

# Combined Effect of Constraint Induced Movement Therapy and Neural Mobilization Technique on Upper Extremity Function in Spastic Hemiplegic Patient – A Single Case Study

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### ABSTRACT

**Purpose:** A single case study was performed carried to understand the benefit of constraint movement therapy and neural mobilization technique and neural mobilization technique on upper extremity function in spastic hemiplegic patient.

**Design/Methodology/Approach:** Numerous advanced researches have been done throughout the world in various study designs including systematic reviews and randomized control trials to analyse the significance of constraint induced movement therapy or neural mobilization technique on upper extremity function spastic hemiplegic patients. But there were very limited research publications on the combined effect of both in the improvement of upper extremity function. In this single case study combined intervention of constrained induced movement therapy and neural mobilization therapy was given to the patient to measure the effect in the form of functional arm reach distance of affected upper extremity. Data was recorded, kept for analysis and reported. The respondent of this single case study was patient encountered with left side hemiplegia with spastic upper extremity.

**Finding/Result:** This case study shown significant improvement in the outcome of modified ashworth scale grades and upper extremity functional arm reach distance in spastic hemiplegic patient after intervention of combined movement of constrained induced movement therapy with neural mobilization for 24 weeks.

**Originality/Value:** Constrained Induced Movement Therapy for improving hand functions in stroke treatment.

**Paper Type:** Case Study Research

**Keywords:** Constrained Induced Movement Therapy, Neural Mobilization, Spastic Hemiplegic, Functional Arm Reach, ABCD Analysis.

### 1. INTRODUCTION :

CVA – Cerebro Vascular Accident is caused by impaired blood flow to the brain and that leads to disturbance in neurological function, and that causes stroke. Interruption in blood flow to the higher centres by means of reduced oxygen and nutritional elements to brain by the way of ischemic changes which happens because of atherosclerotic thrombus developed in the arteries or distant dislodged

thrombus as emboli. If blood vessels is ruptured and leads to haemorrhage that causes of oozing blood around brain structures and causes haemorrhagic stroke [1].

When middle cerebral artery, branch of internal carotid artery gets ischemic, hemorrhagic stroke that leads to opposite side function loss in the form of spastic hemiparesis, face muscles would get weaker muscle function and affected sensory system, motor involvement and reduced function of lower limb and upper limb. But there will be comparatively more involvement of upper limb [2].

### 1.1 Upper Limb Spasticity and its effects in functions:

Increase in muscle tone is known as hyper tonicity or spasticity which generally happens in slow manner in the muscles which are working functionally against gravity. In middle cerebral artery stroke hyper tonicity always affects the depressors of entire shoulder joint and girdle; retracting muscles of scapula and scapula fixator's muscles. Muscles which produce upper trunk side flexion, abduction and medial rotation of the of shoulder joint, forearm pronator muscles, flexors of wrist and elbow joint, finger adductors and flexors are affected and developing spasticity in MCA stroke [3].

The patients who survived stroke feel functionally weak one side of upper limb; they will use more the not affected opposite side to minimize the weakened side functional effect or the limb which is hemiplegic. These kind of patients always have restricted use of the upper extremity which is damaged and more prone to use not affected side more to compensate which will be resulting in phenomenon of non-use upper extremity syndrome [4].

### 1.2 Significance of Constrained Induced Movement Therapy:

Neuro rehabilitation has been added a new way of approach in the form of CIMT - Constraint induced movement therapy which benefits upper limb activity in hemiplegic and in various neuromuscular disorders by involving upper limb activity to progress further. Literary evidence were available in large numbers to support usage of constrained induced movement therapy to minimal to moderate range affected upper limb activity particularly in spastic hemiplegia [5,6].

There were many research articles which were stating that by producing purposeful movements in the form of CIMT there will be more gain in functional outcome of upper extremity [7]. The paretic limb would be benefited by induction of reorganized cortical structure by the introduction of Constrained Induced Movement Therapy. That would have been happened because of repeated movements of the involved upper or lower extremity and that leads to neuroplastic modifications in the anatomical and physiological development of involved cortical structures in hemiplegic patients [8, 9].

### 1.3 Benefits of Neural Mobilization Technique:

Various research works suggested that elongation of peripheral nerves through Neuro muscular stretching were highly beneficial in Neuro rehabilitative measures for the patients with neuromuscular disorders by effectively employing neuro mobilization technique [10, 11]. This suggestion corroborates with scientific studies which indicate the NM can be used in the prevention, assessment and treatment of neuromuscular disorders [11].

Neuro muscular techniques were very effective in reducing increased tone of the muscles, gaining muscle strength, better electrophysiological activity of nerves in the form of NCV and pain in animal subjects [12, 13]. The above mentioned benefits in neuromuscular system were also present in human beings in the form of flexible muscles, increased joint movement range, more motor units firing in fibres of muscle, increased NCV, increased strength and overall functional ability of motor system [14,15].

There is limited studies are available to explain the combined effects of constrained Induced Movement Therapy (CIMT) and Neural Mobilization Techniques to improve the spastic upper extremity functioning in spastic hemiplegic patients. Even though there are numerous research work were available for the benefit of CIMT and NM separately whereas for combined effect there has been a need to further.

This study will provide ample response to study and analyse the combined effect of CIMT and NM on upper extremity functional ability in spastic hemiplegic patients.

## 2. LITERATURE REVIEW :

Search Engines: Google Scholar, DOAJ, zenodo, PubMed.

Year of Search: 1999 – 2017.

**Keywords:** Constrained Induced Movement Therapy (CIMT), Neural Mobilization, Spastic Hemiplegic, Upper Limb Function.

**Table 1:** Literature Review Summary of Upper limb function after CIMT in Stroke  
Literature Review Summary (Source: Author)

S. No.	Field of Research	Focus	Outcomes/Findings	Authors/References
1	Neuro Rehabilitation for stroke patients	Upper limb function	Hyper tonicity is settling first in against gravity musculature of the upper extremity first in spastic hemiplegic patients.	Farmanietal (2016). [3]
2	Stroke Management	Upper limb function	Chronic Hemiplegic Patients use more uninvolved side than involved one for functional activities.	Blatonetal (1999). [4]
3	Neuro Physiology	Involvement of upper limb	Neuronal elongation of peripheral nerve in the functional outcome of lower extremity function.	Chaetal (2014). [18]
4	Neural Mobilization	Limb musculature performance	Neural mobilization improves body balance, muscle flexibility, weight distribution and stability of joint structures.	Santos et al. (2016). [11]
5	Neural Mobilization	Neural stretching	Neural elongation stretches improves the overall neurophysiologic activities of brain.	Kang et al. (2018). [10]
6	Hemiparesis Interventions and management	Constrained Induced Movement Therapy (CIMT)	Multifocal approach of Constrained Induced Movement Therapy with reduced output in the form of functional mobility of involved upper extremity in cerebro vascular accident patients.	Corbett et al., (2016). [19]
7	Neuro Physiotherapy Approaches	Obstacles for CIMT	Obstacles of furthering up the application of CIMT should be analysed and studied.	Vianaetal (2012). [20]
8	Hemiparesis Upper Limb Management	Use of CIMT	The unaffected side got relatively major benefit compared to affected side in upper extremity function because of CIMT.	Schaechter et al., (2002). [21]

Various research studies were available to explain the importance of CIMT – Constrained Induced Movement Therapy in the scheme of things for the treatment of spastic hemiplegic patients, particularly for the benefit of maximizing the functional movements of extremities [16].

For the past 2 decades, the implication and usage of constrained induced movement therapy have emerged in manifolds to manifest the functions of affected limbs in spastic stroke patients generally, upper limb in particular. That was happened by involving movement training of involved upper extremity with target by performing CIMT. The cortical structures of higher centres were redeveloped and reorganised by the application of innovative method of CIMT. That leads overall improvement in functional outcome and development neuroplasticity in stroke patients [4, 17-18].

Mobilizing nerves through neuronal mobilizations would benefit the overall neural mechanism and function by producing more beta waves and rhythms of meu in the cortical area of brain [19]. Usefulness of neuronal mobilizations results in improvement in the joint movement, reduction in had done, increased electrophysiological activities of muscles, evenly distributed weight and improvement in the balance [20].

Previous research studies brought concepts of elongating the nerves of peripheral nervous system by means of exercise movements through neuronal mobilizations methods could be beneficial in neurorehabilitation for central nervous system lesions. There were various scientific works has been done on the efficacy mobilizations of nerves in the form of elongation would be benefiting in screening, preventive measures and treatment of higher centre lesions [21].

### 3. RESEARCH GAP :

There were numerous research articles and publication were done including systematic reviews and randomized controlled trials on the effectiveness of neural mobilization and constrained induced movement therapy available, There are very limited research sources for the combined effect of CIMT and NM on upper extremity function for spastic hemiplegic patients in neuro rehabilitation domain. CIMT with combination of NM might give us new inputs in the treatment of upper extremity function in hemiplegic patients.

### 4. RESEARCH AGENDA :

The prime agenda of this study is to study the effect of combined effect constraint induced movement therapy and neural mobilization technique on upper extremity function in spastic hemiplegic patient.

### 5. OBJECTIVES OF THE STUDY :

The main objectives of this case study are as follows:

- (1) To analyze the combined effect of constraint induced movement therapy and neural mobilization technique on upper extremity function in spastic hemiplegic patient.
- (2) To establish the need of combined methods of NM and CIMT for the management of spastic upper extremity in hemiplegic patients.

To analyze and understand the advantages, benefits, constraints and disadvantages of Constrained Induced Movement Therapy in muscle tone normalization of upper extremity in hemiplegic patients.

**Table 2:** ABCD Analysis of Objectives on Upper Extremity Function, Muscle Tone in Hemiparesis Patients [22-26]

Determinant Issues	Key property	Advantages	Benefits	Constraints	Disadvantages
Researcher	Objectives	Can be used for upper extremity function in spastic hemiparesis	Variety of publication	Wide publication reach	Opportunity loss due to sharing of topic
	Productivity	Increase	Enhanced citation	Time consuming	Exposure to magnetic field
	Cost	Popularity based	Enhanced funding	Not affordable for all	Expensive
Patients	Objective	Muscle tone normalization	Improves ADLs	Time management	It is not a conservative routine approach

	Productivity	Improves functional activities of upper limb	Improves motor function	Incoordination and balance issues	Execution of CIMT may not be perfect
	Cost	Popularity based	Cost effective	Varies as instructor	Concept oriented

## 6. METHODOLOGY :

Study Design: Single Case Study

Study Setting: Abhinav Physiotherapy and Neuro Rehabilitation Centre, Madurai, Tamilnadu.

Study Duration: 6 Months

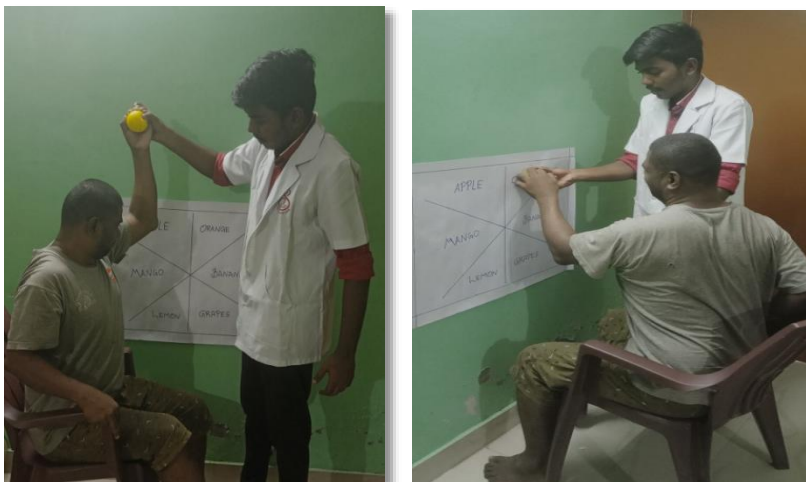
Procedure:

It was a single case study. A 50 year old male was diagnosed with involvement of right MCA ischemic left side spastic hemiplegia before 8 months with spastic upper limb was recruited for this study with explained and taken informed consent. He was undergone conservative physiotherapy treatment involving positioning, strengthening exercises, ambulatory training with balance and coordination exercises after the initial hospital stay for 10 days in Government Rajaji Hospital, Madurai. He came to Abhinav Physiotherapy and Neuro rehabilitation treatment for further progress.

There he was treated with combined constrained induced movement therapy and neural mobilization along conservative physiotherapy management for 24 weeks. Demographic profile of the subject has been recorded. The pre intervention values of outcome measures of modified ashworth scale grades and functional arm reach distance in cm was recorded and kept for further analysis.

CIMT Patients was given functional arm reach with a drawn board which facilitates 360 degree movement of upper extremity in reaching activities. That was given with different tasks and reach for 30 minutes of having minimum 30 tasks for 2 sessions a day, 10 sessions per week for 24 weeks (Picture 1). Along with CIMT neuromuscular mobilization was given for ulnar, radial, and ulnar nerve were given with 10 repetitions of stretch every session (Picture 2).

The post intervention scores of modified ashworth scale grades and functional arm reach distance in cm were measured and reported for further analysis.



Picture 1: Constrained Induced Movement Therapy Technique (Source: Author).  
Constrained Induced Movement Therapy Technique (Source: Author).



Picture 2: Neural Mobilization Technique (Source: Author).  
Neural Mobilization Technique (Source: Author).

**Outcome measures:** Hyper tonicity was measured by modified ashworth scale. Pre intervention score was 3, and post intervention was 2. Pre functional arm reach distance was 19 cm and post one was 25 cm. There was increase in tone of muscles and subsequently the functional arm reach distance was limited. There was significant improvement in both tone and functional arm reach distance. That explains the importance of combination of treatment approaches of CIMT and NM.

## 7. ANALYSIS AND DISCUSSION :

Descriptive statistical method was used to analyse and report the outcome variables of grades of modified ashworth scale and functional arm reach distance in cm. The proposed tasks in the drawn board were explained precisely to the subjects and they were asked to perform exactly to gain improved functional outcomes in the form of CIMT. Additionally neural mobilization was done for all peripheral nerves of upper extremity were done by clinical physiotherapist who was post graduate physiotherapy student. Data collected for this study were recorded, documented and analysed. The results were there was statistically significant improvement in this single case in the outcomes.

**Table 3:** Outcome measures (Table 3)

Intervention	Modified Ashworth Scale	Functional Arm Reach Distance in cm
Pre Intervention	3	19
After 4 week	3	19
After 8 weeks	3	21
After 12 weeks	3	22
After 16 weeks	3	22
After 20 weeks	2	24
Post Intervention After 6 weeks	2	25

Outcome Measures Modified Ashworth Scale and Functional Arm Reach Distance in cm pre, through and post interventions (Source: Author)

The significant changes in the outcome measures were shown after 20 weeks of prolonged intervention of combined constrained induced movement therapy and neural mobilization. That means in the prolonged chronic cases of spastic hemiplegia, there was minimum time period needed to gain physiological benefits in neuromuscular structures happened when the neural structures were benefitted by neuroplastic changes in the cerebral cortex neurons and nervous system as whole [11, 21].

Numerous researches explained the attained benefits of constrained induced movement therapy and neural mobilizations separately. But very limited source was available for understanding the combined effect of CIMT. This study was furthering us to progress forward to apply CIMT and Nm in combination to garner fruitful effects for chronic spastic hemiplegic patients in their functional ability of spastic

upper extremity. This study opens up new conceptual framework of neuro rehabilitative measures for spastic hemiplegic subjects with neglected upper extremity function. Anyway this study is limited to great extend as a single case study, thus more needed research designs have been conducted and studied in future.

### 8. FINDINGS :

The pre, through and post intervention values of outcome measures in the form of Modified Ashworth Scale for spasticity and functional arm reach distance in cm has been improved significantly to maximize the functional and day to day activity use of upper extremity in spastic hemiplegic patients. That drew a new way of treatment to treat spastic functionally limited upper extremity with combination of CIMT and NM.

### 9. LIMITATIONS AND FURTHER RECOMMENDATIONS :

It is a single case study and the treatment duration also for 20 weeks and no follow up was done. Thus this study can be done in advanced research study design and for longer period of intervention with follow ups.

### 10. CONCLUSION :

From this case study, it can be concluded that combination of constrained induced movement therapy adjusted with a dram board and neural mobilization of peripheral nerves of upper extremity were beneficial in treating patient with limited functional movement because of spastic upper extremity in chronic spastic hemiplegic patient.

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**Conflict of Interest:**

None of the authors have conflict of interest.

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