



**EFFECTIVENESS OF INHIBITORY CASTING WITH ELECTRICAL STIMULATION ON  
IMPROVING THE HAND FUNCTION IN PATIENTS WITH MIDDLE CEREBRAL ARTERY  
STROKE**

**Dissertation work submitted to  
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**towards partial fulfillment of the requirements of  
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**Submitted by**

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**THE DISSERTATION ENTITLED**

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Dissertation submitted to

THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY,

CHENNAI-32.

Dissertation evaluated on -----

Internal Examiner

External Examiner

## **CERTIFICATE I**

This is to certify that the dissertation entitled **EFFECTIVENESS OF INHIBITORY CASTING WITH ELECTRICAL STIMULATION ON IMPROVING THE HAND FUNCTION IN PATIENTS WITH MIDDLE CEREBRAL ARTERY STROKE** was carried out by Reg.No.27102320 P.P.G College of physiotherapy, Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R medical university, Chennai-32, under the guidance of Asso.Prof.Mrs. UMA. M.P.T (NEURO).

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Principal

## **CERTIFICATE II**

This is to certify that the dissertation entitled **EFFECTIVENESS OF INHIBITORY CASTING WITH ELECTRICAL STIMULATION ON IMPROVING THE HAND FUNCTION IN PATIENTS WITH MIDDLE CEREBRAL ARTERY STROKE** was carried out by Reg.No. 27102320 P.P.G College of physiotherapy, Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R medical university, Chennai-32, under my guidance and direct supervision.

Asso.Prof. **Mrs. UMA. M.P.T (NEURO)**., MIAP

Professor

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## CONTENTS

<b>CHAPTER</b>	<b>TITLE</b>	<b>PAGE NO.</b>
<b>I</b>	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Need for the study	3
	1.3 Aim of the study	4
	1.4 Objectives of the study	4
	1.5 Hypothesis	5
	1.6 Operational definitions	6
<b>II</b>	REVIEW OF LITERATURE	8
<b>III</b>	MATERIALS AND METHODOLOGY	14
	3.1 Materials Required	14
	3.2 Methodology	14
	3.2.1.Study design	14
	3.2.2 Sampling design	14
	3.2.3.population	15
	3.2.4 sample	15
	3.2.5 .Selection criteria	15
	3.2.5.1Inclusion criteria	16
	3.2.5.2Exclusion criteria	16
	3.2.6.Study setting	16
3.2.7.study method	16	
3.2.8.study duration	18	

	3.2.9.Treatment Duration	18
	3.2.10.Parameter	18
	3.2.11.Statistical Tools	18
	3.2.12Treatment Technique.	19
	3.2.13.Procedure	19
IV	DATA PRESENTATION	22
V	DATA ANALYSIS AND INTERPRETATION	31
VI	RESULTS	32
VII	DISCUSSION	34
VIII	SUMMARY AND CONCLUSION	35
IX	LIMITATIONS AND SUGGESTIONS	36
X	BIBLIOGRAPHY	37
XI	REFERENCES	38
XII	APPENDIX	43

## **ABSTRACT**

**Subject objective :**It is an experimental study design to determine the effectiveness of inhibitory casting with electrical stimulation on improving the hand function in MCA stroke patients .

**Design:** The study was Pre-test and post-test experimental group design.

**Participants:** A sample of 40 MCA stroke patients were divided in to 2 groups : Group A :Experimental group :Treated with inhibitory casting and electrical stimulation and Brunnstorm's approach. Group B : Control group :Treated with traditional stretching and mat activities .

**Outcome measures :**Spasticity, hand function and Brunnstorm's approach were measured using modified ashworthscale,wolf motor function test and Brunnstorm,s recovery scale

**Results :**Statistically group A was significant when compared to group B which received inhibitory casting ,electrical stimulation and Brunnstorm,s approach.

**Conclusion :**The study concludes that inhibitory casting with electrical stimulation and Brunnstorm,s stages in patients with MCA stroke .Thus, this study accepts the alternate hypothesis and rejects the null hypothesis.



# CHAPTER I

## 1.1 INTRODUCTION

Nervous system is the chief controlling and co-ordinating system of the body. Brain is the major organ of the central nervous system controlling body's voluntary & involuntary activities. Adult brain weighs 1.4 kg consumes about 17 % of cardiac output and about 20 % of O<sub>2</sub> used by the body.

Brain is highly sensitive to ischaemia .with CNS artery obstruction of sufficient duration produces tissue death within minutes. How ever changes with in neurons themselves are not evident for 12 to 24 hrs. An inflammatory reaction takes place with in brain tissue resulting in infarction. The damaged neurons will not be replaced and original function of the area will be lost.

Spasticity, is defined here in as a velocity dependent response to passive stretching, most commonly acknowledged sequelae of central nervous system lesions.

Stroke or brain attack is the sudden loss of neurological function caused by an interruption of the blood flow to the brain. Ischaemic stroke is the most common type, affecting about 80 % of individuals with stroke and results when a clot blocks or impairs blood flow, depriving the brain of essential oxygen and nutrients.

\*The middle cerebral artery divides in to a right middle cerebral artery and a left cerebral artery .Damage most often can cause changes in :

- Movement and sensation
- Attention, memory and judgement
- Vision, speech
- Global aphasia and perceptual deficits

\* In an attempt to improve function in patients with spasticity, clinicians prescribed inhibitory casting for many years. The use of electrical stimulation to treat spasticity is not a new concept as early as in 1995, LEVINE ET AL, reported that stimulation of the antagonist to a spastic muscle, followed by vigorous ROM exercises ,led to a dramatic decrease in muscle tone.

\*Stroke is defined as a rapidly developed disturbance of clinical function lasting more than 24 hrs leading to death with no apparent cause other than vascular origin .In south India ,the incidence of

stroke 56.9 per 1000 population .Five and half million survivors of stroke are living in world today.Stroke is second leading cause of death in world next to cardio vascular disease and cancer.

Inhibitory casting produce an effective extrinsic stretch shortening of the extensor musculature,and strengthening of the intrinsic musculature.Electrical stimulation applied to antagonists would reduce agonist muscle tone and increase strength of antagonist muscles and improves the hand function.

In patients with MCA stroke upper limb is commonly affected.Casts provide low load,long duration force by maintaining the affecting extremity in a reflex –inhibiting positions.Casts may cause thermal and tactile receptors to turn-off,thus decreasing motor neuron excitability.

A study by YASUKAMA (1999) found that the use of inhibitory upper extremity casting can enhance function and improves arm-hand position in patients with hemiplegia.Some benefits of casting includes the maintenance of a prolonged,gentle stretch to spastic or contracted muscles.

Brunnstorm a Swedish physical therapist emphasisting the synergistic pattern of movement which develops during recovery from hemiplegia.after these techniques recovery is checked by BRUNNSTORM stages of recovery.

The management of stroke varies from medical to physiotherapy.New techniques were applied accordingly which improves the functional activity in patients with stroke.The progression of the treatment is felt by measuring the spasticity grade and hand function scored by wolf motor function test,finally brunnstorm approach is applied and recovery of the patient is described.Casting with electrical stimulation decreases the spasticity and improves hand function in patients with MCA stroke.

Physiotherapy plays a vital role in the rehabilitation of stroke patients.It includes various techniques in which reduction of spasticity and improvement in hand function plays a major role in upper limb.It helps them in doing various ADL activities .It improves the functional activity and the patients adaptation to environment and social awareness .There are various sensory and motor integration to evaluate the progression and improves safety awareness and prevent the individuals.

Brunnstorm's recovery is well described after applying the combined techniques of inhibitory casting and electrical stimulation.Stages of recovery is measured in each patient in the study which plays major role in establishing the progression of the treatment.

## **1.2 NEED FOR THE STUDY**

The prevalence of stroke is the most common disease in the decade after 50 yrs of age. 28 % of stroke occur in individuals younger than 65 yrs of age. 1.25 times greater in males than females. The early treatment program focuses on to reduce spasticity and increases the range of motion alone. New evolving techniques grades on improvement in hand functional activities showing better recovery.

There were only less reviews concerning inhibitory casting techniques, preferred to electrical stimulation. So I found it would add to the research paper in conducting project with inhibitory casting techniques.

### **1.3 AIM OF THE STUDY**

The aim of the study is to find out The Effectiveness Of Inhibitory Casting With Electrical Stimulation On Improving The Hand Function In Patients With Middle Cerebral Artery Stroke.

### **1.4 OBJECTIVES OF THE STUDY**

To determine the effectiveness of application of an inhibitory casting to patients with MCA stroke in reducing spasticity.

To determine the effectiveness of electrical stimulation with casting in improving hand function in patients with MCA stroke.

## **1.5 HYPOTHESIS**

### **(a) ALTERNATE HYPOTHESIS**

There is significant difference on improvement of hand function of treating the MCA stroke patients with inhibitory casting and electrical stimulation.

### **(b) NULL HYPOTHESIS**

There is no significant difference on improvement of hand function of treating the MCA stroke patients with inhibitory casting and electrical stimulation.

## **1.6 OPERATIONAL DEFINITIONS**

### **Susan O Sullivan**

A **stroke**, previously known medically as a **cerebrovascular accident (CVA)**, is the rapid loss of brain function(s) due to disturbance in the blood supply to the brain. This can be due to ischemia (lack of blood flow) caused by blockage (thrombosis, arterial embolism), or a hemorrhage (leakage of blood).<sup>[1]</sup> As a result, the affected area of the brain cannot function, which might result in an inability to move one or more limbs on one side of the body, inability to understand or formulate speech, or an inability to see one side of the visual field.

### **Fowler Et Al**

A stroke is a medical emergency and can cause permanent neurological damage, complications, and death. It is the leading cause of adult disability in the United States and Europe and the second leading cause of death worldwide.

### **Brunnstorm**

A silent stroke is a stroke that does not have any outward symptoms, and the patients are typically unaware they have suffered a stroke. Despite not causing identifiable symptoms, a silent stroke still causes damage to the brain, and places the patient at increased risk for both transient ischemic attack and major stroke in the future. Conversely, those who have suffered a major stroke are at risk of having silent strokes.

### **Smith**

Spasticity here is defined as a velocity- dependent resistance response to muscle to passive stretching ,may be among the most commonly acknowledged sequelae of central nervous system.

**Ashworth**

Spasm is a jump or twitching of the muscle or limb without control. can be a shooting part of body part in to a position with out control.

**Martin**

Inhibitory casting is a naturally occurring substance derived from gypsum. It mainly reduces spasticity.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

#### **1.BAKER ET AL: 1995**

Reported an increase in wrist and finger extension in 16 adult hemiplegic patients with unilateral flexor spasticity by combining electrical stimulation with inhibitory casting to increase and maintain gain in length of flexors. Range of motion also has improved in wrist flexors and extensors. Position is maintained in reflex-inhibiting position which helps in improving the functional activities.

#### **2.ALFERI : 1995**

States that long-term reduction of muscle tone by administering multiple treatment sessions with inhibitory casting for various small joints .Casting facilitates improved motor function and provides proper stability to the joint being applied for eg, fiber glass cast applied to hand maintains the wrist joint in proper position. it is often used to reduce the muscle tone.

#### **3.TONKIN : 1996**

Describes serial inhibitory casting causes soft tissue changes which has viscoelastic properties of muscle and connective tissue. Provide low load ,prolonged stretch and physiological changes and involves remodeling .Remodeling is mediated by fibroblasts in response to the physical forces due to the casting. He also establishes proper precautions before casting as the patients needs proper sensation to discriminate with other techniques.

#### **4.BRIN MF, ABANY : 1996**

Reported Modified ashworth scale is a reliable scale in measurement of spasticity. This includes maximum score of 4 and describes various stages of spasticity .He studies the various types of stroke and their spasticity level and the significant limb being affected. Also recovery was measured by him 15 randomized controlled trial subjects. The effectiveness was proved by him which measures the spasticity.



## **5. YASUKAMA : 1996**

Found that the use of inhibitory upper extremity casting can enhance function and improves arm-hand position in patients with hemiplegia. Some benefits of casting was well established in study of about 30 subjects. The study approves its

Alternate hypothesis that casting improve shand function and decreases the hand function significantly. Control group was treated with other integrated neuro approaches.

## **6. CUCCURULLO S:1997**

Describes that spasticity is a velocity dependent resistance to movement felt by examiner during stretching a muscle group across a joint, resulting from hyperexcitability of stretch reflex. There is a catch and release which is improved through combination therapy. one such new technique is using casting to the affected limbs and measuring the reduction in spasticity and improvement in hand function.

## **7. STEVEN L. WOLF :1997**

Describes WMFT as a quantitative measure of upper extremity motor ability through timed and functional tasks. The widely used version of WMFT consists of 17 items. Includes 15 function –based tasks and 2 strength based tasks. He first tested the less affected upper extremity followed by the most affected side. Randomized with about 75 subjects with all types of spasticity.

## **8. DE WEERDT W, HARRISON M :1998**

His work is a part of wolf who studied with 25 subjects randomly sampled in to 2 groups who measures the hand function with WMFT and FMAS and concluded and emphasized as a outcome measure to measure the hand function. He selected both sexes of hemiplegic stroke patients and assigned the results. Proved to be an effective tool in measurement.

### **9.LINCOLN,N PARRY H. : 1999**

Brunnstorm approach is a neurological approach which measures the agonist and antagonist activity during voluntary upper limb movement in patients with stroke. These techniques improve function of the arm and hand in chronic hemiplegia. Describes various stages of its recovery in patients with MCA stroke. From initial stage of flaccidity is being explained in the approach and its stages of recovery.

### **10.LEVINE ET AL : 1999**

Reported that stimulation of the antagonist to a spastic muscle, followed by vigorous ROM exercises, led to a dramatic decrease in muscle tone. He studied in about 40 subjects and treated in various other conditions involving spasticity and found that electrical stimulation is effective in reducing the spasticity and improves the hand function.

### **11.GLIMAN AND NEW MAN : 1999**

Investigated a therapeutic regimen using electrical stimulation and dynamic bracing with casts to assess their effectiveness in reducing upper-extremity spasticity in patients with hemiplegia. 19 patients between age group 40-55 yrs with diagnoses of stroke were included and found the efficacy in the treatment regimen.

### **12.DOMISSEE: 2000**

Describes serial inhibitory casting is an intervention practice that is becoming more commonly used in physiotherapy practice, in addition to other intensive treatment. He summarizes the various reviews pertaining to upper and lower limb casting and found various positions to be used. Wrist is being used by fiber glass type of casting in which shape being designed by the therapist according to different shapes of the hands of the patients.

### **13.LAW ET AL : 2000**

States that there are two types of casting namely serial and inhibitory casting in that only a single static cast is used and purpose of both is to reduce the tone than lengthening of the muscles. Static cast worn for 48 hrs found a temporary decrease in spasticity and it allowed active strengthening of the wrist extensors and resultant stability for grasp and release activities.

### **14.PAPPE ET AL : 2001**

Applied electrical stimulation to wrist extensors and triceps of 26 hemiplegic patients but there was a measurable decrease in tone and improves the functional activity in hand .Each patient was treated with electrical stimulation for 30 minutes for 4 weeks in his study.Data concluded decrease in muscle tone and increase in ROM of wrist extensors especially.

### **15.SUSAN O SULLIVAN : 2001**

Stroke is the second leading cause of death and its motor recovery is well described by BRUNNSTORM in his various 6 stages of recovery.Initial stage of flaccidity occurs in acute episode of stroke and is the first stage.He mainly emphasizes on synergy pattern of movement and concentrating on synergy during its recovery.

### **16.BOHANNON RW,SMITH MB : 2002**

Describes spasm is a jumping or twitching of the muscle or limb without control and it can a shooting of the body part in to a position with out control and a rapid series of spasms without significant pausing /resting is defined as one spasm.and the grades were described and the progression is measured.medical research council has also supported the establishment of the scale.

### **17.SAWNER K LAVGNE : 2003**

His work represents a paradigm shift in the approach towards rehabilitation of the stroke injured brain away from pharmacologic flooding of neuronal receptors.He introduced the various stages of Brunnstorm in brief from the immediate affect of stroke that is from the stage of flaccidity.Eventually researchers began to apply his technique and introduced alternate treatment from traditional approach.

#### **18.KING .T :2004**

Reported the existing contractures in specific hemiplegic stroke patients is significantly reduced by casting and stimulation as it improves the reflex inhibiting position in joints and provides stability and improves upper extremity hand function mainly as in MCA stroke patients. Also stimulation causes hyper excitability of stretch reflex.

#### **19.DEMATTEO .C 2005**

His study was to improve hand function in hemiplegic patients who included about 20 subjects and measured using WMFT which provided him insight into joint-specific of total limb movements for patients with hemiplegia. The reliability of the scale was well established by the statistical analysis.

#### **20.WOOD-DAUPHINE .S : 2006**

Included 36 subjects with upper limb spasticity and included treatment of casting and various other combined motor control approaches were applied. There was an improvement in statistical comparison of the values with the study. This shows that casting can be used as a technique used in treating patients with spasticity.

#### **21.MERVILLE O PETRI : 2006**

Describes to test the hypothesis by application of inhibitory casting to spastic upper limb affected with stroke. Outcome measure used by him was spasticity grading scale and its improvement of hand function was well established.

Baseline improvement in decrease of spasticity was observed.

#### **22.KRISTY STEWART :2007**

Explained the complications affecting the MCA stroke patients and determined the combined effect of using inhibitory casting and electrical stimulation. Also he measured the rate of improvement in his studies and used various scales for the measurement.

**23.S.RAMIREZ : 2008**

Investigated the effectiveness of using electrical stimulation using faradic current and shows improvement in hand function in patients with stroke especially in middle cerebral artery stroke.He measured the parameter and resulted that there is a significant improvement in using the above mentioned parameter.

**24.AURI BRUNO PETRINA :2009**

Co-worker in measuring BRUNNSTORM'S APPROACH in measuring the recovery in patients with stroke.Various techniques have been established which particularly measures the spasticity affecting the the upper limb in patients with middle cerebral artery.

**25.SWATHI BISWAS : 2010**

Randomised controlled trial of 30 subjects with middle cerebral artery was done .his work demonstrated the effect of using inhibitory casting as in reflex inhibiting positions provide significant improvement in decreasing the spasticity.

## **CHAPTER III**

### **MATERIALS AND METHODOLOGY**

#### **3.1 MATERIALS REQUIRED**

- Fiber glass cast
- Table, chairs
- Electrical stimulator
- Grading scale assessment sheets
- Stool
- Glass of water, soap and towel

#### **3.2 METHODOLOGY**

##### **3.2.1 STUDY DESIGN**

- The study was an experimental study design with pretest and post test evaluation both in experimental and control group.

##### **3.2.2 SAMPLING DESIGN**

The subjects are selected by non-probability purposive sampling technique.

##### **3.2.3 Population**

The sample size consist of 40 subjects with MCA stroke were selected and assigned in to Group A experimental group and Group B control group.

Experimental group: Consist of 20 MCA stroke subjects treated with inhibitory casting, electrical stimulation and Brunnstorm's approach.

Control group : Consist of 20 MCA stroke subjects treated with traditional stretching and functional mat activities.

### **3.2.4 SAMPLE**

40 Subjects were included in the study.

### **3.2.5 SELECTION CRITERIA**

#### **Inclusion Criteria**

- Both males and females
- Patients with upper limb spasticity
- Patients with middle cerebral artery stroke
- Age group between 45 to 60 yrs
- Patients with normal sensation in affected extremities.

#### **Exclusion criteria**

- Loss of sensation
- Usage of orthotic devices
- Hypersensitive patients
- Brain tumors
- History of diseases like vertigo or vestibular dysfunction
- Cognitive impairment
- Traumatic brain injury

### **3.2.6 STUDY SETTING**

This is proposed to be carried out in the ASHWIN multispecialty hospital  
Coimbatore

### **3.2.7 STUDY METHOD**

Subjects were divided in to control group and experimental group.

## **CONTROL GROUP**

20 Subjects were treated with traditional stretching and mat activities

## **EXPERIMENTAL GROUP**

20 subjects were treated with inhibitory casting with electrical stimulation and Brunnstorm,s approach

### **3.2.8 STUDY DURATION**

The study is proposed to be carried out for the period of 6 months.

### **3.2.9 TREATMENT DURATION**

The study was done for 16 weeks duration for each subject receiving three sessions for a week

### **3.2.10 PARAMETER**

- Modified ashworth spasticity grading scale
- Wolf motor function test
- Brunnstorm's stages of recovery scale.

### **3.2.11 STATISTICAL TOOLS**

Paired 't' – test

The intra group analysis of results were done with paired 't' test with 5% level of significance.

Statistical analysis is done by using dependent 't' test

$$t = \frac{\bar{d}\sqrt{n}}{s}$$



$$S = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

d= difference between the pre-test Vs post test

d = mean difference

n= number of observations

s = standard deviation

### To compare control Group and Experimental Group

Statistical analysis is done by using independent 't' test

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\frac{n_1 n_2}{(n_1 + n_2)}}$$

$$S = \sqrt{\frac{\sum d_1^2 + \sum d_2^2}{n_1 + n_2 - 2}}$$

Where

S = Combined standard deviation

d<sub>1</sub> and d<sub>2</sub> = Difference between initial and final readings in control group and experimental group respectively.

n<sub>1</sub> = No. of patients in control group

n<sub>2</sub> = No. of patients in experimental group

$\bar{X}_1$  and  $\bar{X}_2$  = Mean of control Group and experimental Group respectively.

### **3.2.12 TREATMENT TECHNIQUES**

General instructions about the procedure was explained to the patient .

Warm up exercise were given for a duration of 5 minutes.

Cast was taken in hot water for 2 minutes to bring its softness.

Cast was applied over the affected limb and electrical stimulation was given 12-15 min for a period of 16 weeks.

Electrical stimulation was given with faradic current

Cast was removed and then Brunnstorm approach was given and the recovery of the patient is being checked and the significance is measured.

### **3.2.13 PROCEDURE**

Written consent was being obtained from the patient.Each patient will undergo formal evaluation of inclusion in to the study.Before starting the treatment the complete procedure was explained to the patient.Subjects were advised not to under go any other exercise or treatment during the study period.At the beginning of the study the patients spasticity was measured by modified ashworth scale,WMFT and brunnstorm's recovery stages. The samples were collected randomly,40 patients were randomly assigned in to 2 groups,the study population included only those met the inclusive criteria.40 subjects were divided in to 2 groups ; Experimental group: Consist of 20 mCA stroke subjects treated with inhibitory casting,electrical stimulation and Brunnstorm's approach.

Control group : Consist of 20 MCA stroke subjects treated with traditional stretching and functional mat activities.

Both group were undergone pretest were the patient under experimental group (GROUP A ) are treated for 20-30 minutes in alternate days 3 times per week for 16 weeks and was supervised by the physiotherapist.The patients will undergo initial 5 min of general warm up excercises. The patients under control group (GROUP B) were treated with traditional stretching and functional mat activities .Subjects were advised not to undergo any other exercise or treatment during the study period and were supervised by the physiotherapist.

Data were collected on the first day of treatment and also at end of the treatment.Both groups underwent pretest and post test assessments at regular intervals.

Assessment was performed iimmediately after 16 weeks of study period and measured using various scales.

**TABLE -1**  
**EXPERIMENTAL GROUP (GROUP-A)**

S.No	SPASTICITY WITH IINHIBITORY CASTING		HAND FUNCTION WITH STIMULATION		BRUNNSTORMAPPROACH & RECOVERY STAGE	
	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1	4	1	2	4	2	4
2	3	1	3	5	3	5
3	2	0	1	6	2	5
4	3	1	2	5	2	4
5	4	2	2	4	3	5
6	2	1	2	5	2	6
7	3	1	4	6	3	5
8	4	2	3	4	4	5
9	4	1	4	7	3	6
10	3	0	3	6	2	4
11	3	1	3	5	4	5
12	3	2	2	4	3	6
13	4	1	1	3	4	5
14	2	0	2	4	5	6
15	2	0	3	5	4	6
16	4	2	4	6	3	5
17	3	1	1	4	2	5
18	3	1	2	7	2	4
19	2	0	3	5	3	6
20	2	1	1	4	3	5

**TABLE – 2**  
**CONTROL GROUP (GROUP - B)**

S.No	PRE TEST	POST TEST	PRE TEST	POST TEST	PRE TEST	POST TEST
1.	3	2	1	1	2	2
2	2	2	2	1	3	3
3	2	1	1	2	3	4
4	3	2	2	2	2	3
5	2	2	3	3	2	3
6	2	2	1	1	2	3
7	3	2	1	1	4	5
8	4	3	3	2	5	5
9	2	1	2	2	2	4
10	2	2	1	0	2	3
11	3	2	2	2	5	4
12	4	3	3	2	3	2
13	2	2	4	3	4	5
14	2	1	3	2	4	5
15	3	3	2	2	3	4
16	2	1	1	2	2	3
17	2	2	1	2	2	3
18	3	2	2	2	3	3
19	3	2	2	2	4	5
20	2	1	2	4	3	3

**TABLE-3**

**POST TEST VALUES OF SPASTICITY BETWEEN  
EXPERIMENTAL AND CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	EXPERIMENTAL GROUP (A)	0.95	0.95	0.6458	4.6518
2.	CONTROL GROUP(B)	1.9			

For 38 degrees of freedom at 5% level of significance, the calculated post test ‘t’ values between control and experimental group in spasticity was 4.6518 and the critical value was 2.021 which states that there is significant difference between 2 groups.

**TABLE-4**

**PRE AND POST TEST VALUES OF SPASTICITY IN  
EXPERIMENTAL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	3	2.05	0.1387	66.09
2.	POST TEST	0.95			

For 19 degrees of freedom at 5% level of significance ,the calculated pre test & post test values of experimental group in spasticity was 66.09 and the critical values was 2.093,which states that there exists a significant difference between the groups.

**TABLE-5**

**PRE AND POST TEST VALUES OF SPASTICITY IN CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	2.55	0.65	0.1153	23.272
2.	POST TEST	1.9			

For 19 degrees of freedom at 5% level of significance, the calculated pre & post values of control group in spasticity was 23.272 and critical value was 2.093, which states that there exists a significant difference between the groups.

**TABLE-6**

**POST TEST VALUES OF HAND FUNCTIONS BETWEEN  
EXPERIMENTAL AND CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	A	4.95	3.05	0.7788	12.384
2.	B	1.9			

For 38 degrees of freedom at 5% level of significance, the calculated post test ‘t’ values between control and experimental group in hand function was 12.384 and the critical value was 2.021 which states that there is significant difference between 2 groups.



**TABLE-7**

**PRE AND POST TEST VALUES OF HAND FUNCTION IN  
EXPERIMENTAL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	2.4	2.55	0.2291	49.72
2.	POST TEST	4.95			

For 19 degrees of freedom at 5% level of significance ,the calculated pre test & post test values of experimental group in hand function was 49.72 and the critical values was 2.093,which states that there exists a significant difference between the groups.

**TABLE-8**

**PRE AND POST TEST VALUES OF HAND FUNCTION IN CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	2	0.1	0.1372	19.55
2.	POST TEST	1.9			

For 19 degrees of freedom at 5% level of significance, the calculated pre & post values of control group in hand function was 19.55 and critical value was 2.093, which states that there exists a significant difference between the groups.

**TABLE-9**  
**POST TEST VALUES OF BRUNNSTORM'S RECOVERY STAGE**  
**BETWEEN**  
**EXPERIMENTAL AND CONTROL GROUP**

S. NO	GROUP	MEAN+	MEAN DIFFERENCE	STANDARD DEVIATION	"T" VALUE
1.	A	5.1	1.5	0.8675	5.4679
2.	B	3.6			

For 38 degrees of freedom at 5% level of significance, the calculated post test 't' values between control and experimental group in Brunnstorm's recovery stages was 5.4679 and the critical value was 2.021 which states that there is significant difference between 2 groups.

**TABLE-10**

**PRE AND POST TEST VALUES OF BRUNNSTORM'S RECOVERY  
STAGE IN  
EXPERIMENTAL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	"T" VALUE
1.	PRE TEST	2.95	2.15	0.1864	51.58
2.	POST TEST	5.1			

For 19 degrees of freedom at 5% level of significance ,the calculated pre test & post test values of experimental group in Brunnstorm's recovery stages was 51.58 and the critical values was 2.093,which states that there exists a significant difference between the groups.

**TABLE-11**

**PRE AND POST TEST VALUES OF BRUNNSTORM'S RECOVERY  
STAGE IN  
CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	"T" VALUE
1.	PRE TEST	3	0.6	0.1200	29.814
2.	POST TEST	3.6			

For 19 degrees of freedom at 5% level of significance, the calculated pre & post values of control group in Brunnstorm's recovery stages was 29.814 and critical value was 2.093, which states that there exists a significant difference between the groups.

## **CHAPTER VI**

### **RESULTS**

Effectiveness of control group was measured by comparing pre test and post test values in spasticity ,hand function and checked by using Brunnstorm's recovery stages.The calculated 't' values is greater than the critical value 2.093 which states that there is significant difference in between the groups.

Effectiveness of experimental group was measured by comparing pre-test &post-test values in spasticity,hand function and checked by using Brunnstorm's recovery stages.The calculated 't' value is greater than the critical value 2.093 which states that there is significant difference between the groups.

By comparing the 't' values of experimental and control group 't' value of experimental group is greater than 't' value of control group which states there exists a significant difference in improvement between two groups.

Stroke is a major neurological disorder and its management varies from one stage to another.This study focuses on improving the hand function and shows better recovery according to Brunnstorm.

The technique used was inhibitory casting in reducing the spasticity and electrical stimulation in improving the hand function and brunnstorm's approach finally.statistical significance of 5% level of significance in this study states that there exists a significance of 5% level of significance in this study states that there exists a significant improvement in improvement of hand function and better recovery.spasticity measured by using modified ashworth scale and hand function using wolf motor function test and Brunnstorm's approach using Brunnstorm,s recovery stages.

## **CHAPTER VII**

### **DISCUSSION**

Inhibitory casting and electrical stimulation program adds to growing evidence of management of spasticity and impairment of hand function in patients with MCA stroke which is proved by outcome measures confirmed by many randomized control trials.

Stroke is a major neurological disorder in adults over 50 yrs of age and ceases the functional activity. In this study, the effectiveness of inhibitory casting and electrical stimulation program on spasticity and hand function was found out as evidenced by outcome measures modified ashworth spasticity scale, WMFT and Brunnstorm's stages of recovery. The results of this study could yield greater understanding of new techniques performed as a part of stroke rehabilitation program by the patients with MCA stroke.

Group a (20 subjects ) who fulfill the inclusive criteria received inhibitory casting with electrical stimulation and brunnstorm's approach were given.

Group B (20 subjects ) who fulfill the inclusive criteria received traditional stretching and functional mat activities. The results were analysed using 't'tests. The results showed that there is significant improvement in reduction of spasticity, improvement in hand function and better recovery in group A compared to Group B.

This improvement is due to the fact that inhibitory maintains a position that reduces spasticity and facilitates improved motor function and the position is called reflex-inhibiting position and it normalizes the proprioceptive input, alignment and weight bearing position of the joint. Electrical stimulation to wrist extensors improves the passive range of wrist extension and releases the muscles and improves the functional activities of hand. Brunnstorm's approach finally given enhances the recovery of the patient.

#### **BAKER ET AL: 1999**

Reported an increase in wrist and finger extension in 16 adult hemiplegic patients with unilateral flexor spasticity by combining electrical stimulation with inhibitory casting to increase and maintain gain in length of flexors.

## **TONKIN : 1995**

Describes serial inhibitory casting causes soft tissue changes which has viscoelastic properties of muscle and connective tissue. Provide low load ,prolonged stretch and physiological changes and involves remodeling .Remodeling is mediated by fibroblasts in reponse to the physical forces due to the casting.

The calculated pre test & post test values of experimental group in spasticity was 66.09 and the critical values was 2.093, The calculated pre & post values of control group in spasticity was 23.272 and critical value was 2.093, which states that there exists a significant difference between the groups. The calculated pre test & post test values of experimental group in hand function was 49.72 and the critical values was 2.093 .The calculated pre & post values of control group in hand function was 19.55 and critical value was 2.093.The calculated pre test & post test values of experimental group in Brunnstorm's recovery stages was 51.58 and the critical values was 2.093.The calculated pre & post values of control group in Brunnstorm's recovery stages was 29.814 and critical value was 2.093,which states that there exists a significant difference between the groups. Thus,inhibitory casting and electrical stimulation program adds to growing evidence of management of spasticity and impairment of hand function in patients with MCA stroke which is proved by outcome measures confirmed by many randomized control trials.



## **CHAPTER VIII**

### **CONCLUSION**

The pre test and post test scores are noted and analysis was done using independent 't' test which favored the alternate hypothesis.

The intra group analysis was done and results were analysed using paired 't' test, which favored the alternative hypothesis.

The statistical analysis shows there is significant improvement in reduction of spasticity and improvement in hand function and shows better recovery in patients with affected side as dominant site.

The study concludes that inhibitory casting with electrical stimulation and brunstorm's stages is beneficial on improving hand function and shows better recovery by Brunstorm's stages in patients with MCA stroke. Thus, this study accepts the alternate hypothesis and rejects the null hypothesis.

## **CHAPTER IX**

### **LIMITATIONS & SUGGESTIONS**

- The period of time allotted for the study was found to be insufficient for the inclusion of greater number of subjects. The time allotted for the study per day can be increased to get prognosis.
- Influence of drug, nutritional ,psychological state and climate cannot be controlled
- Study focuses on patients reduction in spasticity and hand function only .Further study ca be done for voluntary control and dual task movements.
- Patients were not instructed for home exercises program. Study can be done with prescribing home exercises.
- Though MAS&WMFT were administered, bias is possible.
- The time allotted for the study per day can be increased to get better prognosis
- My study was done with out follow up further study can be done with follow up program can be included to know the long term effect of treatment
- Small study (40 subjects ) were only used in my study. Study with more number of patients is recommended.

## CHAPTER X

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## CHAPTER XI

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**CHAPTER XII**  
**APPENDIX -1**

**PATIENT CONSENT FORM**

**TITLE : EFFECTIVENESS OF INHIBITORY CASTING WITH ELECTRICAL STIMULATION ON IMPROVING THE HAND FUNCTION IN PATIENTS WITH MIDDLE CEREBRAL ARTERY STROKE.**

**Investigator : -----**

**PURPOSE OF THE STUDY :**

I -----,have been informed that this study will work towards achieving on functional activities of daily living in post stroke conditions for me and other patients.

**PROCEDURE :**

Each term of the study protocol has been explained to me in detail.I understand that during the procedure ,I will be receiving the treatment for one time a day .I understand that I will have to take this treatment for 16 weeks.

I understand that this will done under investigator ,----- supervision .I am aware also that I have to follow therapist's instructions as told to me.

**CONFIDENTIALITY :**

I understand that medical information provided by this study will be confidential. If the data are used for publication in the medical literature or for teaching purposes, no names will be used and other literature such as audio or video tapes will be used only with permission.

**RISK AND DISCOMFORT :**

I understand that there are no potential risks associated with this procedure ,and understand that investigator will accompany me during this procedure..There is no known hazards associated with this procedure.

**REFUSAL OR WITHDRAWAL OF PARTICIPATION :**

I understand that the decision my participation is wholly voluntary and I may refuse participate, may withdraw consent at any time during the study .

I also understand that the investigator may terminate my participation in the study at any time after researcher has explained me the reasons to do so.

I -----have explained the purpose of the research ,the procedures required and the possible risks and benefits, to the best of my ability,I have read and understood this consent to participate we as a subject in this research project.

Signature of the witness :

DATE :

Signature of the patient :

## **APPENDIX-2**

### **PATIENT PROFILE**

NAME :  
AGE :  
SEX :  
OCCUPATION :  
DATE OF ASSESSMENT :  
CHIEF COMPLAINTS :

#### **SUBJECTIVE**

##### **a)History**

Present medical history

Past medical history

##### **b)Surgical history**

##### **c)Drug history**

##### **d) Personel history**

##### **e)Family history**

#### **ON OBSERVATION**

##### **a)Built**

##### **b)Swelling**

##### **c)Soft tissue contours**

#### **VITAL SIGNS**

##### **a)Temperature**

##### **b)Blood pressure**

##### **c)Heart rate**

##### **d)Respiratory rate**



## EXAMINATION ;

1. Higher functions
2. Mental status
3. Speech
4. Hearing Sensory system
5. Vision
6. Cranial nerves
7. Sensory system
8. sensation
9. Motor system
10. Reflexes
11. Co-ordination
12. Involuntary movements
13. Balance
14. Gait analysis
15. hand function
16. Assistive devices
  
17. Functional assessment

## PROBLEM LIST

## MEANS

## **APPENDIX-3**

### **MODIFIED ASHWORTH GRADING SCALE**

0 -No increase in muscle tone

- 1 -Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
- 1+ -Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
- 2 -More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
- 3 -Considerable increase in muscle tone, passive movement difficult
- 4 -Affected part(s) rigid in flexion or extension

## **APPENDIX -4**

### **Wolf Motor Function Scale**

All tasks are performed as quickly as possible and are truncated at 120 seconds. Tasks are as follows: 1. Forearm to table (side): Subject attempts to place forearm on the table by abduction at the shoulder. 2. Forearm to box (side): Subject attempts to place a forearm on the box by abduction at the shoulder. 3. Extend elbow (side): Subject attempts to reach across the table by extending the elbow (to the side). 4. Extend elbow (to the side), with weight: Subject attempts to push the sandbag against outer wrist joint across the table by extending the elbow. 5. Hand to table (front): Subject attempts to place involved hand on the table. 6. Hand to box (front): Subject attempts to place hand on the box. 7. Reach and retrieve (front): Subject attempts to pull 1-lb weight across the table by using elbow flexion and cupped wrist. 8. Lift can (front): Subject attempts to lift can and bring it close to lips with a cylindrical grasp. 9. Lift pencil (front): Subject attempts to pick up pencil by using 3-jaw chuck grasp. 10. Pick up paper clip (front): Subject attempts to pick up paper clip by using a pincer grasp. 11. Stack checkers (front): Subject attempts to stack checkers onto the center checker. 12. Flip cards (front): Using the pincer grasp, patient attempts to flip each card over. 13. Turning the key in lock (front): Using pincer grasp, while maintaining contact, patient turns key fully to the left and right. 14. Fold towel (front): Subject grasps towel, folds it lengthwise, and then uses the tested hand to fold the towel in half again. 15. Lift basket (standing): Subject picks up basket by grasping the handles and placing it on bedside table.

## APPENDIX -5

	Flaccidity no voluntary movements in the affected limb
	Hyperflexia: emergence of spasticity and synergies, Min. Voluntary movement in the affected limbs
	Voluntary movement within synergy, spasticity increases to peak level
	isolated voluntary movements, spasticity and synergies decline
	increasing voluntary control, coordination deficits persist
	motor control and coordination near normal

## **APPENDIX -6**

### **TECHNIQUES :**

- General instructions about the procedure was explained to the patient .
- Warm up exercise were given for a duration of 5 minutes.
- Cast was taken in hot water for 2 minutes to bring its softness.
- Cast was applied over the affected limb and electrical stimulation was given 12-15 min for a period of 16 weeks.
- Cast was removed and then Brunnstorm approach was given and the recovery of the patient is being checked and the significance is measured.

## LIST OF TABLES

<b>TABLE NO</b>	<b>CONTENTS</b>	<b>PAGE NO</b>
1	EXPERIMENTAL GROUP (GROUP -A)	20
2	CONTROL GROUP (GROUP - B)	21
3	POST TEST VALUES OF SPASTICITY BETWEEN EXPERIMENTAL AND CONTROL GROUP	22
4	PRE AND POST TEST VALUES OF SPASTICITY IN EXPERIMENTAL GROUP	23
5	PRE AND POST TEST VALUES OF SPASTICITY IN CONTROL GROUP	24
6	POST TEST VALUES OF HAND FUNCTIONS BETWEEN EXPERIMENTAL AND CONTROL GROUP	25
7	PRE AND POST TEST VALUES OF HAND FUNCTION IN EXPERIMENTAL GROUP	26
8	PRE AND POST TEST VALUES OF HAND FUNCTION IN CONTROL GROUP	27
9	POST TEST VALUES OF BRUNNSTORM'S RECOVERY STAGE BETWEEN EXPERIMENTAL AND CONTROL GROUP	28
10	PRE ANDPOST TEST VALUES OF BRUNNSTORM'S RECOVERY STAGE BETWEEN EXPERIMENTAL GROUP	29
11	PRE ANDPOST TEST VALUES OF BRUNNSTORM'S RECOVERY STAGE BETWEEN CONTROL GROUP	30

## LIST OF GRAPHS

<b>GRAPH.NO</b>	<b>CONTENTS</b>	<b>PAGE.NO</b>
1.	COMPARISON OF PRE TEST VALUE AND POST TEST VALUE IN SPASTICITY	26
2.	COMPARISON OF PRE TEST AND POST TEST VALUE IN HAND FUNCTION	29
3.	COMPARISON OF PRE TEST AND POST TEST VALUE BRUNNSTORM RECOVERY STAGE OF STROKE.	31