International Journal of Science and Healthcare Research
Vol. 8; Issue: 2; April-June 2023
Website: ijshr.com
Original Research Article *ISSN: 2455-7587*

Effectiveness of Truncal Motor Imagery Practice on Trunk Performance, Gait Performance and Functional Outcome Among Patients with Acute Hemiparetic Stroke

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DOI: https://doi.org/10.52403/ijshr.20230206

ABSTRACT

BACKGROUND: "Motor imagery" is considered to be as one of the latest rehabilitation strategies to treat the post-stroke disabilities. It is beneficial to treat upper and lower limb motor impairment in stroke patients, but the effect of imagery in the trunk recovery have not been reported yet.
OBJECTIVE: To find the effectiveness of truncal motor imagery practice on trunk performance, gait performance and functional outcome among the patients with acute hemiparetic stroke.
METHODOLOGY: A quasi-experimental study with a purposive sampling technique was conducted at KMCH institute of health sciences, Coimbatore. Patients who were clinically diagnosed with stroke and fit the study's eligibility criteria were chosen and were randomly allocated into two groups. Group A (30 patients) received Truncal motor imagery technique along with conventional therapy and Group B (30 patients) received conventional therapy alone as 1 session(90min) /day, 4 days a week for 6 weeks.
OUTCOME MEASURES: The outcome measures such as trunk performance, gait performance, functional outcome were assessed with trunk impairment scale (TIS), Dynamic gait index (DGI) and functional independence measure respectively.
RESULTS: Among 60 patients included in the study, The outcomes were measured in three different time periods and were analysed with One way ANOVA. Post hoc analysis was done with Tukey's HSD test analysis effect size showed statistically significant improvement ($p < .05$)
CONCLUSION: Truncal motor imagery in addition to the physical practice showed benefits in improving trunk performance, gait performance and functional outcome among patients with acute hemiparetic stroke.

Keywords: [Motor imagery, trunk performance, gait performance, functional outcome, acute hemiparetic stroke.]

INTRODUCTION

Stroke is defined by the World Health Organization as a clinical syndrome consisting of rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 h or leading to death with no apparent cause other than that of vascular origin.(1)
Stroke is the third leading cause of death and main cause of long term disability in the societies. It is a clinical syndrome rather than the single disease.(2,3) The common symptoms of a stroke are motor and balance ability not only for upper and lower limb, but also the trunk, Loss of balance is an important factor that causes falls.(4,5)
The frequency of cerebrovascular disease is increasing, so that nowadays approximately

5.7 million people are estimated to die from acute stroke per year worldwide.

A major role of the trunk is to predict the movements of limbs in advance and allow the body to prepare so that normal movements can occur.[2,3] Trunk control is one of the important prognostic indicators for the functional outcome of stroke patients.[1] If there is instability in the trunk, excessive load on the spinal structure and soft tissues may cause disturbance in balance and postural control ,so that stability of the trunk is the basic of all functional movements, Trunk muscles not only help in maintaining an erect trunk/posture but also allow effective weight shifts during dynamic postures.[7]

Trunk rehabilitation strategies to improve postural control in turn improving trunk performance evolved from basic approaches such as proprioceptive neuromuscular facilitation[8], Bobath approach[9,10], angular biofeedback[11] to task-related motor training Program[12] Task-specific motor programs focused on the movement components which are in coherence to the tasks performed as a part of daily routine.[13] It has been shown that the administration of task-specific training on various platforms such as plinth[14] and physio ball[13] resulted better trunk performance post-stroke.

"Motor imagery" is considered to be one of the latest rehabilitation strategies to treat the post-stroke disabilities, The imagery helps in activating the mirror neuron system located in the primary motor cortex to absorb both observation and execution of an movement in turn enhancing the cortico-spinal facilitation and cortical reorganization.[15,16] Recent systematic reviews have suggested that motor imagery practice may be effective in enhancing motor performance in sports and in patients after stroke, but the evidence for using it in people who present with cognitive, sensory, and motor difficulties is limited.[17-20]

"Mental imagery" can be defined as a Dynamic state during which an individual simulates a given action.[21] Mental imagery is a multimodal cognitive simulation process that enables us to represent perceptual information in our minds in the absence of actual sensory input A "motor imagery" is the mental representation of a previously executed movement, while motor imagery based mental practice is a process whereby a motor image is evoked repeatedly to improve motor behaviour.[22] Active Motor Imagery includes: 1) Laterality reconstruction 2) Mirror therapy

AIM OF THE STUDY

The aim of this study is to find out the effectiveness of truncal motor imagery practice on trunk performance, gait performance and functional outcome among patients with acute hemiparetic stroke.

OBJECTIVE

To evaluate the performance of truncal motor imagery practice on trunk performance, gait performance and functional outcome in three different timr periods(by the end of 2^{nd} , 4^{th}, 6^{th} weeks)

MATERIALS & METHODS

STUDY DESIGN:

Non Randomized, pre test post test control trial

STUDY SETTING

The study was conducted in Department of physical medicine and rehabilitation, Kovai Medical Center and Hospital participants were included considering the inclusion and exclusion criteria

INCLUSION CRITERIA

1. Age 40 to 50 years.
2. Acute stroke with hemodynamic stability.
3. First time stroke.
4. MMSE score > 20.
5. Able to sit without support (5 to 10 sec).
6. Functional Ambulation Category level 2 and above
7. TIS total score should have been between 9 to 12 (static should be 4/7, dynamic between 3 to 6 /10, co-ordination should be 2/6).

EXCLUSION CRITERIA

1. Visual and auditory impairment (Lighthouse near visual acuity test, Rinne's test)
2. History of multiple stroke.
3. Other neurological diseases (Parkinson's disease, Multiple sclerosis etc).
4. Musculoskeletal diseases (low back pain, osteoporosis).
5. Spinal surgeries.

Procedure was explained to the participants and participants were then asked to sign the consent form. Assessment of all the included participants was done as per the assessment form. Participants were randomly divided into two groups Group A and Group B. Group A received truncal motor imagery practice and conventional therapy. Group B received conventional therapy alone outcome measures were taken using Trunk impairment scale(TIS), Dynamic Gait Index(DGI) and Functional independence measure(FIM).

Group A received Truncal motor imagery practice (video based) and conventional therapy:

The patients were instructed to view a 15-min of trunk exercises video on an audio-visual display terminal (motor imagery video).

They were given 45 min of trunk exercises during the first session and 30 min of conventional therapy during the second session.

1. Bridging
2. Trunk rotation in supine
3. Unilateral bridging with single leg raise
4. Lateral trunk flexion
5. Pelvic tilt
6. Forward reach out
7. Forward reach out in multiple direction

All the exercises shown were looped to repeat for six to seven times. While projecting the video on the laptop screen, it was ensured that the patients were in a comfortable position and the screen is in the patient's visual field.

Group B received conventional therapy alone:

Received 45 min of conventional therapy during the first session for the day and 15 min were spent to advice the patient on how to improve the performance of the previous session. They were administered additional 30 min of conventional exercises in the second session

CONVENTIONAL THERAPY

1. Diaphragmatic breathing exercises
2. Range of motion exercises(by passive or assisted)
3. Stretching exercises are given both upper and lower limb – hold it 10 seconds.
4. Strengthening exercises
5. Mat training
6. Wall standing with support
7. Parallel bar training (by a mirror)

RESULT

The difference within and between the groups was analysed using One-way ANOVA and Tukey's HSD post-hoc analysis.

TRUNK IMPAIRMENT SCALE (TIS) FOR GROUP-A

The weekly post test values of the trunk impairment scale (TIS) score for group A were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 30.73592 and the p value is 0.0001.For 2,87 degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected.

TRUNK IMPAIRMENT SCALE (TIS) FOR GROUP-B

The weekly post test values of the trunk impairment scale (TIS) score for group B were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 23.37549 and the p value is 0.0001.For 2,87

degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected.

DYNAMIC GAIT INDEX (DGI) FOR GROUP A

The weekly post test values of the Dynamic gait index (DGI) score for group A were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 29.37593 and the p value is 0.0001.For 2,87 degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected.

DYNAMIC GAIT INDEX (DGI) FOR GROUP B

The weekly post test values of the Dynamic gait index (DGI) score for group B were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 18.56342 and the p value is 0.0001.For 2,87 degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected.

FUNCTIONAL INDEPENDENNCE MEASURE (FIM) FOR GROUP A

The weekly post test values of the functional independent measure (FIM) score for group A were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 88.93724 and the p value is 0.0001.For 2,87 degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected.

FUNCTIONAL INDEPENDENCE MEASURE (FIM) FOR GROUP B

The weekly post test values of the functional independent measure (FIM) score for group B were analysed using One-way ANOVA and Tukey's HSD post-hoc analysis. The post test F value for trunk impairment scale is 23.37549 and the p value is 0.0001. For 2,87 degrees of freedom and 5% level of significance the table F value is 3.10 . As the calculated F value is greater than the table value , the null hypothesis is rejected

Table No 1: Mean analysis of variance among group A for three weeks for Trunk impairment scale

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	26.7556	13.3778	30.73592	<0.00001
Within weeks	87	37.8667	0.4352		
Total	89	64.6222			

Table No 2: Mean analysis of variance among group A for three weeks for Dynamic Gait Index

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	48.6222	24.3111	29.37593	<0.00001
Within weeks	87	72	0.8276		
Total	89	120.6222			

Table No 3: Mean analysis of variance among group A for three weeks for Functional Independence Measure

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	1653.7556	826.8778	88.93724	<0.00001
Within weeks	87	808.8667	9.2973		
Total	89	2462.6222			

Table No 4: Mean analysis of variance among group B for three weeks for Trunk impairment scale

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	23.0889	11.5444	23.37549	<0.00001
Within weeks	87	42.9667	0.4939		
Total	89	66.0556			

Table No 5: Mean analysis of variance among group B for three weeks for Dynamic Gait Index

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	19.2889	9.6444	18.56342	<0.00001
Within weeks	87	45.2	0.5195		
Total	89	64.4889			

Table No 6: Mean analysis of variance among group B for three weeks for Functional Independence Measure

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-STAT	P-VALUE
Between weeks	2	432.0222	216.0111	24.05859	<0.00001
Within weeks	87	781.1333	8.9785		
Total	89	1213.1556			

POST HOC TUKEY'S HSD

GROUP A

T1- 2ND WEEK

T2- 4TH WEEK

T3- 6TH WEEK

TRUNK IMPAIRMENT SCALE (TIS)

WEEKS	$HSD_{.05}$=0.4062 $HSD_{.01}$=0.5096	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	0.73	Q = 6.09 (p= .00013)	Significant
T1:T3	1.33	Q = 11.07 (p= .0000)	Significant
T2:T3	0.60	Q =4.98 (p = .00196)	Significant

DYNAMIC GAIT INDEX (DGI)

WEEKS	$HSD_{.05}$=0.5601 $HSD_{.01}$=0.7027	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	0.93	Q = 5.62 (p= .00042)	Significant
T1:T3	1.80	Q = 10.84 (p= .0000)	Significant
T2:T3	0.87	Q = 5.22 (p = .00113)	Significant

FUNCTIONAL INDEPENDENT MEASURE (FIM)

WEEKS	$HSD_{.05}$=1.8773 $HSD_{.01}$=2.3553	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	5.23	Q = 9.40 (p= .00000)	Significant
T1:T3	10.50	Q = 18.86 (p= .00000)	Significant
T2:T3	5.27	Q = 9.46 (p = .00000)	Significant

CONTROL GROUP

TRUNK IMPAIRMENT SCORE (TIS)

WEEKS	$HSD_{.05}$=0.4327 $HSD_{.01}$=0.5428	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	0.50	Q = 3.90 (p= .01935)	Significant
T1:T3	1.23	Q = 9.61 (p= .0000)	Significant
T2:T3	0.73	Q = 5.72 (p = .00033)	Significant

DYNAMIC GAIT INDEX (DGI)

WEEKS	$HSD_{.05}$=0.4438 $HSD_{.01}$=0.5568	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	0.53	Q = 4.05 (p= .01428)	Significant
T1:T3	1.13	Q = 8.61 (p= .0000)	Significant
T2:T3	0.60	Q = 4.56 (p = .00502)	Significant

FUNCTIONAL INDEPENDENCE MEASURE (FIM)

WEEKS	$HSD_{.05}$=1.8448 $HSD_{.01}$=2.3145	Q.05= 3.3722 Q.01= 4.2308	RESULT
T1:T2	2.70	Q = 4.94 (p= .00218)	Significant
T1:T3	5.37	Q = 9.81 (p= .0000)	Significant
T2:T3	2.67	Q = 4.87 (p = .00250)	Significant

DISCUSSION

The objective of the study is to find the effectiveness of truncal motor imagery practice on trunk performance, gait performance and functional outcome among patients with acute hemiparetic stroke. In the present study, 60 subjects both males and females between the age of 40 to 50 years were selected according to the inclusion and exclusion criteria. The selected subjects were divided into 2 groups Group A and Group B by random allocation by chit method. Group A received truncal motor imagery practice with conventional therapy. Group B received only conventional therapy. Both groups received treatment for 6 weeks, 4 days a week.

The overall effectiveness was found using one-way ANOVA and Tukey's post- HOC HSD for a 2nd, 4th, and 6th week which shows $p<0.05$. the difference is calculated by comparing three weeks by post-hoc analysis and shows group A and group B both has significant level of improvement

but statistically group A shows more improvement than the group B.

The pre and post-outcome measures used were the trunk impairment scale (TIS) for trunk performance, dynamic gait index scale (DGI) for gait performance and functional independence measurement scale (FIM) for functional outcome.

In group A, it was observed that truncal motor imagery practice along with conventional therapy when given for 6 weeks is effective on trunk performance, gait performance and functional outcome in acute hemiparetic stroke patients. The pre and post-scores of TIS, DGI, and FIM shows a considerable difference.

Trunk rehabilitation found an evolution of clinical measurement tools (TCT and TIS) considering the importance of trunk control. Outcomes of rehabilitation were assessed from the acute stage of stroke when the patients are bed bound and have limited mobility. TIS was an evolved tool to measure the truncal involvement of the patients once they attain independent sitting ability.

The rationale for the efficacy of mental practice in stroke as a useful rehabilitation method is that activation of motor areas through imagery will enhance brain plasticity. The upper limb functions especially grasp, grip, pinch, gross movement, ADLs are seriously affected by stroke.

Alternatively, it is possible that an indirect effect of neuroplasticity accounts for the findings, where mental practice reactivates recently used motor representations allowing for an increased effect of the physical practice itself.

As this study enrolled patients for trunk rehabilitation very early poststroke, outcomes capable of recording the effects both in early and sub-acute stages was a mandate. Since TCT emphasizes on early assessment and treatment of trunk, we opted it alongside TIS as our outcome measure.

Robertson and Murre (1999) suggest that 'timely and intensive application of patterned stimulation to accelerate self-repair of networks may be of crucial importance'. It would therefore not be helpful to dismiss the lack treatment effects in this study as being due to involving patients early post-stroke.

combined mental and physical practice gave improvement on the trained task only (Dijkerman et al., 2004), we felt it was necessary to evaluate the benefit of mental practice when not combined with physical practice of the movements.

According to Page SJ, kinesthetic "sensations" of movement, could be highly effective in activating the non-conscious processes involved in motor training. Mental practice is also reported to enhance self confidence as well because subjects can easily apply mental practice techniques prior to performance of any task, which helps their confidence in taking control of task performances.

Trunk motor imagery practice is a clinically important early rehabilitation strategy along with the routine trunk rehabilitation in improving trunk performance, which in turn improves functional balance and daily activity in subjects with acute stroke.

Ryerson et al. compared the proprioceptive trunk position sense of stroke patients with that of normal persons based on trunk repositioning error and reported that stroke patients showed larger differences in the proprioceptive trunk position sense.

Improvement in trunk proprioception and the activation of trunk muscles through motor imagery training can prevent falls that may have occurred and play an important role in activities of daily living and balance.

CONCLUSION

The study was done for 6 weeks. After the completion of 6 weeks of treatment trunk impairment scale (TIS) for trunk performance, dynamic gait index scale (DGI) for gait performance and functional independence measurement scale (FIM) for functional outcome are taken. These values are taken as post-test values. Group A showed significant difference in Trunk performance, Gait performance and

Functional outcome of acute hemiparetic patients before and after the specific truncal motor imagery practice in the 2nd,4th and 6th week after treatment.

The one-way ANOVA and Tukey's post-HOC HSD for a 2nd, 4th, and 6th week showed a significant difference in the truncal motor imagery practice group than the conventional therapy group. The one-way ANOVA and Tukey's post HOC HSD showed that there were significant differences between the groups.

The results suggested that the truncal motor imagery practice along with the conventional therapy is effective in increasing the trunk performance, Gait performance and Functional outcome. So it can be implemented in the treatment of patients with acute hemiparetic patients.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: T.K. Santhosh Kumar, R. Selvaeswaran, V. Dhiviya Dharshini. Effectiveness of truncal motor imagery practice on trunk performance, gait performance and functional outcome among patients with acute hemiparetic stroke. *International Journal of Science & Healthcare Research.* 2023; 8(2): 51-59.
DOI: *https://doi.org/10.52403/ijshr.20230206*

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