



Modified Constrained Induced Movement Therapy Versus Mirror Therapy Analysis through Fugl-Meyer and Nine Hole Peg Scales

Sneha Tiwari*

Department of Neurology, India

*Corresponding Author: Sneha Tiwari, Department of Neurology, India.

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Abstract

Background: To compare effectiveness of modified constrained induced movement therapy versus mirror therapy in improving hand dexterity in patients with sub-acute stroke.

Objective: To evaluate the effectiveness of modified constraint induced movement therapy (MCIMT) and Mirror therapy in improving hand dexterity to patients with sub-acute stroke.

Methods: 20 patients with sub-acute stroke were enrolled and divided into two groups: Modified constraint induced movement therapy (MCIMT) and mirror therapy (MT). Training for MCIMT will be for 2 hrs per day, 5 days per week for 5 weeks and training for mirror therapy will be 2 hrs per day, 5 days per week for 5 weeks with the help of assessment scales Fugl-meyer scale and Nine hole peg scale.

Keywords: Modified Constraint Induced Movement Therapy (MCIMT); Mirror Therapy (MT)

Experiment sample description for statistical analysis

Sample Size is 20 patients which is divided into 2 groups of 10 sample size each randomly.

Male vs female ratio in the sample

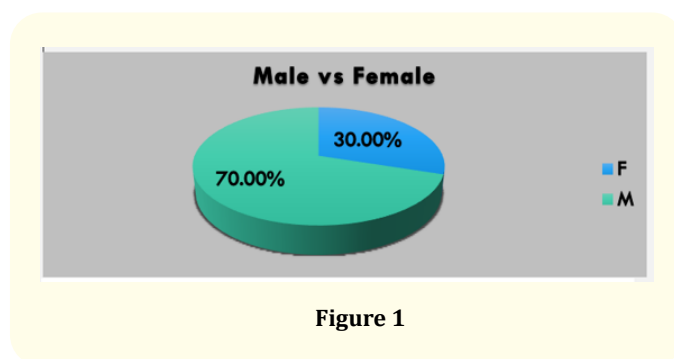


Figure 1

70% of the sample were the males and 30% were the female in the sample.

Stroke type ratio in the sample

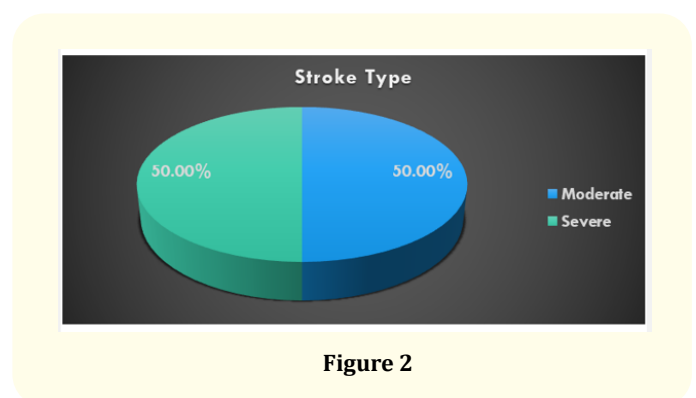


Figure 2

50% were hemorrhagic and 50% were Ischemic were the stroke type patients in the sample.

Stroke severity type in the sample

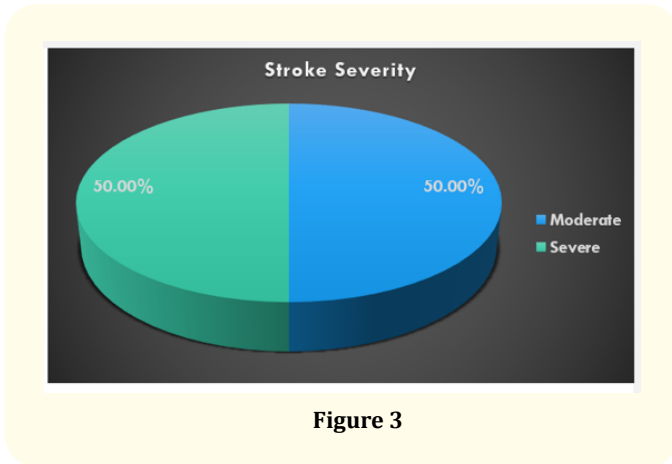


Figure 3

50% were Moderate and 50% were Severe were the stroke type patients in the sample.

Time since stroke in the sample

More than 3 months cases were taken for the study in the sample.

Age of the patients in the sample

More than 40 years of age were considered for the study in the sample.

Data collection and experimental conditions

Inclusion criteria

1. 40 - 60 years of age.
2. Men and women with sub-acute stroke.
3. Subjects with dominant side hemi-paretic.
4. Brunstromm's stage (3 - 5 level).
5. Mini-Mental Status Examination. (MMSE) not less than 24 score.

Exclusion criteria

1. Acute and Chronic.
2. Subjects more than 60 years old.
3. Subjects less than 40years old.
4. Patients with visual deficits.
5. Severe cognitive impairment.

Study variables

- Constrain induced movement therapy.
- Mirror therapy.

Equipments and materials

1. Nine-holepegboard.
2. Stopwatch.
3. Mirror 75 x 64 centimeters.

Statistical tools

1. Computer.
2. The Excel Statistical Software version is used with the help of statistic after collection of data (pre-intervention and post intervention data).

Assessment tools

1. **Nine-hole peg scale:** It is simple and easy, simple and quick to use, to assess fine motor coordination and hand-eye coordination. In this scale first unaffected (non-dominant hand) is practiced, followed by affected/dominant hand. It has high inter-rater reliability and evidence for concurrent and convergent validity.
2. **Fugl-Meyer scale:** It is widely used to assess and measure fine motor activities. Hand activity is assessed with eight components, this is made by assistance provided to the arm at the elbow and just proximal to the wrist in order to position the arm for the grasp tasks. I.e. 8a, finger mass flexion, 8b, finger mass extension. 8c, extension of MCP 2nd to 5th fingers and flexion of proximal and distal IP joints are assumed patient holding a brief case, 8d grasping with involving thumb abduction and first digit holding scrap of a paper. 8e, it involves holding a pen or a pencil involving thumb and index finger prehension. 8f, grasping of small cylindrical things like a small can. Opposing the volar surface of the thumb and fingers. 8g, spherical grasping with the help of a tennis ball.

Data-collection procedure

The patient with sub-acute stroke will be referred to college of physiotherapy, the subject will be checked for inclusion and exclusion criteria. If inclusion criteria is met, they will be asked to fill the consent form, If they are willing to participate in the study. Then the subjects will be included in the study and divided into two groups by simple random sampling method.

This will be followed by a pre-Intervention data collection which is done by mini-mental status examination (MMSE).

The MMSE is the best tool that can be used to systematically and thoroughly assess mental status. It is an 11-questionable measure that tests five areas of cognitive function: Orientation, registration, attention and calculation, recall and language. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. This test takes only 5 - 10 minutes to administer and therefore, it is practical to use repeatedly and routinely.

Intervention

Subjects are divided into 2 groups. Group A are treated with constrained induced movement therapy and Group B treated with mirror therapy.

Active assisted exercises and active range of motion (AROM) exercises are done at the end of the treatment to whole upper limb to both the groups.

Both the groups are taught DOS and Don'ts.

Group A

Subjects who are assigned into this group will be treated with constrained induced movement therapy, and AROM exercises.

Group B

Subjects who are assigned into this group will be treated with mirror therapy, activity of daily living (ADL) exercises and AROM exercises.

MCIMT will be for 2 hrs per day, 5 days per week for 5 weeks and training for mirror therapy will be 2 hrs per day, 5 days per week for 5 weeks with the help of assessment scales Fugl-meyer scale and Nine hole peg scale.

Fugl-meyer scale test

Method used to perform statistical analysis on the sample data.

We have used the T-Test Unpaired test sample assuming unequal variances test for 2 reasons:

1. The sample size is less than 30.
2. Sample standard deviations are unknown.

So, we are using T -Test for Unpaired samples when their Variances are Unknown.

Modified constraint induced movement therapy (MCIMT) and mirror therapy (MT) Test on fugl-meyer scale test

Fugl-meyer scale

- For No score- 0
- For medium score- 1
- For best score- 2

Data- Fugl-meyer scale

Patient No.	MCIMT-FMS	Patient No.	Mirror-FMS
Patient 1	43	Patient 11	40
Patient 2	37	Patient 12	40
Patient 3	44	Patient 13	43
Patient 4	41	Patient 14	40
Patient 5	39	Patient 15	38
Patient 6	34	Patient 16	39
Patient 7	36	Patient 17	39
Patient 8	44	Patient 18	44
Patient 9	38	Patient 19	42
Patient 10	32	Patient 20	42

Table 1: Data input of combined "MCIM and Mirror".

Hypothesis- Fugl-Meyer Scale

- **Null Hypothesis:** Mean score of MCIMT-FMS are Equal to Mean Score of Mirror-FMS.
- **Alternative Hypothesis:** Mean score of MCIMT-FMS are not equal to Mean Score of Mirror-FMS.

Test Results: Fugl-Meyer Scale

	MCIMT-FMS	Mirror-FMS
Mean	36.1	40.7
Variance	9.655555556	3.788888889
Observations	10	10
Hypothesized Mean Difference	0	
Df	15	
t Stat	-3.967221065	
P(T<=t) one-tail	0.000619643	
t Critical one-tail	1.753050356	
P(T<=t) two-tail	0.001239285	
t Critical two-tail	2.131449546	

Table 2: Results of the T-test of MCIMT over mirror therapy.

Analysis- Fugl-Meyer Scale

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .000619 which is less than .05 and P-Value two tail is .00123 which is less than .025, suggests there is sufficient evidence to believe that the performance of Modified Constraint Induced Movement Therapy (MCIMT) and Mirror Therapy (MT) conducted through Fugl-meyer test are not same, here in this experiment the Mirror Test are showing better results over Modified Constraint Induced Movement Therapy (MCIMT).

Combined modified constraint induced movement therapy (MCIMT) and mirror therapy (MT) test to mirror therapy FMS test

Data- Fugl-Meyer Scale

Patient No.	MCIMT	MCIMT + Mirror
Patient 1	42	46
Patient 2	35	43
Patient 3	39	44
Patient 4	36	42
Patient 5	37	42
Patient 6	33	43
Patient 7	34	44
Patient 8	37	42
Patient 9	37	39
Patient 10	31	39

Table 3: Data input of combined “MCIMT+Mirror and MCIMT”.

Hypothesis- Fugl-Meyer Scale

- **Null Hypothesis:** Mean score of Combined MCIMT and Mirror are Equal to Mean Score of MCIMT.
- **Alternative Hypothesis:** Mean score of Combined MCIMT and Mirror are Not Equal to Mean Score of MCIMT.

We are using T-Test for Paired Samples as a test of hypothesis.

Test Results: Fugl-Meyer Scale

	MCIMT	MCIMT + Mirror
Mean	36.1	42.4
Variance	9.655555556	4.711111111
Observations	10	10
Pearson Correlation	0.553536752	
Hypothesized Mean Difference	0	
Df	9	
t Stat	-7.584308744	
P(T<=t) one-tail	1.69069E-05	
t Critical one-tail	1.833112933	
P(T<=t) two-tail	3.38138E-05	
t Critical two-tail	2.262157163	

Table 4: Results of the T-test of MCIMT+Mirror over MCIMT.

Analysis- Fugl-Meyer Scale

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .0000169 which is less than .05 and P-Value two tail is .0000338 which is less than .025, suggests there is sufficient evidence to believe that the performance of Combined impact of the Modified Constraint Induced Movement Therapy (MCIMT) and Mirror Therapy (MT) over Modified Constraint Induced Movement Therapy (MCIMT) conducted through Fugl-meyer test are not same, here in this experiment the Combined Modified Constraint Induced Movement Therapy (MCIMT) is performing better than the MCIMT test as per the table 4 results.

Combined mirror therapy and modified constraint induced movement therapy (MCIMT) to mirror therapy FMS test

Data- Fugl-Meyer Scale

Patient No.	Mirror-FMS	Mirror + MCIMT
Patient 11	40	49
Patient 12	40	49
Patient 13	43	43
Patient 14	40	46
Patient 15	38	38
Patient 16	39	38
Patient 17	39	43
Patient 18	44	49
Patient 19	42	50
Patient 20	42	49

Table 5: Data input of combined “Mirror+MCIMT and Mirror”.

Hypothesis- Fugl-Meyer Scale

- **Null Hypothesis:** Mean score of Combined Mirror and MCIMT are Equal to Mean Score of Mirror.
- **Alternative Hypothesis:** Mean score of Combined Mirror and MCIMT are Not Equal to Mean Score of Mirror.

We are using T-Test for paired samples as a test of hypothesis.

Test Results: Fugl-Meyer Scale

	Mirror-FMS	Mirror + MCIMT
Mean	40.7	45.4
Variance	3.788888889	21.6
Observations	10	10
Pearson Correlation	0.592000016	
Hypothesized Mean Difference	0	
Df	9	
t Stat	-3.87942807	
P(T<=t) one-tail	0.00186733	
t Critical one-tail	1.833112933	
P(T<=t) two-tail	0.003734659	
t Critical two-tail	2.262157163	

Table 6: Results of the T-test of Mirror + MCIMT over mirror.

Analysis- Fugl-Meyer Scale

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .0018 which is less than .05 and P-Value two tail is .0037 which is less than .025, suggests there is sufficient evidence to believe that the performance of Combined impact of the Mirror Therapy and Modified Constraint Induced Movement Therapy (MCIMT) over Mirror Therapy test conducted through Fugl-meyer test are not same, here in this experiment the Combined Mirror Therapy and Modified Constraint Induced Movement Therapy (MCIMT) is performing better than the Mirror Therapy as per the table 6 results.

Nine hole peg test

Modified constraint induced movement therapy (MCIMT) and mirror therapy (MT) test on nine hole peg test

Nine hole peg scale

- Time to fill the Nine holes from the right hand = Average of 2 trails.
- Time to fill the Nine holes from the left hand = Average of 2 trails.

Average of the 4 trails is the score which we have taken for the T-Test.

Data- NHPS

Patient No.	MCIMT - NHPS	Patient No.	Mirror -NHPS
Patient 1	16.65	Patient 11	15.87
Patient 2	16.89	Patient 12	15.41
Patient 3	18.34	Patient 13	16.39
Patient 4	17.71	Patient 14	15.23
Patient 5	16.46	Patient 15	16
Patient 6	17.34	Patient 16	15.81
Patient 7	16.86	Patient 17	15.37
Patient 8	16.94	Patient 18	15.89
Patient 9	16.9	Patient 19	15.75
Patient 10	16.92	Patient 20	15.84

Table 7: Data input of combined “MCIM and Mirror”.

Hypothesis- NHPS

- **Null Hypothesis:** Mean score of MCIMT-NHPS are Equal to Mean Score of Mirror-NHPS.
- **Alternative Hypothesis:** Mean score of MCIMT-NHPS are not equal to Mean Score of Mirror-NHPS.

We are using T-Test for Unpaired Samples with Unequal Variances.

Test Results: NHPS

	MCIMT	Mirror
Mean	17.101	15.756
Variance	0.30878778	0.11642667
Observations	10	10
Hypothesized Mean Difference	0	
df	15	
t Stat	6.52256296	
P(T<=t) one-tail	4.8226E-06	
t Critical one-tail	1.75305036	
P(T<=t) two-tail	9.6451E-06	
t Critical two-tail	2.13144955	

Table 8: Results of the T-Test of MCIMT over mirror therapy.

Analysis- NHPS

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .00000482 which is less than .05 and P-Value two tail is .000009645 which is less than .025, suggests there is sufficient evidence to believe that the performance of Modified Con-

straint Induced Movement Therapy (MCIMT) and Mirror Therapy (MT) conducted through Nine Hole Peg test are not same, here in this experiment the Mirror Test are showing better results over Modified Constraint Induced Movement Therapy (MCIMT) as per table 8.

Combined modified constraint induced movement therapy (MCIMT) and mirror therapy (MT) test to mirror therapy nine hole peg test

Data- NHPS

Patient No.	MCIMT	MCIMT + Mirror
Patient 1	16.65	14.28
Patient 2	16.92	14.88
Patient 3	16.89	14.46
Patient 4	18.34	14.53
Patient 5	17.71	14.68
Patient 6	16.46	14.6
Patient 7	17.34	14.57
Patient 8	16.86	14.9
Patient 9	16.94	14.66
Patient 10	16.9	14.47

Table 9: Data input of combined “MCIMT+Mirror and MCIMT”.

Hypothesis- MCIMT+MIRROR TO MIRROR (NHPS)

- **Null Hypothesis:** Mean score of Combined MCIMT and Mirror are Equal to Mean Score of MCIMT (NHPS).
- **Alternative Hypothesis:** Mean score of Combined MCIMT and Mirror are Not Equal to Mean Score of MCIMT (NHPS).

We are using T-Test for Paired Samples as a test of hypothesis.

Test Results: MCIMT+Mirror to Mirror (NHPS)

	MCIMT	MCIMT+Mirror
Mean	17.101	14.603
Variance	0.308787778	0.03589
Observations	10	10
Pearson Correlation	0.023399491	
Hypothesized Mean Difference	0	
Df	9	
t Stat	13.55226831	
P(T<=t) one-tail	1.3574E-07	
t Critical one-tail	1.833112933	
P(T<=t) two-tail	2.71481E-07	
t Critical two-tail	2.262157163	

Table 10: Results of the T-test of MCIMT+Mirror over MCIMT.

Analysis- NHPS

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .000000135 which is less than .05 and P-Value two tail is .000000271 which is less than .025, suggests there is sufficient evidence to believe that the performance of Combined impact of the Modified Constraint Induced Movement Therapy (MCIMT) and Mirror Therapy (MT) over Modified Constraint Induced Movement Therapy (MCIMT) conducted through Nine Hole Peg test are not same, here in this experiment the Combined Modified Constraint Induced Movement Therapy (MCIMT) is performing better than the MCIMT test as per the table 10 results.

Average time taken to fill the Nine Hole Peg in case of patients who have received MCIMT and Mirror therapy have taken 14.603 seconds which is lesser than as patients who have taken only MCIMT therapy with their average time to fill the nine hole is 17.1 seconds.

Combined mirror therapy and modified constraint induced movement therapy (MCIMT) to mirror therapy nine hole peg test

Data- NHPS

Patient No.	Mirror-NHPS	Mirror + MCIMT -NHPS
Patient 11	15.87	14.87
Patient 12	15.84	14.9
Patient 13	15.41	15.03
Patient 14	16.39	15
Patient 15	15.23	14.76
Patient 16	16	14.36
Patient 17	15.81	14.88
Patient 18	15.37	14.48
Patient 19	15.89	14.76
Patient 20	15.75	14.92

Table 11: Data input of combined “Mirror+MCIMT and Mirror”.

Hypothesis- NHPS

- **Null Hypothesis:** Mean score of Combined Mirror and MCIMT are Equal to Mean Score of Mirror.
- **Alternative Hypothesis:** Mean score of Combined Mirror and MCIMT are Not Equal to Mean Score of Mirror.

We are using T-Test for paired samples as a test of hypothesis.

Test Results: NHPS

	Mirror	Mirror+MCIMT
Mean	15.756	14.796
Variance	0.11642667	0.047515556
Observations	10	10
Pearson Correlation	0.14795307	
Hypothesized Mean Difference	0	
Df	9	
t Stat	8.05803282	
P(T<=t) one-tail	1.0446E-05	
t Critical one-tail	1.83311293	
P(T<=t) two-tail	2.0892E-05	
t Critical two-tail	2.26215716	

Table 12: Results of the T-test of Mirror+MCIMT over mirror.

Analysis- NHPS

Benchmark P Value for one tail test is .05 and Benchmark P-Value for two tail tests is .025.

P Value one tail is .0018 which is less than .05 and P-Value two tail is .0037 which is less than .025, suggests there is sufficient evidence to believe that the performance of Combined impact of the Mirror Therapy and Modified Constraint Induced Movement Therapy (MCIMT) over Mirror Therapy test conducted through Nine Hole Peg Test are not same, here in this experiment the Combined Mirror Therapy and Modified Constraint Induced Movement Therapy (MCIMT) is performing better than the Mirror Therapy as per the table 12 results.

Time taken by Patients who have taken Mirror and MCIMT is 14.796 seconds as compared to patients who have taken mere Mirror Therapy is 15.756 which is higher than patients who have taken the Mirror as well as MCIMT Therapy both.

Test-retest reliability and inter-rater reliability test report for nine hole peg test

	Test-Retest Reliability	Interrater reliability
MCIMT	90%	88%
Mirror	95%	94%
MCIMT+Mirror	98%	94%
Mirror + MCIMT	99%	97%

Table 13

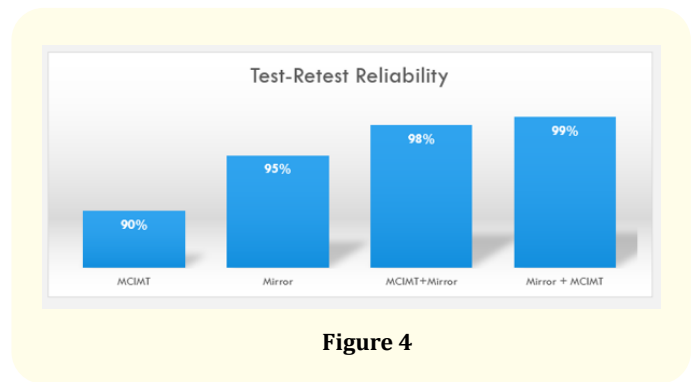


Figure 4

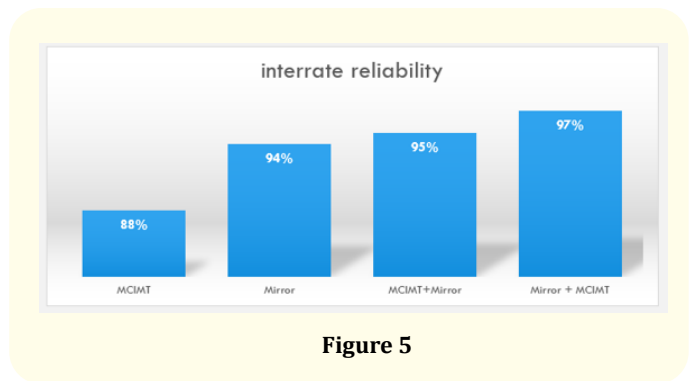


Figure 5

“MCIMT+Mirror” and “Mirror+MCIMT” combined therapies are showing better Test-Re-Test Reliabilities than MCIMT alone and Mirror alone therapies.

“MCIMT+Mirror” and “Mirror+MCIMT” combined therapies are showing better Inter-rater Reliabilities than MCIMT alone and Mirror alone therapies.

Conclusion

The Modified constraint induced movement therapy (MCIMT) combined with mirror therapy (MT) showed more improvement compared to MCIMT only group in the improvement of functions of hand dexterity for the patients with sub-acute stroke.

Bibliography

Snehalata Tiwari, Postgraduate. I am first year masters student studying Neurology. My research Effectiveness of the modified constraint induced movement therapy (MCIMT) versus mirror therapy in improving hand dexterity in patients with sub-acute stroke mainly focuses on improving the fine movements of the patients which are used in ADL's and other motor functions with increase in motivational and functional activities of the patients.

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