISCUSSION

The present study was done to evaluate the effectiveness of mirror therapy with conventional therapy versus conventional therapy alone to improve functional activity of upper extremity in chronic stroke patients.

The stroke is one of the major cause of the disability and impairment, the impaired muscle strength after a stroke poses a therapeutic challenge for the patients, guardians, and specialists in rehabilitation therapy, In particular, the learned non-use phenomenon of the affected upper extremity is characterized by the tendency

to use the less affected upper extremity for the purpose of habitually performing the functional tasks. If hemiplegic patients use the unaffected upper extremity, they would lose the functional independence. This leads to the speculation that the patients would increasingly use the hemiplegic upper extremity and eventually would achieve a functional recovery, if they concomitantly receive short-term intensive rehabilitation treatments, such as conventional therapy and mirror therapy, following the onset of symptoms. (Wilkinson PR et al., 1997)³²

In present study, total 30 chronic stroke patients with impaired upper limb functions were selected randomly and divided into two groups - Group A and Group B (15 patients in each group), who received Mirror therapy with conventional therapy and conventional therapy alone, respectively. The improvement in upper limb function and upper limb motor assessment were assessed by using Fugl meyer assessment – upper extremity and motor assessment scale – upper limb, respectively.

In present study, Group A had a mean age of 59.20 years and Group B had a mean age of 59.80 years.

Regarding the sex of patients, 56.67% patients were male and only 43.33% patients were females. The results are consistent with the result of similar findings that among 25 patients with stroke, 14 were males and 11 females. (Young et al., 2007).³³ Contradictory results showed in other study females were more prone to get stroke than males. (Bhattacharya, 2011).³⁴

Group A received Mirror therapy with conventional therapy showed improvement in functional activities of upper limb in chronic stroke patients when comparing the pre and post test values proved by Fugl Meyer Assessment – Upper Extremity (FMA-UE) and motor assessment scale – upper limb (MAS-UL). The mean improvement in FMA – UE and MAS – UL score was 29.20 and 16.53, respectively. This analysis found highly significant difference between pre and post test score within group A. The above scores have shown that mirror therapy with conventional therapy is effective in improving functional activities of upper limb in chronic stroke patients. The findings were strongly supported by Arya et al. (2015),³⁵ Park et al. (2015),³⁶ Snehal and Suvarana (2017)³⁷ and Penina Langhu et al. (2018)³⁸ they concluded that there was a significant improvement on motor function of the upper limb in stroke patients after implementation of mirror therapy.

Group B received conventional therapy alone is also showed improvement in functional activities of upper limb in chronic stroke patients when comparing the pre and post test values proved by Fugl Meyer Assessment – Upper Extremity (FMA-UE) and motor assessment scale – upper limb (MAS-UL). The mean improvement in FMA – UE and MAS – UL score was 14.73 and 10.07, respectively. This analysis found significant difference between pre and post test score within group B. The above scores have shown that conventional therapy alone is also effective in improving functional activities of upper limb in chronic stroke patients. This statement is strongly supported by the earlier findings of Fletcher – Smith JC et al. (2016)³⁹ who concluded that early electric stimulation for wrist flexors and extensors improves the muscle power and prevent contractures. The study was supported by Orihuela – Espina F et al. (2016)⁴⁰ who found that robotic training and conventional therapy improves hand motion. Shin et al. (2016)⁴¹ suggested that virtual reality based rehabilitation on distal upper extremity improves functions of upper extremity.

The study was to comparing the mirror therapy with conventional therapy and conventional therapy alone in improving upper limb activities of chronic stroke patients. The upper limb function score of each patient was assessed by using Fugl meyer assessment – upper extremity before the start of the treatment as pre-test values and at the end of 12th week as post-test values. The mean of pre-test and post – test values were 20.00 and 49.20, respectively in group A and 20.33 and 36.87, respectively in group B. The mean improvement in upper limb function score of group A and group B was 29.20 and 16.53, respectively. The statistical analysis correlates the study by proposing that groups taken for study either Group A treated by mirror therapy with conventional therapy or Group B treated by conventional therapy alone showed significant effect in improvement in upper limb functions. The Group A treated with mirror therapy with conventional therapy had a superior effect in improving upper limb functions when compared to Group B treated with conventional therapy. This finding was supported by a study showed that upper limb motor performance was improved more in the experimental group after mirror therapy than in the control group. (Lee et al., 2012⁴² and Pournima Pawar et al., 2017⁴³).

The statistical analysis correlates the study by proposing that groups taken for study either Group A treated by mirror therapy with conventional therapy or

Group B treated by conventional therapy alone showed significant effect in improvement in upper limb motor assessment functions.

Thus, the study resulted that Group A treated with mirror therapy with conventional therapy had a superior effect in improving upper limb functions when compared to Group B treated with conventional therapy. In favour to present study Yavuzer et al. (2008)⁴⁴ and Thieme et al. (2013)⁴⁵ who concluded that hand functioning improved more after mirror therapy in addition to a conventional rehabilitation program. Wen Samuel et al (2014)⁴⁶, Lim et al. (2016)⁴⁷, Perez-Cruzado et al. (2017)⁴⁸ and Wen Zeng et al. (2017)⁴⁹ were also concluded that mirror therapy significantly improve motor function of the upper limb in stroke patients. The similar result found in another study showed that mirror therapy after stroke was a promising method to improve sensory function, passive joint motion in a hemiparesis upper limb. (Sathian et al., 2000).⁵⁰ This study finding was consistent with the result of another study showed that the mirror therapy was significantly helps to improve motor performance, sensory function, passive joint motion and joint pain of the upper extremity (Holm et al., 2018).⁵¹

Based on data, the Group A treated by mirror therapy with conventional therapy had a superior effect in improving upper limb functions when compared to Group B treated with conventional therapy alone. Thus, alternative hypothesis is accepted.

1. LIMITATIONS OF THE STUDY:

1. The study was limited due to shorter duration of treatment
2. The study was limited due to less number of chronic stroke patients with upper limb function involvement.
3. The study was limited age group between 40 – 70 years.
4. The study was limited to only upper limb function involvement in chronic stroke patients.
5. The study was limited on mirror therapy with conventional therapy for treatment of chronic stroke patients.

2. RECOMMENDATIONS FOR FURTHER STUDY

1. It may be recommended that treatment course could be more than 12 weeks, so that more results could be evaluated.

2. It may be recommended that study could be done on more than 30 chronic stroke patients with upper limb function involvement.
3. It may be recommended that study could be done on different age groups.
4. It may be recommended that more studies are needed to be done in single techniques to improve upper limb functions in chronic stroke patients.
5. It may be recommended that study could be done on lower limb function also to see the effect of mirror therapy in lower limb functions in chronic stroke patients.
6. It may be recommended that study could be done on upper limb function in acute and subacute stroke patients.

CONCLUSION

The present study resulted that mirror therapy with conventional therapy and conventional therapy alone have got beneficial effect on upper limb functions in chronic stroke patients but mirror therapy with conventional therapy was more effective than conventional therapy in upper limb functions of chronic stroke patients. Thus, Based on the results it can be concluded that mirror therapy with conventional therapy is a safe and effective technique to treat upper limb dysfunction in chronic stroke patients

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