# "AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"

**A Dissertation submitted to**

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

**CHENNAI**

*In partial fulfillment of the requirements for the award of the*

## MASTER OF PHYSIOTHERAPY

**Degree Programme**

**Submitted by**

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**SARAVANAM PATTY**

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The Dissertation is entitled

**"AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"**

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Under the guidance of

**Prof. Dr. M. PRADEEPA,**

MPT (Neurology), MIAP.

A Dissertation submitted to

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**CHENNAI**

Dissertation Evaluated on: ……………………...

**INTERNAL EXAMINER** **EXTERNAL EXAMINER**

# CERTIFICATE - I

This is to certify that the dissertation entitled **"AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"** is a bonafide compiled work, carried by **Reg. No: 271520204,** PPG College of Physiotherapy, Coimbatore-641035 in partial fulfillment for the award of degree in Master of Physiotherapy as per the doctrines of requirements for the degree from **THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY, CHENNAI-32.**

This work was guided and supervised by **Prof. Dr. M. PRADEEPA, MPT (Neurology), MIAP**.

**PRINCIPAL**

**DATE:**

**PLACE:**

# CERTIFICATE - II

This is to certify that the dissertation entitled**"AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"** is a bonafide compiled work, carried by **Reg. No: 271520204,** PPG College of Physiotherapy, Coimbatore-641035 in partial fulfillment for the award of degree in Master of Physiotherapy as per the doctrines of requirements for the degree from **THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY, CHENNAI-32,**under my guidance and supervision.

**GUIDE**

**Prof. Dr. M. PRADEEPA,**

**MPT (Neurology)., MIAP.**

**DATE:**

**PLACE:**

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# "AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"


## ABSTRACT

### INTRODUCTION:

The term Stroke is "rapidly developing clinical sign of focal (or global) distribution of cerebral function, lasting for more than 24 hours or leading to death, with no apparent cause other than that of vascular origin. Functional electrical stimulation uses the electrical impulses to produce the muscular contraction in order to induce functional outcomes of non-innervated muscles in patient with neurological disorder. [1]

### METHODOLOGY:

20 patients with sub-acute ischemic middle cerebral artery stroke were selected for this study based on the selection criteria and they were randomly allocated in to two groups by using closed envelop method.

Subjects in group A were treated with convention physiotherapy and subjects in group B were treated with conventional physiotherapy along with the functional electrical stimulation. Both the group received intervention for 6 weeks. The baseline and post test score were measured by using fugl-meyer assessment scale and jebsen and taylor hand function test.

### RESULTS:

The post-test mean values and standard error mean of fugl-meyer assessment scale (upper extremity) for both groups were 34.70 ± 0.366 and 44.700 ± 0.300. The F value was 0.691 and the P value was 0.000 showed there were significant differences between the groups.

The post score values of the jebsen and taylor hand function test score in all the variables showed significant difference in between groups.

## CONCLUSION:

Finally the study concluded that the 6 weeks of upper extremity training program with conventional physiotherapy along with the functional electrical stimulation showed statistically significant improvement in upper extremity gross manual dexterity when compared to the conventional physiotherapy training alone.

## KEYWORDS:

Conventional physiotherapy, Functional electrical stimulation, Upper extremity gross manual dexterity, Fugl-meyer assessment scale, Jebsen and Taylor hand function test, Stroke.

# CHAPTER – I

## 1.1 BACKGROUND OF THE STUDY:

The term Stroke is "rapidly developing clinical sign of focal (or global) distribution of cerebral function, lasting for more than 24 hours or leading to death, with no apparent cause other than that of vascular origin. [1]

By applying this definition transient ischemic attack (TIA), which is defined to last less than 24 hours, and patients with stroke symptoms caused by subdural hemorrhage, tumors, poisoning, or trauma, are excluded. [1,2]

The stroke is one of the leading causes of mortality and morbidity in worldwide. According to the WHO 2012, about 56 million global deaths were estimated, on that 38 million or 68% were due to non-communicable diseases. The leading causes of non-communicable disease deaths were cardiovascular disease (46% of all NCD deaths), which included an estimated 7.4 million deaths due to coronary heart disease and 6.7 million deaths due to cerebrovascular accident or stroke. [2]

The pathological background for stroke may either be ischemic or hemorrhagic disturbances of the cerebral blood circulation.

**ISCHEMIC STROKE:**

Thrombotic cerebral infarction results from the atherosclerotic obstruction of large cervical and cerebral arteries, with ischemia in all or part of the territory of the occluded artery. This can be due to occlusion at the site of the main atherosclerotic lesion or to embolism from this site to more distal cerebral arteries.[3]

Embolic cerebral infarction is due to embolism of a clot in the cerebral arteries coming from other parts of the arterial system, for example, from cardiac lesions, either at the site of the valves or of the heart cardiac cavities, or due to rhythm disturbances with stasis of the blood, which allows clotting within the heart as seen in atrial fibrillation.

Lacunar cerebral infarctions are small deep infarcts in the territory of small penetrating arteries, due to a local disease of these vessels, mainly related to chronic hypertension.[4]

## HEMORRHAGIC STROKE:

Spontaneous intra-cerebral hemorrhages (as opposed to traumatic ones) are mainly due to arteriolar hypertensive disease, and more rarely due to coagulation disorders, vascular malformation within the brain, and diet (such as high alcohol consumption, low blood cholesterol concentration, high blood pressure, etc.). [5]

## SUBARACHNOID STROKE:

This group of strokes is mainly due to the rupture of aneurysms at the bifurcations of large arteries at the inferior surface of the brain. Often they do not cause direct damage to the brain and some studies of stroke have therefore excluded them. However, patients with subarachnoid hemorrhage may develop symptoms that are in accordance with the stroke definitions and should as such be regarded as a stroke. [4,5]

## EPIDEMIOLOGY OF STROKE:

In India, the survey studies reveal that ischemic stroke occurs in 68-80% and hemorrhagic stroke occurs in 20-32%. The Ischemic stroke comprises large vessels (41%), lacunar (18%), cardio-embolic (10%), other determined (10%) and undetermined (20%) subtypes. The intracranial carotid disease is the etiological factor in 30% of ischemic stroke and extra-cranial carotid disease in 25-26% of ischemic stroke cases. [6]

According to the India stroke factsheet updated in 2012, the estimated age-adjusted prevalence rate for stroke ranges between 84/100,000 and 262/100,000 in rural and between 334/100,000 and 424/100,000 in urban areas. [7]

The important risk factors were 57% is due to hypertension, 34% is due to hypocholestreomia, 15% is due to alcohol, and 3.5% is due to anticoagulants. Underlying etiologies were hypertension (79%), vascular malformation (4%), coagulopathy (4%), thrombocytopenia (0.7%), vacuities (0.5%), and cryptogenic stroke (9%). [8]

Many risk factors for stroke have been described. They may refer to inherent biological traits such as age and sex, physiological characteristics that predict future occurrence such as high blood pressure, serum cholesterol, fibrinogen; behaviors such as smoking, diet, alcohol consumption, physical inactivity; social characteristics such as education, social class and ethnicity; and environmental factors that may be physical (temperature, altitude), geographical, or psychosocial.[9,10]

In addition, medical factors including previous TIA or stroke, ischemic heart disease, atrial fibrillation, and glucose intolerance, all increase the risk of stroke.

At a population level, blood pressure and tobacco use are the two most important modifiable risk factors for stroke due to their strong associations, high prevalence and the possibility for intervention. Epidemiological research has shown that raised blood pressure is the single most important risk factor for ischemic stroke with a population attributable risk of 50%. [11-14]

The MCA territory is the one most frequently affected by acute strokes. MCA territory infarcts can be subtle or a devastating clinical syndrome, depending on the site of the occlusion, the extent of ischemia, the etiology, and the collateral arterial network.

Clinically, a patient with an acute complete MCA infarction presents contralateral hemiparesis, hemihypesthesia, hemianopia, and ipsilateral conjugated eye and head deviation (the patient looks at his/her lesion). The patient is usually awake or presents mild drowsiness or agitation, particularly with a right infarct. Cognitive signs are always present: in the case of a left lesion, aphasia, and most of the time global, ideomotor apraxia. [15-18]

Recovery of the upper limb after stroke is poor. Up to 80% of stroke survivors have some upper limb disability during the acute to sub-acute phase after stroke. By various estimates, only 5% to 20% demonstrate complete functional recovery [19-21].

Thus, stroke survivors with upper limb disability appear to be a rehabilitation challenge. There is therefore, a pressing need to increase the potential for functional recovery of the upper limb after stroke.

Research has shown that high intensity, repetitive, goal orientated treatment strategies are important therapeutic components for recovery of upper limb function following stroke. [27, 28]

Most of the improvement in the upper extremity functions occurs in the first three months after stroke, however, the improvement may continue up to six months. [22,23] After the stroke related to middle cerebral artery occlusion, complete or near-complete recovery of the upper extremity functions is only 11.6% in the first six months. [24]

There is no definitive therapy that accelerates the recovery process and increases the level of neurologic improvement. In this period, neurophysiologic exercises, sensorimotor integration, proprioceptive neuromuscular facilitation, biofeedback, and functional electrical stimulation are the techniques that are believed to improve motor recovery.[25,26]

The concept of Functional Electrical Stimulation (FES) is first described by Liberson et al, [28] uses electrical impulses to stimulate the peripheral nerves and to produce controlled functional movements. Functional electrical stimulation uses the electrical impulses to produce the muscular contraction in order to induce functional outcomes of non-innervated muscles in patient with neurological disorder.

Functional electrical stimulation (FES) is a promising therapeutic treatment that complements these strategies, as it allows repetitive training of precise movements despite muscle weakness and paralysis often found post-stroke. [28]

Most research has use done or two channel systems in which one or two muscle groups of the upper limb are stimulated (usually a combination of the wrist extensors, triceps or deltoids).These studies have shown that FES treatments can be effective in improving upper limb motor function. [29-34]

Statistical evidence shows that benefits of FES are greatest when combined with maximum voluntary effort from the patient.[35] However, most upper-extremity (UE) rehabilitation systems that have been clinically trialed employ open-loop or triggered control of one or two muscles. [36]

The purpose of the study is to find out the efficacy of conventional physiotherapy versus conventional physiotherapy along with functional electrical stimulation to improve upper extremity gross manual dexterity among subjects with sub-acute ischemic middle cerebral artery stroke.

## 1.2 NEED OF THE STUDY:

Recovery of the upper limb after stroke is poor. Up to 80% of stroke survivors have some upper limb disability during the acute to sub-acute phase after stroke. By various estimates, only 5% to 20% demonstrate complete functional recovery

Rehabilitation is the main treatment of the individuals with hemiplegia. In all cases, the major aim of rehabilitation is to regain maximum function and quality of life. The exact cause of hemiplegia is not known in all cases, but it appears that the brain is deprived of oxygen and this result in the death of neurons.

In particular, people with severe motor impairments may not be able to benefit from existing conventional therapies. One of the few interventions was available for individuals with severe hemiplegia following stroke is functional electrical stimulation (FES). Several reports suggest that this intervention is one of the most successful strategies to promote recovery after stroke and spinal cord injury.

The need of this current study is to find out the effectiveness of FES is compared to the conventional physiotherapy program on improving gross manual dexterity among subjects with stroke.

## 1.3 AIM OF THE STUDY:

The aim of the study is to examine the efficacy of conventional physiotherapy versus conventional physiotherapy along with functional electrical stimulation to improve upper extremity gross manual dexterity among subjects with sub-acute ischemic middle cerebral artery stroke.

## 1.3 OBJECTIVES OF THE STUDY:

- To find out the effectiveness of conventional physiotherapy to improve upper extremity gross manual dexterity on fugl-meyer assessment (UE) among subject with sub-acute stroke.
- To find out the effectiveness of conventional physiotherapy to improve upper extremity gross manual dexterity on Jebsen and Taylor hand function test among subject with sub-acute stroke.
- To find out the effectiveness of functional electrical stimulation to improve upper extremity gross manual dexterity on fugl-meyer assessment (UE) among subject with sub-acute stroke.
- To find out the effectiveness functional electrical stimulation to improve upper extremity gross manual dexterity on Jebsen and Taylor hand function test among subject with sub-acute stroke.

To compare the effectiveness of conventional physiotherapy and functional electrical stimulation to improve upper extremity gross manual dexterity on fugl-meyer assessment (UE) among subject with sub-acute stroke.

To compare the effectiveness of conventional physiotherapy and functional electrical stimulation to improve upper extremity gross manual dexterity on Jebsen and Taylor hand function test among subject with sub-acute stroke.

## 1.4 HYPOTHESIS:

### 1.4.1: NULL HYPOTHESIS:

There would not have been any statistically significant difference in upper extremity gross manual dexterity on fugl-meyer assessment (UE) after the application of intervention in both the groups among subjects with sub-acute stroke.

There would not have been any statistically significant difference in upper extremity gross manual dexterity on Jebsen and Taylor hand function test after the application of intervention in both the groups among subjects with sub-acute stroke.

### 1.4.2: ALTERNATE HYPOTHESIS:

There would have been any statistically significant difference in upper extremity gross manual dexterity on fugl-meyer assessment (UE) after the application of intervention in both the groups among subjects with sub-acute stroke.

There would have been any statistically significant difference in upper extremity gross manual dexterity on Jebsen and Taylor hand function test after the application of intervention in both the groups among subjects with sub-acute stroke.

## 1.5 OPERATIONAL DEFINITION:

**CEREBROVASCULAR ACCIDENT:**

The term Stroke or cerebrovascular accident is "rapidly developing clinical sign of focal (or global) distribution of cerebral function, lasting for more than 24 hours or leading to death, with no apparent cause other than that of vascular origin.

- **WORLD HEALTH ORGANIZATION**

**ISCHEMIC STROKE:**

Ischemic (clots) stroke occurs as a result of an obstruction within the blood vessels supplying to the central nervous system which is caused by atherosclerotic formation in the blood vessels, cerebral thrombus and cerebral emboli.

- **AMERICAN STROKE ASSOCIATION**

**FUNCTIONAL ELECTRICAL STIMULATION:**

Functional electrical stimulation uses the electrical impulses to produce the muscular contraction in order to induce functional outcomes of non-innervated muscles in patient with neurological disorder.

- **SUSAN B O'SULLIVAN**

**CONVENTIONAL PHYSIOTHERAPY:**

Conventional physiotherapy is defined as the treatment of movement disorders caused by impairment of joints, muscle and nervous system that reproduce the function.

- **SUSAN B O'SULLIVAN**

**GROSS MANUAL DEXTERITY:**

It is the ability to make coordinated hand and finger movements to grasp and manipulate objects. Manual Dexterity includes muscular, skeletal, and neurological functions to produce small, precise movements.

- **SUSAN B O'SULLIVAN**

# CHAPTER – II

# REVIEWS OF LITERATURE

## 2.1 REVIEWS RELATED TO STROKE:

- **TAPAS KUMAR BANERJEE[37] et al., (2016):**

He conducted a fifty years of stroke research in India. He states that the stroke incidence in India is much higher than western industrialized countries. On that large vessel intracranial atherosclerosis is the commonest cause of ischemic stroke in India. The common risk factors, that is, hypertension, diabetes, smoking, and dyslipidemia are quite prevalent and inadequately controlled; mainly because of poor public awareness and inadequate infrastructure.

Only small numbers of ischemic stroke cases are able to have the benefit of thrombolytic therapy. Benefits from stem cell therapy in established stroke cases are under evaluation. Presently prevention of stroke is the best option considering in India scenario through control and/or avoiding the risk factors of stroke.

- **BEYAERT C[38]et al.,(2015):**

He conducted a study on Gait post-stroke: Pathophysiology and rehabilitation strategies. We reviewed neural control and biomechanical description of gait in both non-disabled and post-stroke subjects. In addition, we reviewed most of the gait rehabilitation strategies currently in use or in development and observed their principles in relation to recent Pathophysiology of post-stroke gait. In both non-disabled and post-stroke subjects, motor control is organized on a task-oriented basis using a common set of a few muscle modules to simultaneously achieve body support, balance control, and forward progression during gait. Hemiparesis following stroke is due to disruption of descending neural pathways, usually with no direct lesion of the brainstem and cerebellar structures involved in motor automatic processes. Post-stroke, improvements of motor activities including standing and locomotion are variable but are typically characterized by a common postural behavior which involves the unaffected side more for body support and balance control, likely in response to initial muscle weakness of the affected side. Various rehabilitation strategies are regularly used or in development, targeting muscle activity, postural and gait tasks, using more or less high-technology equipment. Reduced walking speed often improves with time and with various rehabilitation strategies, but asymmetric postural behavior during standing and walking is often reinforced, maintained, or only transitorily decreased. This asymmetric compensatory postural behavior appears to be robust, driven by support and balance tasks maintaining the predominant use of the unaffected side over the initially impaired affected side. Based on these elements, stroke rehabilitation including affected muscle strengthening and often stretching would first need to correct the postural asymmetric pattern by exploiting postural automatic processes in various particular motor tasks secondarily beneficial to gait.

- **VALERY L. FEIGIN[39], et al., (2015):**

He conducted a research on update on the global burden of ischemic and hemorrhagic stroke in 1990-2013: the GBD 2013 study. His study objectives is to estimate the incidence, prevalence, mortality, disability adjusted life years (DALYs) and years lived with disability (YLDs) and their trends for ischemic stroke (IS) and hemorrhagic stroke (HS) for 188 countries from 1990-2013.

He found that there were globally almost 25.7 million stroke survivors (71% with IS), 6.5 million deaths from stroke (51% died from IS), 113 million DALYs due to stroke (58% due to IS) and 10.3 million new strokes (67% IS).

Finally he concluded that the there was a significant increase in the absolute number of DALYs due to ischemic stroke, and of deaths from ischemic stroke and hemorrhagic stroke, survivors and incidents for both IS and HS. The preponderance of the burden of stroke continued to reside in developing countries; comprising 75.2% of deaths from stroke and 81.0% of stroke related DALYs.

- **L. BREWER[40] et al., (2014):**

He conducted a study on Stroke rehabilitation: recent advances and future therapies despite advances in the acute management of stroke, a large proportion of stroke patients are left with significant impairments. Over the coming decades the prevalence of stroke-related disability is expected to increase worldwide and this will impact greatly on families, healthcare systems and economies. Effective neuro-rehabilitation is a key factor in reducing disability after stroke. In this article we have reviewed and discussed the effects of stroke, principles of stroke rehabilitative care and predictors of recovery. We also have also discussed on novel therapies in stroke rehabilitation, including non-invasive brain stimulation, robotics and pharmacological augmentation. Many trials are currently underway, which, in time, may impact on future rehabilitative practice.

- **JAYARAJ DURAI PANDIAN[41] et al., (2013):**

He did the study on stroke epidemiology and stroke care services in India. He reviewed the changing burden of stroke and also the available stroke care services in India. The papers were searched in the search engine PUBMED. The search terms used were ‘stroke in India’, ‘Stroke epidemiology’, ‘Stroke Burden’, ‘Stroke and India’, ‘Stroke care in India’, etc. Totally 1620 papers were listed; out of this around fifty papers were short listed and reviewed. The stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas. The incidence rate is 119-145/100,000 based on the recent population based studies. There is also a wide variation in case fatality rates with the highest being 42% in Kolkata.

He states that stroke units, thrombolysis, and rehabilitation are predominantly available in urban areas, particularly, in private sector hospitals. As a first step, the government of India has started the National program for prevention and control of cancer, diabetes, cardiovascular disease & stroke (NPCDCS). The government is focusing on early diagnosis, management, infrastructure, public awareness, and capacity building at different levels of health care for all the non-communicable diseases including stroke. An organized effort from both the government and the private sector is needed to tackle the rising stroke burden in India.

## 2.2 REVIEWS RELATED TO CONVENTIONAL PHYSIOTHERAPY:

- **G VARADHARAJULU, et al., (2017):**

He did the study on the Effect of Bobath Concept and Conventional Approach on the, Functional Outcome in the Post Stroke Hemiplegic Individuals. He tried to find significant difference in the outcome in both the approaches before and after the treatment. Pre post experimental design of study included total 60 patients who fulfills the inclusion criteria and treated with above mentioned approaches the functional outcomes were assessed by using modified Barthel index which has got highest value of inter and intra rater reliability.

There was no statistically significant difference between group A and group B($p=0.0002$).Within group pre post analysis were highly significant ($p<0.0001$). Based on the statistical analysis and interpretations the study accepts the null hypothesis but in the group B (experimental group) the functional recovery attained by the clients was quiet earlier than Group A (control group).

- **CHUNG-SHAN HUNG, et al., (2016):**

He did the study on the Effects of Combination of Robot-Assisted Therapy with Task-Specific or Impairment-Oriented Training on Motor Function and Quality of Life in Chronic Stroke.

Twenty-one subjects with chronic stroke were selected for this study. Participants were recruited and randomized into 1 of 2 groups: (1) RT combined with task-specific (RTT) training (enrolled, n=11; completed, n=11) or (2) RT combined with impairment-oriented (RTI) training (enrolled, n=10; completed, n=9). Participants received 20 intervention sessions (90-100 min/d, 5 d/wk for 4 weeks).The Fugl-Meyer Motor Assessment Upper Extremity subscale, Stroke Impact Scale, Action Research Arm Test, and Medical Research Council Scale were administered at baseline, post treatment, and at 3-month follow-up. Two-way repeated measures analysis of variance was used to investigate the treatment effects.

The improvements of the RTT group in motor function measured by the Fugl-Meyer Motor Assessment Upper Extremity Subscale and quality of life assessed by the Stroke Impact Scale were significantly superior to the RTI group after the interventions. The improvements of the RTT group were maintained for 3 months. Both groups demonstrated significant within group improvements in motor function, muscle power, and quality of life. RTT may be a more compelling approach to enhance motor function and quality of life for a long-term period than RTI. The combination of RT with task-specific training and with impairment-oriented training had similar benefits on upper limb motor function and muscle strength immediately after the interventions.

- **CHANUK YOO, et al., (2015):**

He did the study on Impact of task-oriented training on hand function and activities of daily living after stroke.

Thirty-two patients who had been diagnosed with stroke and underwent rehabilitation therapy participated in the task-oriented training. The participants carried out task-oriented training for 30 min per day for 4 weeks. Their hand function and activities of daily living were evaluated before and after the training. The task-oriented training had a significant impact in terms of improving hand function and activities of daily living.

According to the results of this study, task oriented training resulted in improved hand function and activities of daily living in stroke patients.

- **CHIANG-SOON SONG, et al., (2014):**

He did the study on Effects of Task-oriented Approach on Affected Arm Function in Children with Spastic Hemiplegia Dueto Cerebral Palsy.

Twelve children were recruited by convenience sampling from 2 local rehabilitation centers. The present study utilized a one grouppre-test and post-test design. All of children received task-oriented training for 6 weeks (40 min/day, 5 days/week)and also underwent regular occupational therapy. Three clinical tests, Box and Block Test (BBT), Manual Ability Measure (MAM-16), and Wee Functional Independence Measure (WeeFIM) were performed 1 day before and after training to evaluate the effects of the training. Compared with the pretest scores, there was a significant increase in the BBT, MAM-16, and WeeFIM scores of the children after the 6-week practice period.

The results of this study suggest that a task-oriented approach to treatment of the affected arm improves functional activities, such as manual dexterity and fine motor performance, as well as basic daily activities of patients with spastic hemiplegia due to cerebral palsy.

- **THOMAS PLATZ, et al., (2009):**

He did the study on Best Conventional Therapy Versus Modular Impairment-Oriented Training for Arm Paresis after Stroke: A Single-Blind, Multicenter Randomized Controlled Trial.

A total of 148 anterior circulation ischemic stroke patients were randomly assigned to 45 minutes of additional daily arm therapy over 3 to 4 weeks as either ( *a*) passive therapy with inflatable splints or active arm motor therapy as either (*b*) individualized best conventional therapy (CONV) or ( *c*) standardized IOT, that is Arm BASIS training for severe paresis or Arm Ability training for mild paresis. Main outcome measures included the following: Fugl-Meyer arm motor score (severely paretic arms) and the TEMPA time scores (mildly affected arms). Pre—post (immediate effects) and pre—4 weeks follow-up analyses (long-term effects) were performed.

Overall improvements were documented (mean baseline and change scores efficacy: Fugl-Meyer, arm motor scores, 24.4, +9.1 points; TEMPA, 119, −26.6 seconds; $P < .0001$), but with no differential effects between splint therapy and the combined active motor rehabilitation groups. Both efficacy and effectiveness analyses indicated, however, bigger immediate motor improvements after IOT as compared with best conventional therapy (Fugl-Meyer, arm motor scores: IOT +12.3, CONV +9.2 points; TEMPA: IOT −31.1 seconds, CONV −20.5 seconds; $P = .0363$); for mildly affected patients long-term effects could also be substantiated. Specificity of active training seemed more important for motor recovery than intensity (therapy time). The comprehensive modular IOT approach promoted motor recovery in patients with either severe or mild arm paresis.

## 2.3 REVIEWS RELATED TO FUNCTIONAL ELECTRICAL STIMULATION:

- **SANG HYUNMOON, et al., (2017):**

He did the study on the effects of functional electrical stimulation on muscle tone and stiffness of stroke patients. Ten patients who had suffered from stroke were recruited. The intervention was functional electrical stimulation on ankle dorsi flexor muscle (tibialis anterior). The duration of functional electrical stimulation was 30 minutes, 5 times a week for 6 weeks. The Myoton was used a measure the muscle tone and stiffness of the gastrocnemius muscle (medial and lateral part) on paretic side.

In the assessment of muscle tone, medial and lateral part of gastrocnemius muscle showed differences before and after the experiment. Muscle stiffness of medial gastrocnemius muscle showed differences, and lateral gastrocnemius muscle showed differences before and after the experiment. The changes were greater in stiffness scores than muscle tone. These results suggest that FES on ankle dorsi flexor muscle had a positive effect on muscle tone and stiffness of stroke patients.

- **JAYME S. KNUTSON, et al., (2016):**

He did the study on Contra-laterally Controlled Functional Electrical Stimulation Improves Hand Dexterity in Chronic Hemiparesis - A Randomized Trial.

Stroke patients with chronic (>6 months) moderate to severe upper extremity hemiparesis (n=80) were randomized to receive 10 sessions/wk of CCFES- or cNMES-assisted hand opening exercise at home plus 20 sessions of functional task practice in the laboratory for 12 weeks. The task practice for the CCFES group was stimulation assisted. The primary outcome was change in Box and Block Test (BBT) score at 6 months post treatment. Upper extremity Fugl–Meyer and Arm Motor Abilities Test were also measured.

At 6 months post treatment, the CCFES group had greater improvement on the BBT, 4.6 (95% confidence interval [CI], 2.2–7.0), than the cNMES group, 1.8 (95% CI, 0.6–3.0), between-group difference of 2.8 (95% CI, 0.1–5.5), *P*=0.045. No significant between-group difference was found for the upper extremity Fugl–Meyer (*P*=0.888) or Arm Motor Abilities Test (*P*=0.096). Participants who had the largest improvements on

BBT were <2 years post stroke with moderate (ie, not severe) hand impairment at baseline. Among these, the 6-month post-treatment BBT gains of the CCFES group, 9.6 (95% CI, 5.6–13.6), were greater than those of the cNMES group, 4.1 (95% CI, 1.7–6.5), between group difference of 5.5 (95% CI, 0.8–10.2), *P*=0.023. The study finally concluded that CCFES improved hand dexterity more than cNMES in chronic stroke survivors.

- **S. MAHESWARI, et al., (2014):**

She did the study on Functional Electrical Stimulation for Grasping in Hemiplegic Patients.

Functional electrical stimulation (FES) is an effective technique for the hand rehabilitation functions such as grasping and releasing. The paralyzed patients cannot carry out the activities of daily living. This system can be used for the stroke and spinal cord injured individuals. The technology used in the restoration of hand functions are generally used for the neuro prosthetic restoration. Several prospective studies have shown that repeated motor practice and the motor activity in the real world environment have a favorable effect on the motor recovery in stroke patients. Functional Electrical Stimulation induces greater muscle contraction by providing stimulus through the electrode. By applying stimulus through the electrode, the grasping and the releasing actions has been achieved. The level of stimulation for the paralyzed hand can be adjusted by using the control knob. This stimulation adjustment makes the patient to feel comfort.

- **LIU HUI-HUA, et al., (2013):**

He did the study on functional electrical stimulation increases neural stem/ progenitor cell proliferation and neurogenesis in the sub-ventricular zone of rats with stroke. Adult male Sprague-Dawley rats with permanent middle cerebral artery occlusion (MCAO) were randomly assigned to the control group, the placebo stimulation group, and the FES group. The rats in each group were further assigned to one of four therapeutic periods (1, 3, 7, or 14 days). FES was delivered 48 hours after the MCAO procedure and divided into two 10-minute sessions on each day of treatment with a 10-

minute rest between them. Two intra peritoneal injections of bromodeoxyuridine (BrdU) were given 4 hours apart every day beginning 48 hours after the MCAO. Neurogenesis was evaluated by immunofluorescence staining. Wnt-3 which is strongly implicated in the proliferation and differentiation of neural stem cells (NSCs) was investigated by Western blotting analysis.

FES significantly increased the number of BrdU-positive cells and BrdU/glial fibrillary acidic protein double-positive neural progenitor cells in the SVZ on days 7 and 14 of the treatment ($P < 0.05$). FES augments the proliferation, differentiation, and migration of NSCs and thus promotes neurogenesis, which may be related to the improvement of neurological outcomes.

❖ **YOUNG KIM, et al., (2013):**

He did the research topic on the effects of EMG-triggered functional electrical stimulation on upper extremity function in stroke patients.

A systematic literature search was performed to identify clinical trials evaluating the effects of EMG-triggered functional electrical stimulation (EMG-FES) and task-oriented EMG-triggered FES on the hand functions in stroke patients. Literature review was conducted with the following key words: hand function, functional electrical stimulation, task-oriented, stroke.

Ten clinical trials were included; 8 of them were randomized controlled trial, 1 was block-randomized, and 1 was a pre-post comparison study. A positive effect of electrical stimulation was reported in the patient groups that were treated with functional electrical stimulation combined with specific tasks, and volitional muscle contraction-triggered stimulation that was synchronized with tasks. Motor capabilities of the hand and arm were improved after the rehabilitation.

EMG-triggered electrical stimulation may be more effective than non-triggered electrical stimulation in facilitating the hand functions in stroke patients in terms of muscle strength and voluntary muscle contraction of the paretic hand and arm. Triggered electrical stimulation can be even more effective when it is combined with specific tasks.

❖ **RUNE THORSEN, et al., (2013):**

He did the study on Myo-electrically driven functional electrical stimulation may increase motor recovery of upper limb in post stroke subjects: A randomized controlled pilot study.

Eleven post stroke hemi paretic subjects with residual proximal control of the arm, but impaired volitional opening of the paretic hand, were enrolled and randomized into a treated and a control group. Subjects received 3 to 5 treatment sessions per week until totaling 25 sessions. In the experimental group, myoelectric activity from wrist and finger extensors was used to control stimulation of the same muscles. Patients treated with MeCFES ($n = 5$) had a significant ($p = 0.04$) and clinically important improvement in Action Research Arm Test score (median change 9 points), confirmed by an Individually Prioritized Problem Assessment self-evaluation score. This improvement was maintained at follow-up. The control group did not show a significant improvement ($p = 0.13$). The reduced sample size of participants, together with confounding factors such as spontaneous recovery, calls for larger studies to draw definite conclusions. However, the large and persistent treatment effect seen in our results indicate that MeCFES could play an important role as a clinical tool for stroke rehabilitation.

❖ **T. ADAM THRASHER, et al., (2008):**

He did the study on Rehabilitation of Reaching and Grasping Function in Severe Hemiplegic Patients Using Functional Electrical Stimulation Therapy.

A total of 21subjects with acute stroke were randomized into 2 groups, FES plus conventional occupational and physiotherapy (FES group) or only conventional therapy (control group) 5 days a week for 12 to 16 weeks. A third group of 7 subjects with chronic hemiplegia (at least 5 months post stroke) received only FES therapy (chronic group) and pre–post training changes were compared. FES was applied to proximal and then distal muscle groups during specific motor tasks. At baseline and at the end of treatment, grasping function was assessed using the Rehabilitation Engineering

Laboratory Hand Function Test, along with more standard measures of rehabilitation outcome.

The FES group improved significantly more than the control group in terms of object manipulation, palmar grip torque, and pinch grip pulling force, Barthel Index, Upper Extremity Fugl–Meyer scores, and Upper Extremity Chedoke–McMaster Stages of Motor Recovery. The chronic stroke subjects demonstrated improvements in most categories, but the changes were not statistically significant. FES therapy with upper extremity training may be an efficacious intervention in the rehabilitation of reaching and grasping function during acute stroke rehabilitation.

- **GAD ALON, et al., (2007):**

He did the study on Functional Electrical Stimulation Enhancement of Upper Extremity Functional Recovery during Stroke Rehabilitation: A Pilot Study.

Patients were assigned to either FES combined with task-specific upper extremity rehabilitation (n = 7) or a control group that received task-specific therapy alone (n = 8) over 12 weeks. Hand function (Box & Blocks, B&B; Jebsen-Taylor light object lift, J-T) and motor control (modified Fugl-Meyer, mF-M) were video-recorded for both upper extremities at baseline, 4, 8, and 12 weeks. B&B mean score at 12 weeks favored (*P* = .049) the FES group (42.3 ± 16.6 blocks) over the control group (26.3 ± 11.0 blocks). The FES group J-T task was 6.7 ± 2.9 seconds and faster (*P* = .049) than the 11.8 ± 5.4 seconds of the control group. Mean mF-M score of the FES group at 12 weeks was 49.3 ± 5.1 points out of 54, compared to the control group that scored 40.6 ± 8.2 points (*P* = .042). All patients regained hand function. Upper extremity task-oriented training that begins soon after stroke that incorporates FES may improve upper extremity functional use in patients with mild/moderate paresis more than task-oriented training without FES.

## 2.4 REVIEWS RELATED TO FUGL-MEYER ASSESSMENT SCALE:

- **HEESOO KIM, et al., (2012):**

He did the study on reliability, concurrent validity and responsiveness of the Fugl-Meyer assessment (FMA) for hemiplegic patients.

For the reliability and validity study, 50 patients with stroke were recruited, for responsiveness study 16 hemiplegic patients were participated. Two physical therapists and one occupational therapist rated 50 video recording of hemiplegic patients using the FMA to test the inter rater reliability, and one physical therapist (Rater A) rated each of the 50 video clips on two occasions, two weeks apart, to evaluate the test retest reliability. Responsiveness was calculated three months after the baseline assessment. Reliability was calculated using the intra-class correlation coefficient, standard error of measurement, and smallest real difference. Concurrent validity was examined using Pearson's correlation coefficient and responsiveness was calculated using the effect size and standard response mean.

Assessment using the FMA showed high relative reliability and the absolute reliability was satisfactory for the inter rater and test retest reliabilities. The correlation between motor function of the FMA and Jebsen and Taylor hand function, grip power, motor assessment scale and the Berg balance scale were moderate to good and were highly significant ($p=0.05$), while responsiveness was moderate to large. The result indicates that the FMA is reasonable assessment of the function of the upper and lower extremities of the patient with stroke.

- **KATHERINE J. SULLIVAN, ET AL., (2011):**

She did the study on Fugl-Meyer Assessment of Sensorimotor Function after Stroke Standardized Training Procedure for Clinical Practice and Clinical Trials.

Fifteen individuals with hemiparetic stroke, 17 trained physical therapists across 5 regional clinical sites, and an expert rater participated in an inter-rater reliability study of the Fugl-Meyer motor (total, upper extremity, and lower extremity subscores) and sensory (total, light touch, and proprioception subscores) assessments.

Intra-rater reliability for the expert rater was high for the motor and sensory scores (range, 0.95–1.0). Inter-rater agreement (intraclass correlation coefficient, 2, 1) between expert and therapist raters was high for the motor scores(total, 0.98; upper extremity, 0.99; lower extremity, 0.91) and sensory scores (total, 0.93; light touch, 0.87; proprioception, 0.96).Standardized measurement methods and training of therapist assessors for a multi-site, rehabilitation, and randomized, clinical trial resulted in high inter-rater reliability for the Fugl-Meyer motor and sensory assessments. Poststroke sensorimotor impairment severity can be reliably assessed for clinical practice or rehabilitation research with these methods.

# CHAPTER – III

## MATERIALS AND METHODOLOGY

### 3.1 STUDY DESIGN:

An experimental study design with pre and post- test evaluations was used.

### 3.2 STUDY POPULATION:

Patients with sub-acute ischemic middle cerebral artery stroke were selected for this study.

### 3.3 SAMPLE SIZE:

20 subjects with sub-acute ischemic middle cerebral artery stroke were included for this study.

### 3.4 SAMPLING TECHNIQUE:

20 subjects were randomly allocated in to two groups by using envelop method.

### 3.5 STUDY DURATION:

Duration of the treatment for control group and experimental groups was for 30 minutes per session, 6 days in a week for 6 weeks.

### 3.6 SELECTION CRITERIA:

❖ **INCLUSION CRITERIA:**

- Age group ranges between 45 to 55 years
- Sub-acute stroke with middle cerebral artery involvement confirmed by computer tomography or MRI,
- More than 3 months resulting from first stroke
- Subjects who can follow the verbal commands

❖ **EXCLUSION CRITERIA:**

- Refusal to give informed concern form,
- Subject with severe cognitive deficits,
- Subjects with upper extremity peripheral nerve injury
- Metal implants in the upper extremity(humeral shaft and lower end fracture implants)

- Articular range of motion limited in the wrist (in case of forearm both bone fracture leads to stiff hand or RSD).
- Sever cardiac arrhythmias,
- Subjects who having other neurological disorder,
- Shoulder hand syndrome,
- Inco-operative subjects,

**3.7 MATERIALS USED:**

- Informed Consent Form
- Functional Electrical Stimulator and its accessories
- Fugl-Meyer Assessment scale (Upper Extremity)
- Jebsen and Taylor hand function test score
- Small sized objects – paper clips, button, Bottle caps, and U.S pennies
- 1 regular teaspoon
- Kidney beans (5 Nos)
- Red wooden checkers (5 Nos)
- Large silver tumblers – Empty cans (5 Nos)
- Large peg board blocks (5 Nos)
- Pen and note pad
- Chair, Wooden table
- Stop  watch
- Tennis ball

**3.8 STUDY PROCEDURE:**

The objectives and need of the study was clearly explained to the ethical committee of PPG College of Physiotherapy and Ashwin Stroke care unit. After getting approval from the ethical committee the study was conducted at Department of Neurorehabilitation, Ashwin Stroke Care Unit, Coimbatore.

Based on the selection criteria 20 patients with sub-acute ischemic middle cerebral artery stroke were selected for this study. All the participants were received clear explanation about the study and they were asked to submit the written informed concern form.

All the subjects were asked to submit the informed concern form prior to the study. After that patient was divided into two groups by using closed envelop method. Group A (control group) consisting of 1 subjects and group B (Experimental group) consisting of 12 subjects.

Subjects in control group (Group A) received conventional physiotherapy program. Subjects in experimental group (Group B) received conventional physiotherapy along with functional electrical stimulation therapy.

Both the groups were received intervention for 45 minutes per session, 6 days in a week for 6 weeks. Rather than that both the groups were received routine physiotherapy, occupational therapy and speech therapy treatment.

The baseline score value of upper extremity gross manual dexterity were evaluated by using Fugl-Meyer assessment scale (UE) and Jebsen and Taylor hand function test. After the 6 weeks, the post score were measured by using same measurement tool and the data were recorded.

## 3.9 TECHNIQUES:

Subjects in group A were treated with conventional physiotherapy program and the subjects in group B were treated with conventional physiotherapy program along with the functional electrical stimulation.

### CONVENTIONAL PHYSIOTHERAPY:

The routine rehabilitation session consisted approximately 30 minutes of therapeutic exercises such as range of motion exercise, stretching and strengthening exercise, task oriented approaches, Neuro Developmental technique (NDT), MAT exercise, and facilitation techniques to recruit muscle activity on the paretic extremity.

### FUNCTIONAL ELECTRICAL STIMULATION:

All subjects were received standardized electrical stimulation modality, including the wave form and pulse width and the stimulation intensity was adjusted by the supervising physical therapist according to how successful the correct limb movement was elicited and to the subject's comfort threshold.

The functional electrical stimulation was applied to the Extensor digitorum communis, extensor carpi ulnaris and extensor carpi radialis were stimulated through surface electrodes in the treatment group while the task.

The stimulation current intensity was set to produce full wrist and finger extension with a duty cycle of 10 seconds on and 12 seconds off. The stimulus pulse was a biphasic rectangular waveform with a pulse width of 250 µsn, frequency of 36 Hz, and ramp up and down time of 3 seconds each. The current intensity was adjusted to subject comfort.

# CHAPTER – IV

## DATA ANALYSIS AND RESULTS

This study comprised of two groups, group A subjects were treated with body weight supported treadmill training and subjects in group B were treated with body weight supported treadmill training added functional electrical stimulation.

The values of functional mobility and balance was analysed by SPSS-20 version. The Paired't' test was used for within group analysis. The unpaired't' test was used for inter group analysis.

### 4.1 DEMOGRAPHICAL DATA:

| | **CONTROL GROUP** | **EXPERIMENTAL GROUP** |
|---|---|---|
| **AGE (YEARS)** | 48.6 (2.3) | 49.0 (1.0) |
| **GENDER (MALE)** | 12 | 12 |
| **DURATION OF STROKE (WEEKS)** | 2.5±1.2 | 2.7 ±1.2 |

**Table No: 1:** Demographical Data

## 4.2 WITHIN GROUP ANALYSIS OF GROUP A:

- **FUGL-MEYER ASSESSMENT SCALE (UPPER EXTREMITY):**

| TEST | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | T VALUE | P VALUE |
|---|---|---|---|---|
| **PRE TEST** | 23.000 ± 0.365 | 1.154 | -23.611 | 0.000 |
| **POST TEST** | 34.70 ± 0.366 | 1.159 | | |

**Table No: 2:** Within group analysis of fugl-meyer assessment scale (upper extremity) in control group (Group A).

The Pre mean and standard error mean value of fugl-meyer assessment scale (upper extremity) in group A were 23.000 ± 0.365 and the standard deviation value was 1.154 respectively.

The Post mean and standard error mean value of fugl-meyer assessment scale (upper extremity) in group A were 34.70 ±0.366 and the standard deviation value was 1.159 respectively.

The T value and P value were -23.611 and 0.000 respectively. The statistical report states that there was significant improvement in upper extremity gross manual dexterity after the application of conventional physiotherapy in control group.

- **JEBSEN AND TAYLOR HAND FUNCTION TEST:**

| JTHFT VARIABLES | TEST | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | T VALUE | P VALUE |
|---|---|---|---|---|---|
| HAND WRITING | PRE TEST | 20.600 ±0.400 | 1.264 | 5.667 | 0.000 |
| | POST TEST | 18.900 ± 0.348 | 1.100 | | |
| SIMULATED PAGE TURNING | PRE TEST | 14.200 ± 0.290 | 0.918 | 11.759 | 0.000 |
| | POST TEST | 11.600 ± 0.163 | 0.516 | | |
| PICKING UP SMALL COMMONOBJECT S | PRE TEST | 14.900 ± 0.276 | 0.875 | 16.155 | 0.000 |
| | POST TEST | 12.000 ± 0.210 | 0.666 | | |
| SIMULATED FEEDING | PRE TEST | 13.100 ±0.233 | 0.737 | 7.216 | 0.000 |
| | POST TEST | 11.300 ± 0.213 | 0.674 | | |
| STACKING CHECKERS | PRE TEST | 12.000 ± 0.298 | 0.942 | 8.143 | 0.000 |
| | POST TEST | 10.100 ± 0.179 | 0.567 | | |
| PICKING UP LARGE LIGHT OBJECTS | PRE TEST | 14.300 ± 0.300 | 0.948 | 13.416 | 0.000 |
| | POST TEST | 12.300 ± 0.213 | 0.674 | | |
| PICKING UP LARGE HEAVY OBJECTS | PRE TEST | 15.100 ± 0.233 | 0.737 | 6.866 | 0.000 |
| | POST TEST | 12.800 ± 0.200 | 0.632 | | |

**Table No: 3:** Within group analysis of Jebsen and Taylor hand Function test in control group (Group A).

**HAND WRITING:**

The Pre mean and standard error mean value of hand writing components of Jebsen and Taylor hand Function test in group A were 20.600 ±0.400 and the standard deviation value was 1.264 respectively.

The Post mean and standard error mean value of hand writing components of Jebsen and Taylor hand Function test in group A were 18.900 ± 0.348 and the standard deviation value was 1.100 respectively.

The T value and P value were 5.667 and 0.000 respectively. The statistical report states that there was significant improvement hand writing components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**SIMULATED PAGE TURNING:**

The Pre mean and standard error mean value of simulated page turning components of Jebsen and Taylor hand Function test in group A were 14.200 ± 0.290 and the standard deviation value was 0.918 respectively.

The Post mean and standard error mean value of simulated page turning components of Jebsen and Taylor hand Function test in group A were 11.600 ± 0.163 and the standard deviation value was 0.516 respectively.

The T value and P value were 11.759 and 0.000 respectively. The statistical report states that there was significant improvement hand simulated page turning components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**PICKING UP SMALL COMMON OBJECTS:**

The Pre mean and standard error mean value of pick up small common objects components of Jebsen and Taylor hand Function test in group A were 14.900 ± 0.276 and the standard deviation value was 0.875 respectively.

The Post mean and standard error mean value of pick up small common objects components of Jebsen and Taylor hand Function test in group A were 12.000 ± 0.210 and the standard deviation value was 0.666 respectively.

The T value and P value were 16.155 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up small common objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**SIMULATED FEEDING:**

The Pre mean and standard error mean value of simulated feeding components of Jebsen and Taylor hand Function test in group A were 13.100 ±0.233 and the standard deviation value was 0.737 respectively.

The Post mean and standard error mean value of simulated feeding components of Jebsen and Taylor hand Function test in group A were 11.300 ± 0.213 and the standard deviation value was 0.674 respectively.

The T value and P value were 7.216 and 0.000 respectively. The statistical report states that there was significant improvement hand simulated feeding components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**STACKING CHECKERS:**

The Pre mean and standard error mean value of stacking checker components of Jebsen and Taylor hand Function test in group A were 12.000 ± 0.298 and the standard deviation value was 0.942 respectively.

The Post mean and standard error mean value of stacking checker components of Jebsen and Taylor hand Function test in group A were 10.100 ± 0.179 and the standard deviation value was 0.567 respectively.

The T value and P value were 8.143 and 0.000 respectively. The statistical report states that there was significant improvement hand stacking checker components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**PICKING UP LARGE LIGHT OBJECTS:**

The Pre mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group A were 14.300 ± 0.300 and the standard deviation value was 0.948 respectively.

The Post mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group A were 12.300 ± 0.213 and the standard deviation value was 0.674 respectively.

The T value and P value were 13.416 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up large light objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

**PICKING UP LARGE HEAVY OBJECTS:**

The Pre mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group A were 15.100 ± 0.233 and the standard deviation value was 0.737 respectively.

The Post mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group A were 12.800 ± 0.200 and the standard deviation value was 0.632 respectively.

The T value and P value were 6.866 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up large light objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in control group.

## 4.3 WITHIN GROUP ANALYSIS OF GROUP B:

❖ **FUGL-MEYER ASSESSMENT SCALE (UPPER EXTREMITY):**

| TEST | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | T VALUE | P VALUE |
|---|---|---|---|---|
| **PRE TEST** | 23.600 ± 0.266 | 0.843 | -55.733 | 0.000 |
| **POST TEST** | 44.700 ± 0.300 | 0.948 | | |

**Table No: 4:** Within group analysis of fugl-meyer assessment scale (upper extremity) in experimental group (Group B)

The Pre mean and standard error mean value of fugl-meyer assessment scale (upper extremity) in group B were 23.600 ± 0.266 and the standard deviation value was 0.843 respectively.

The Post mean and standard error mean value of fugl-meyer assessment scale (upper extremity) in group B were 44.700 ±0.300 and the standard deviation value was 0.948 respectively.

The T value and P value were -55.733 and 0.000 respectively. The statistical report states that there was significant improvement in fugl-meyer assessment scale (upper extremity) after the application of functional electrical stimulation in experimental group.

❖ **JEBSEN AND TAYLOR HAND FUNCTION TEST:**

| JTHFT VARIABLES | TEST | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | T VALUE | P VALUE |
|---|---|---|---|---|---|
| HAND WRITING | PRE TEST | 21.200 ± 0.416 | 1.316 | 17.441 | 0.000 |
| | POST TEST | 14.700 ±0.260 | 0.823 | | |
| SIMULATED PAGE TURNING | PRE TEST | 14.800 ± 0.326 | 1.032 | 21.336 | 0.000 |
| | POST TEST | 8.600 ± 0.305 | 0.966 | | |
| PICKING UP SMALL COMMON OBJECTS | PRE TEST | 15.000 ± 0.258 | 0.816 | 26.842 | 0.000 |
| | POST TEST | 7.200 ± 0.290 | 0.918 | | |
| SIMULATED FEEDING | PRE TEST | 13.100 ± 0.276 | 0.875 | 22.841 | 0.000 |
| | POST TEST | 9.000 ± 0.210 | 0.666 | | |
| STACKING CHECKERS | PRE TEST | 12.600 ± 0.339 | 1.074 | 22.021 | 0.000 |
| | POST TEST | 7.900 ± 0.233 | 0.737 | | |
| PICKING UP LARGE LIGHT OBJECTS | PRE TEST | 14.600 ± 0.300 | 0.966 | 23.275 | 0.000 |
| | POST TEST | 6.500 ± 0.166 | 0.527 | | |
| PICKING UP LARGE HEAVY OBJECTS | PRE TEST | 15.200 ± 0.326 | 1.032 | 51.439 | 0.000 |
| | POST TEST | 6.800 ± 0.290 | 0.918 | | |

**Table No: 5:** Within group analysis of Jebsen and Taylor hand Function test in Experimental group (Group B).

**HAND WRITING:**

The Pre mean and standard error mean value of hand writing components of Jebsen and Taylor hand Function test in group B were 21.200 ± 0.416 and the standard deviation value was 1.316 respectively.

The Post mean and standard error mean value of hand writing components of Jebsen and Taylor hand Function test in group B were 14.700 ±0.260 and the standard deviation value was 0.823 respectively.

The T value and P value were 17.441 and 0.000 respectively. The statistical report states that there was significant improvement hand writing components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**SIMULATED PAGE TURNING:**

The Pre mean and standard error mean value of simulated page turning components of Jebsen and Taylor hand Function test in group B were 14.800 ± 0.326 and the standard deviation value was 1.032 respectively.

The Post mean and standard error mean value of simulated page turning components of Jebsen and Taylor hand Function test in group B were 8.600 ± 0.305 and the standard deviation value was 0.966 respectively.

The T value and P value were 21.336 and 0.000 respectively. The statistical report states that there was significant improvement hand simulated page turning components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**PICKING UP SMALL COMMON OBJECTS:**

The Pre mean and standard error mean value of pick up small common objects components of Jebsen and Taylor hand Function test in group B were 15.000 ± 0.258 and the standard deviation value was 0.816 respectively.

The Post mean and standard error mean value of pick up small common objects components of Jebsen and Taylor hand Function test in group B were 7.200 ± 0.290 and the standard deviation value was 0.918 respectively.

The T value and P value were 26.842 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up small common objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**SIMULATED FEEDING:**

The Pre mean and standard error mean value of simulated feeding components of Jebsen and Taylor hand Function test in group B were 13.100 ± 0.276 and the standard deviation value was 0.875 respectively.

The Post mean and standard error mean value of simulated feeding components of Jebsen and Taylor hand Function test in group B were 9.000 ± 0.210 and the standard deviation value was 0.666 respectively.

The T value and P value were 22.841 and 0.000 respectively. The statistical report states that there was significant improvement hand simulated feeding components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**STACKING CHECKERS:**

The Pre mean and standard error mean value of stacking checker components of Jebsen and Taylor hand Function test in group B were 12.600 ± 0.339 and the standard deviation value was 1.074 respectively.

The Post mean and standard error mean value of stacking checker components of Jebsen and Taylor hand Function test in group B were 7.900 ± 0.233 and the standard deviation value was 0.737 respectively.

The T value and P value were 22.021 and 0.000 respectively. The statistical report states that there was significant improvement hand stacking checker components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**PICKING UP LARGE LIGHT OBJECTS:**

The Pre mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group B were 14.600 ± 0.300 and the standard deviation value was 0.966 respectively.

The Post mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group B were 6.500 ± 0.166 and the standard deviation value was 0.527 respectively.

The T value and P value were 23.275 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up large light objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

**PICKING UP LARGE HEAVY OBJECTS:**

The Pre mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group B were 15.200 ± 0.326 and the standard deviation value was 1.032 respectively.

The Post mean and standard error mean value of pick up large light objects components of Jebsen and Taylor hand Function test in group B were 6.800 ± 0.290 and the standard deviation value was 0.918 respectively.

The T value and P value were 51.439 and 0.000 respectively. The statistical report states that there was significant improvement hand pick up large light objects components of Jebsen and Taylor hand Function test after the application of conventional physiotherapy in experimental group.

## 4.4 BETWEEN GROUP ANALYSES:

❖ **FUGL-MEYER ASSESSMENT SCALE (UPPER EXTREMITY):**

| TEST | GROUP | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | F VALUE | P VALUE |
|---|---|---|---|---|---|
| **PRE TEST** | **GROUP A** | 23.000 ± 0.365 | 1.154 | 0.176 | 0.201 |
| | **GROUP B** | 23.600 ± 0.266 | 0.843 | | |
| **POST TEST** | **GROUP A** | 34.70 ± 0.366 | 1.159 | 0.691 | 0.000 |
| | **GROUP B** | 44.700 ± 0.300 | 0.948 | | |

**Table No: 6:** Between group analyses of fugl-meyer assessment scale (upper extremity).

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of fugl-meyer assessment scale (upper extremity) for both groups were 23.000 ± 0.365 and 23.600 ± 0.266. The F value was 0.176 and the P value was 0.201 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of fugl-meyer assessment scale (upper extremity) for both groups were 34.70 ± 0.366 and 44.700 ± 0.300. The F value was 0.691 and the P value was 0.000 showed there were significant differences between the groups.

❖ **JEBSEN AND TAYLOR HAND FUNCTION TEST:**

| TEST | GROUP | MEAN ± STANDARD ERROR MEAN | STANDARD DEVIATION | F VALUE | P VALUE |
|---|---|---|---|---|---|
| **HAND WRITING** | | | | | |
| **PRE TEST** | **GROUP A** | 20.600 ±0.400 | 1.264 | 0.061 | 0.312 |
| | **GROUP B** | 21.200 ± 0.416 | 1.316 | | |
| **POST TEST** | **GROUP A** | 18.900 ± 0.348 | 1.100 | 0.022 | 0.000 |
| | **GROUP B** | 14.700 ±0.260 | 0.823 | | |
| **SIMULATED PAGE TURNING** | | | | | |
| **PRE TEST** | **GROUP A** | 14.200 ± 0.290 | 0.918 | 0.417 | 0.187 |
| | **GROUP B** | 14.800 ± 0.326 | 1.032 | | |
| **POST TEST** | **GROUP A** | 11.600 ± 0.163 | 0.516 | 4.397 | 0.000 |
| | **GROUP B** | 8.600 ± 0.305 | 0.966 | | |
| **PICKING UP SMALL COMMON OBJECTS** | | | | | |
| **PRE TEST** | **GROUP A** | 14.900 ± 0.276 | 0.875 | 0.315 | 0.795 |
| | **GROUP B** | 15.000 ± 0.258 | 0.816 | | |
| **POST TEST** | **GROUP A** | 12.000 ± 0.210 | 0.666 | 1.313 | 0.000 |
| | **GROUP B** | 7.200 ± 0.290 | 0.918 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SIMULATED FEEDING** | | | | | |
| **PRE TEST** | **GROUP A** | 13.100 ±0.233 | 0.737 | 0.788 | 1.000 |
| | **GROUP B** | 13.100 ± 0.276 | 0.875 | | |
| **POST TEST** | **GROUP A** | 11.300 ± 0.213 | 0.674 | 0.685 | 0.000 |
| | **GROUP B** | 9.000 ± 0.210 | 0.666 | | |
| **STACKING CHECKERS** | | | | | |
| **PRE TEST** | **GROUP A** | 12.000 ± 0.298 | 0.942 | 0.135 | 0.201 |
| | **GROUP B** | 12.600 ± 0.339 | 1.074 | | |
| **POST TEST** | **GROUP A** | 10.100 ± 0.179 | 0.567 | 0.813 | 0.000 |
| | **GROUP B** | 7.900 ± 0.233 | 0.737 | | |
| **PICKING UP LARGE LIGHT OBJECTS** | | | | | |
| **PRE TEST** | **GROUP A** | 14.300 ± 0.300 | 0.948 | 0.033 | 0.492 |
| | **GROUP B** | 14.600 ± 0.300 | 0.966 | | |
| **POST TEST** | **GROUP A** | 12.300 ± 0.213 | 0.674 | 0.336 | 0.000 |
| | **GROUP B** | 6.500 ± 0.166 | 0.527 | | |
| **PICKING UP LARGE HEAVY OBJECTS** | | | | | |
| **PRE TEST** | **GROUP A** | 15.100 ± 0.233 | 0.737 | 1.789 | 0.806 |
| | **GROUP B** | 15.200 ± 0.326 | 1.032 | | |
| **POST TEST** | **GROUP A** | 12.800 ± 0.200 | 0.632 | 3.692 | 0.000 |
| | **GROUP B** | 6.800 ± 0.290 | 0.918 | | |

**Table No: 7:** Between group analyses of Jebsen and Taylor hand Function test

**HAND WRITING:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of hand writing components of Jebsen and Taylor Hand Function test for both groups were 20.600 ±0.400 and 21.200 ± 0.416. The F value was 0.061 and the P value was 0.312 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of hand writing components of Jebsen and Taylor Hand Function test for both groups were 18.900 ± 0.348 and 14.700 ±0.260. The F value was 0.022 and the P value was 0.000 showed there were significant differences between the groups.

**SIMULATED PAGE TURNING:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of simulated page turning components of Jebsen and Taylor Hand Function test for both groups were 14.200 ± 0.290 and 14.800 ± 0.326. The F value was0.417 and the P value were 0.187 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of simulated page turning components of Jebsen and Taylor Hand Function test for both groups were 11.600 ± 0.163 and 8.600 ± 0.305. The F value was 4.397 and the P value was 0.000 showed there were significant differences between the groups.

**PICKING UP SMALL COMMON OBJECTS:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of pick up small common objects components of Jebsen and Taylor Hand Function test for both groups were 14.900 ± 0.276 and 15.000 ± 0.258. The F value was 0.315 and the P value was 0.795 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of pick up small common objects components of Jebsen and Taylor Hand Function test for both groups were 12.000 ± 0.210 and 7.200 ± 0.290. The F value was 1.313 and the P value was 0.000 showed there were significant differences between the groups.

**SIMULATED FEEDING:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of simulated feeding components of Jebsen and Taylor Hand Function test for both groups were 13.100 ±0.233 and 13.100 ± 0.276. The F value was 0.788 and the P value was 1.000 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of simulated feeding components of Jebsen and Taylor Hand Function test for both groups were 11.300 ± 0.213 and 9.000 ± 0.210. The F value was 0.685 and the P value was 0.000 showed there were significant differences between the groups.

**STACKING CHECKERS:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of stacking checker components of Jebsen and Taylor Hand Function test for both groups were 12.000 ± 0.298 and 12.600 ± 0.339. The F value was 0.135 and the P value was 0.201showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of stacking checker components of Jebsen and Taylor Hand Function test for both groups were 10.100 ± 0.179 and 7.900 ± 0.233. The F value was 0.813 and the P value was 0.000 showed there were significant differences between the groups.

**PICKING UP LARGE LIGHT OBJECTS:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of pick up large light objects components of Jebsen and Taylor Hand Function test for both groups were 14.300 ± 0.300 and 14.600 ± 0.300. The F value was 0.033 and the P value was 0.492 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of pick up large light objects components of Jebsen and Taylor Hand Function test for both groups were 12.300 ± 0.213 and 6.500 ± 0.166. The F value was 0.336 and the P value was 0.000 showed there were significant differences between the groups.

**PICKING UP LARGE HEAVY OBJECTS:**

The pre-test values of both group A and group B were calculated. The pre mean values and standard error mean of pick up large light objects components of Jebsen and Taylor Hand Function test for both groups were 15.100 ± 0.233 and 15.200 ± 0.326. The F value was 1.789 and the P value was 0.806 showed there were no homogenicity among the groups.

The post-test mean values and standard error mean of pick up large light objects components of Jebsen and Taylor Hand Function test for both groups were 12.800 ± 0.200 and 6.800 ± 0.290. The F value was 3.692 and the P value was 0.000 showed there were significant differences between the groups.

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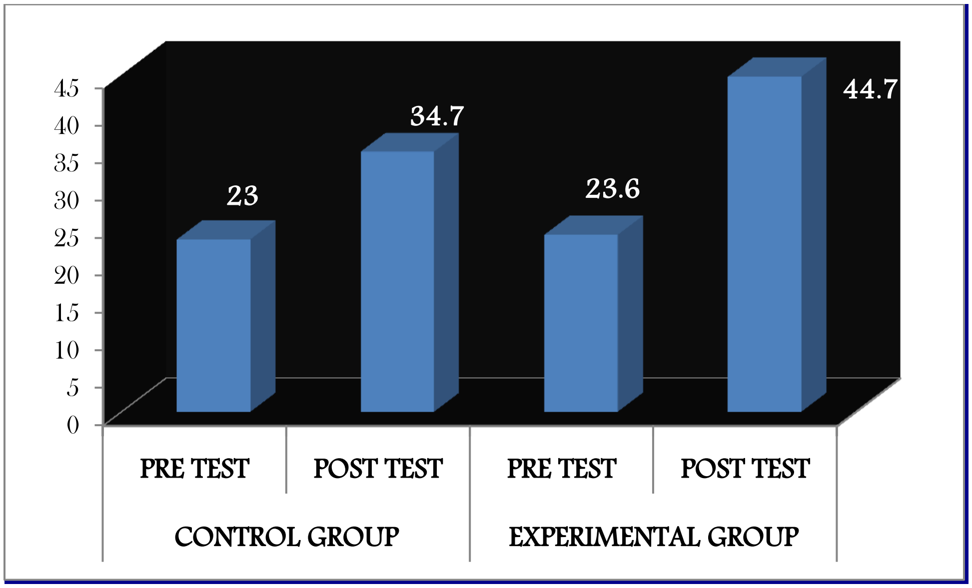
## GRAPHICAL REPRESENTATION

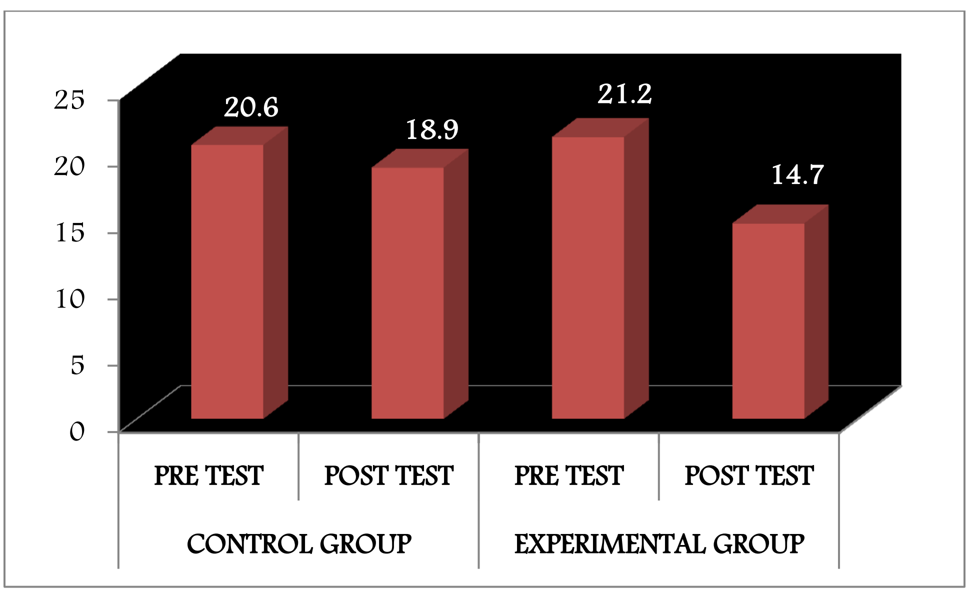
### ❖ FUGL-MEYER ASSESSMENT SCALE (UPPER EXTREMITY):




**GRAPH NO: 1:** Graphical representation of Fugl-Meyer assessment scale values in both the groups.

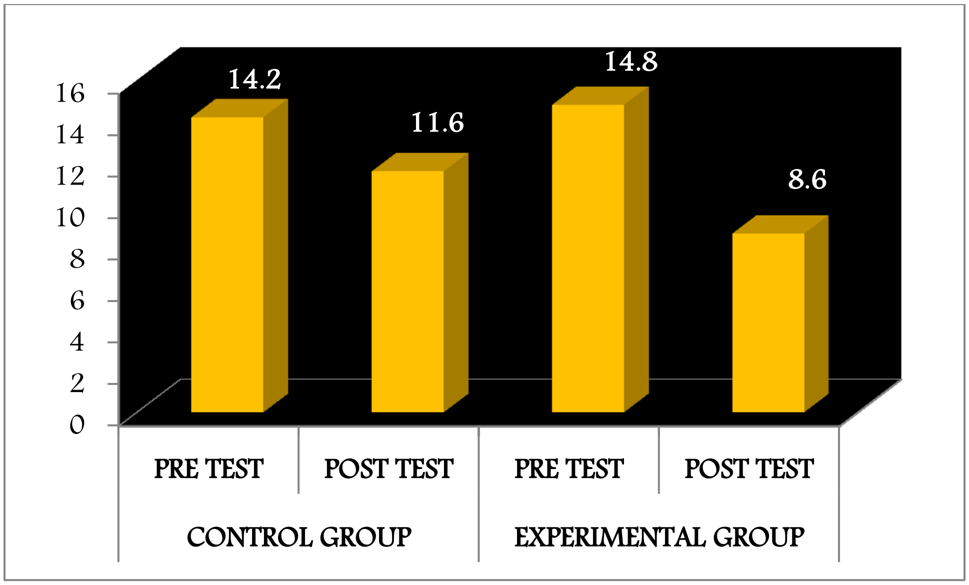
### ❖ JEBSEN AND TAYLOR HAND FUNCTION TEST:

**HAND WRITING:**



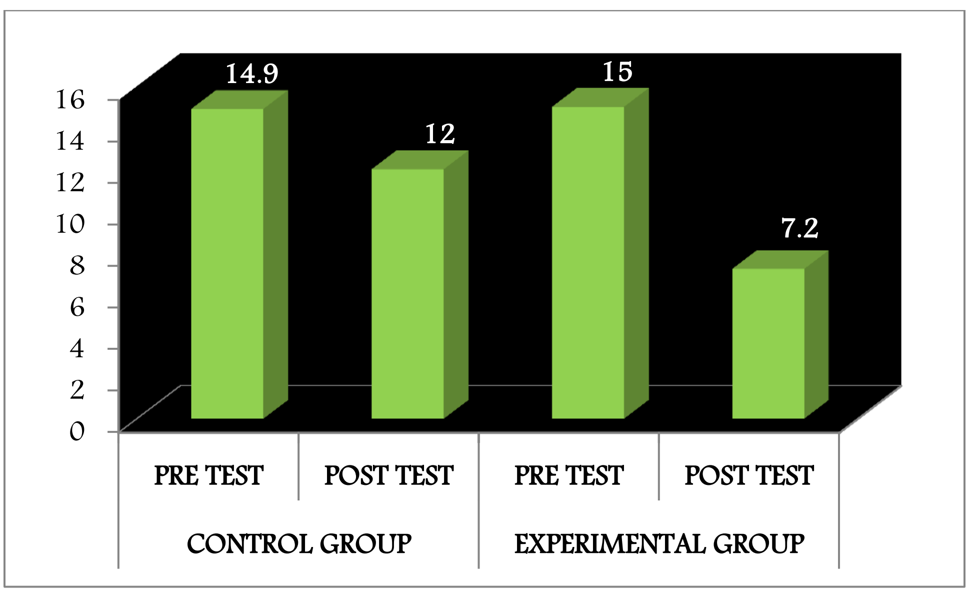

**GRAPH NO: 2:** Graphical representation of hand writing component of Jebsen and Taylor Hand Function Test score values in both the groups.

**SIMULATED PAGE TURNING:**



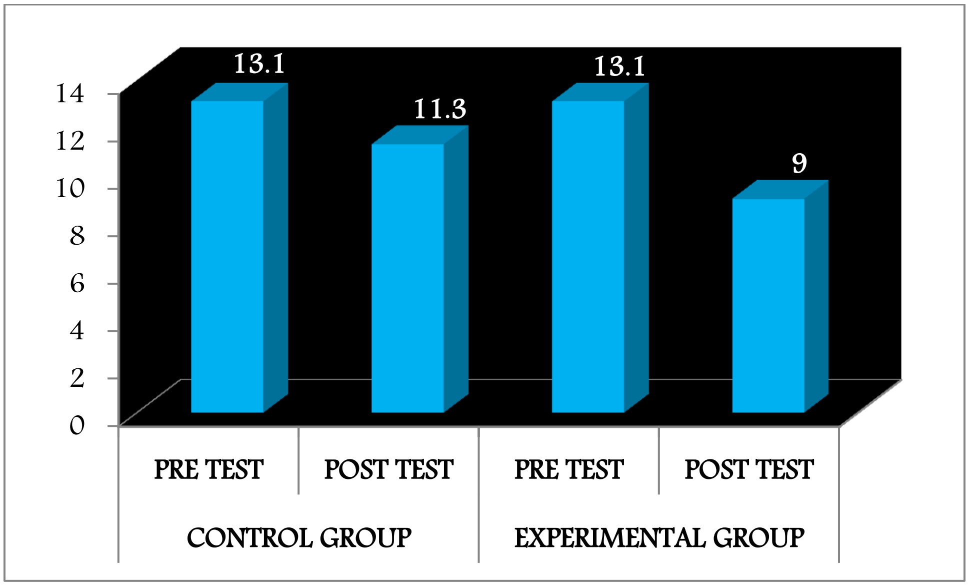

**GRAPH NO: 3:** Graphical representation of simulated page turning component of Jebsen and Taylor Hand Function Test score values in both the groups.

**PICKINGUP SMALL COMMON OBJECTS:**



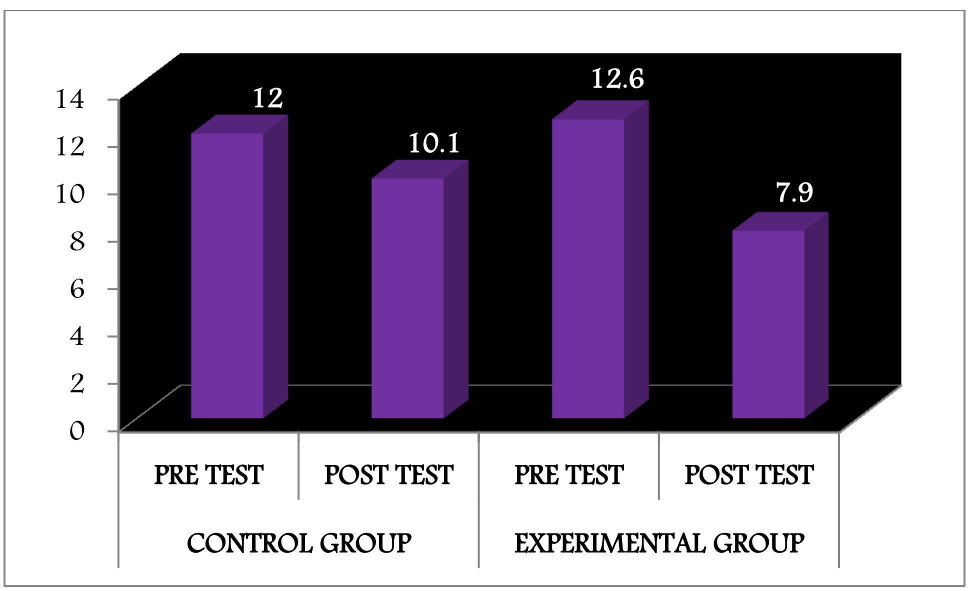

**GRAPH NO: 4:** Graphical representation of picking up small common objects component of Jebsen and Taylor Hand Function Test score values in both the groups.

**SIMULATED FEEDING:**



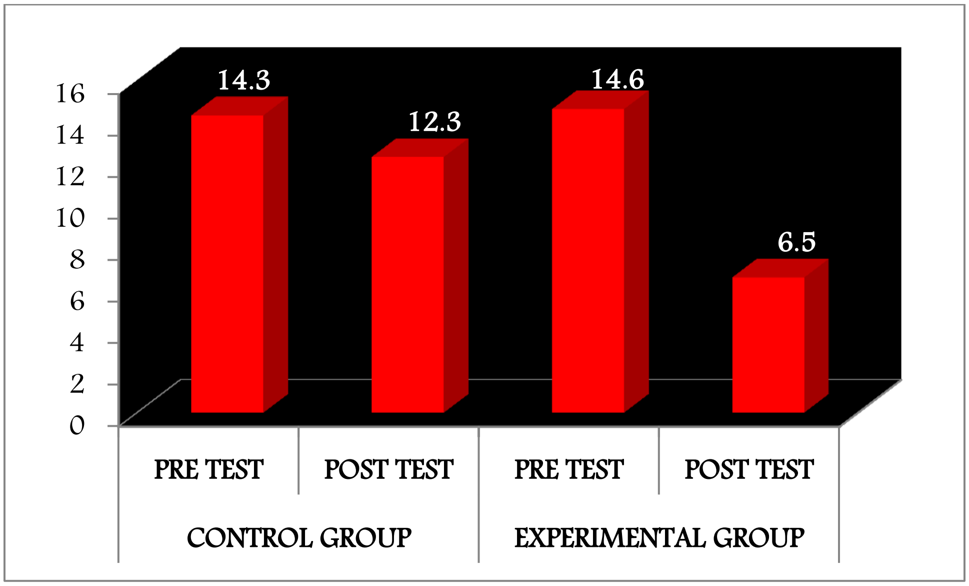

**GRAPH NO: 5:** Graphical representation of simulated feeding component of Jebsen and Taylor Hand Function Test score values in both the groups.

**STACKING CHECKERS:**



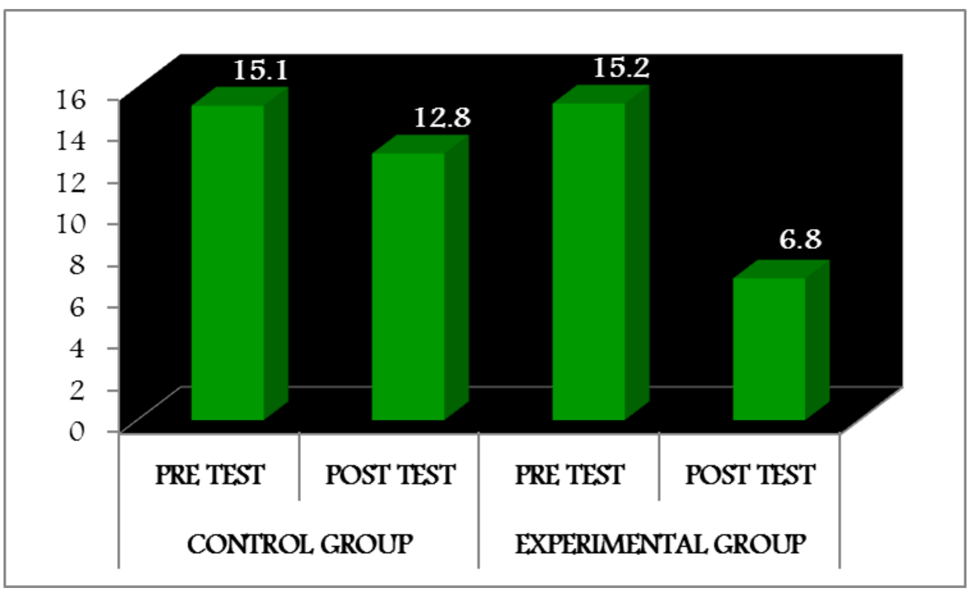

**GRAPH NO: 6:** Graphical representation of stacking checker component of Jebsen and Taylor Hand Function Test score values in both the groups.

**PICKING UP LARGE LIGHT OBJECT:**




**GRAPH NO: 7:** Graphical representation of picking up large light objects component of Jebsen and Taylor Hand Function Test score values in both the groups.

**PICKING UP LARGE HEAVY OBJECT:**




**GRAPH NO: 8:** Graphical representation of picking up large heavy objects component of Jebsen and Taylor Hand Function Test score values in both the groups.

# CHAPTER – V

# DISCUSSIONS

JAYME S. KNUTSON, et al., did the study on Functional Electrical Stimulation, a contra-laterally controlled study which improves Hand Dexterity in Chronic Hemiparesis - A Randomized Trial. Stroke patients with chronic (>6 months) moderate to severe upper extremity hemiparesis (n=80) were randomized to receive 10 sessions/week of CCFES- or cNMES-assisted hand opening exercise at home plus 20 sessions of functional task practice in the laboratory for 12 weeks. The task practice for the CCFES group was stimulation assisted. The primary outcome was change in Box and Block Test (BBT) score at 6 months post treatment. Upper extremity Fugl–Meyer and Arm Motor Abilities Test were also measured.

At 6 months post treatment, the CCFES group had greater improvement on the BBT, 4.6 (95% confidence interval [CI], 2.2–7.0), than the cNMES group, 1.8 (95% CI, 0.6–3.0), between-group difference of 2.8 (95% CI, 0.1–5.5), *P*=0.045. No significant between-group difference was found for the upper extremity Fugl–Meyer (*P*=0.888) or Arm Motor Abilities Test (*P*=0.096). Participants who had the largest improvements on BBT were <2 years post stroke with moderate (i.e., not severe) hand impairment at baseline. Among these, the 6-month post-treatment BBT gains of the CCFES group, 9.6 (95% CI, 5.6–13.6), were greater than those of the cNMES group, 4.1 (95% CI, 1.7–6.5), between group difference of 5.5 (95% CI, 0.8–10.2), *P*=0.023. The study finally concluded that CCFES improved hand dexterity more than cNMES in chronic stroke survivors.

Another author named RUNE THORSEN, et al., did the study on Myo-electrically driven functional electrical stimulation may increase motor recovery of upper limb in post stroke subjects: A randomized controlled pilot study.

Eleven post stroke hemi paretic subjects with residual proximal control of the arm, but impaired volitional opening of the paretic hand, were enrolled and randomized into a treated and a control group. Subjects received 3 to 5 treatment sessions per week until totaling 25 sessions. In the experimental group, myoelectric activity from wrist and finger extensors was used to control stimulation of the same muscles. Patients treated with MeCFES ($n$ = 5) had a significant ($p$ = 0.04) and clinically important improvement in Action Research Arm Test score (median change 9 points), confirmed by an Individually Prioritized Problem Assessment self-evaluation score. This improvement was maintained at follow-up. The control group did not show a significant improvement ($p$ = 0.13). The reduced sample size of participants, together with confounding factors such as spontaneous recovery, calls for larger studies to draw definite conclusions. However, the large and persistent treatment effect seen in our results indicate that MeCFES could play an important role as a clinical tool for stroke rehabilitation.

T. ADAM THRASHER, et al., in this study on Rehabilitation of Reaching and Grasping Function in Severe Hemiplegic Patients Using Functional Electrical Stimulation Therapy had done. A total of 21subjects with acute stroke were randomized into 2 groups, FES plus conventional occupational and physiotherapy (FES group) or only conventional therapy (control group) 5 days a week for 12 to 16 weeks. A third group of 7 subjects with chronic hemiplegia (at least 5 months post stroke) received only FES therapy (chronic group) and pre–post training changes were compared. FES was applied to proximal and then distal muscle groups during specific motor tasks. At baseline and at the end of treatment, grasping function was assessed using the Rehabilitation Engineering Laboratory Hand Function Test, along with more standard measures of rehabilitation outcome.

The FES group improved significantly more than the control group in terms of object manipulation, palmar grip torque, and pinch grip pulling force, Barthel Index, Upper Extremity Fugl–Meyer scores, and Upper Extremity Chedoke–McMaster Stages of Motor Recovery. The chronic stroke subjects demonstrated improvements in most categories, but the changes were not statistically significant. FES therapy with upper extremity training may be an efficacious intervention in the rehabilitation of reaching and grasping function during acute stroke rehabilitation.

In this current study the effectiveness of conventional physiotherapy and conventional physiotherapy along with functional electrical stimulation to improve upper extremity gross manual dexterity among subjects with sub-acute ischemic middle cerebral artery stroke was examined.

Upper limb was selected for this study because upper limb functional improvement was comparatively less than improvement in the lower extremity.

Subjects in group A were treated with conventional physiotherapy and the subjects in group B were treated with conventional physiotherapy which includes task oriented training, passive movement, active assisted movement, stretching and strengthening exercises of paretic limb.

Subjects in group B were treated with conventional physiotherapy along with functional electrical stimulation. Wrist and finger extensors were selected to apply electrical stimulation to regain reaching and grasping activities of the hand. The surface electrodes were used to stimulate the targeted muscle (EDC, ECU, ECRL, ECRB) during the task.

Both the groups were received the intervention for 30 minutes per session, 6 days in a week, for a duration of 6 weeks along with their routine therapy protocol.

The statistical report indicates that there was significant improvement was seen in the fugl-meyer assessment scale score (upper extremity) and jebsen and taylor hand function test score after the application of 6 weeks functional electrical stimulation. So the functional electrical stimulation therapy is one of the best treatment techniques to improve upper extremity gross manual dexterity among subjects with ischemic middle cerebral artery stroke patients.

# CHAPTER – VI

## SUMMARY AND CONCLUSIONS

The study comprises of two groups. Group A (control group) consisting of 10 subjects and group B (Experimental group) consisting of 10 subjects. Subjects in control group (Group A) received conventional physiotherapy. Subjects in experimental group (Group B) received conventional physiotherapy along with functional electrical stimulation therapy.

Both the groups were received intervention for 30 minutes per session, 6 days in a week for 6 weeks along with their routine physiotherapy, occupational therapy and speech therapy treatment.

Finally the study concluded that the 6 weeks of upper extremity training program with conventional physiotherapy along with the functional electrical stimulation showed statistically significant improvement in upper extremity gross manual dexterity when compared to the conventional physiotherapy training alone.

# CHAPTER - VII

## LIMITATIONS AND SUGGESTIONS

1. Small number of subjects only selected for this study and the future study should be done with large sample size.
2. Specific types of stroke were taken in the present study. Future studies should be conducted across various types of stroke and various arterial involvements and various duration of stroke. Thus, variations in finding under the influence of various types, various arterial involvements and various duration of stroke can be studied.
3. The same study can be conducted in patients with other neurological disorder such as spinal cord injury, cerebral palsy, traumatic brain injury.
4. The same study can be conducted with other advanced techniques like robotics etc.

# CHAPTER - VIII

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# CHAPTER IX

## ANNEXURE I

### INFORMED CONSENT FORM

**TITLE:**"AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB-ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE"

**INVESTIGATOR:** Ms. N. Kalaivani

**CO-INVESTIGATOR:** Dr. M. Pradeepa

**PURPOSE OF THE STUDY:**

I _________________ have been informed that this study will help clinicians & therapists to find out the effectiveness of the abdominal binder on blood pressure in lying and standing position among young healthy self-reported college students.

**PROCEDURE:**

I ___________________ understand that I will undergo experiment with Ms. N. Kalaivani/ Dr. M. Pradeepa under the direct supervision of the physiotherapist. I am aware that I have to follow therapist's instruction as has been told to me.

**RISKS AND DISCOMFORT:**

I ___________________ understand that there are no potential risks associated with this procedure, and understand that Ms. N. Kalaivani/Dr. M. Pradeepa will accompany me during this procedure. There are no known hazards associated with this procedure.

## CONFIDENTIALITY:

I ___________________ understand that the medical information produced by this study will be confidential. If the data are used for publication in the medical literature or for teaching purpose, no names will be used. And photographs, audio and videotapes will be used without identity for publication and presentation.

## PHOTOGRAPHY CONSENT:

Ms. N. Kalaivani/ Dr. M. Pradeepa have been explained to me that photography are required in order to illustrate various aspects of the study for the thesis and at the presentation or conference by giving my consent I ________________ authorize Ms. N. Kalaivani/ Dr. M. Pradeepa to use any of the photography taken of me in printed format, in slides for presentation.

## REQUEST FOR MORE INFORMATION:

I ___________________ understand that I ask any questions about the study at any time Ms. N. Kalaivani/ Dr. M. Pradeepa are available to answer my question. Copy of this concern form will be given to me keep for my careful reading.

## REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I __________________ understand that my participation is voluntary and I may withdraw consent and discontinue participation at any time after he has explained the reasons for doing so.

## INJURY STATEMENT:

I understand that the treatment procedure, under the guidance of my therapist, is likely to cause any / no injury. In such case medical attention will be provide, but no compensation will be provided. I understand my agreement to participate in this study and I am not waiving any of my legal rights.

I ________________________ confirm that Ms. N. Kalaivani/ Dr. M. Pradeepa have explained me the purpose of the study, the study procedure and possible risk that I may experience. I have read and I have understood this concern to participate as a subject in this study.

____________________ ________________

**SUBJECT** **DATE**

____________________ ________________

**WITNESS TO SIGNATURE** **DATE**

I have explained (Ms. N. Kalaivani/ Dr. M. Pradeepa) the purpose of the research, the procedure required and the possible risks and benefits, to the best of my ability.

____________________ ________________

**INVESTIGATOR** **DATE**

1. Ms. N. Kalaivani
2. Dr. M. Pradeepa

# ANNEXURE II

## ASSESSMENT CHART

**SUBJECTIVE ASSESSMENT:**

Name:

Age:

Gender:

Occupation:

Address:

Chief complaints:

**HISTORY TAKING:**

Present medical history:

Past medical history:

Personal history:

Family history:

Socio-economical history:

Treatment history:

- Medical treatment:
- Surgical
- Physiotherapy treatment

**OBJECTIVE ASSESSMENT:**

**ON OBSERVATION:**

Attitude of the limb:

Body built:

Posture:

Muscle wasting:

Pattern of movement:

Pressure sore:

Deformity / contracture:

Tropical changes:

Mode of ventilation:

External appliances:

**ONPALPATION:**

Warmth:

Tenderness:

Tone:

Swelling:

Edema:

**VITALS:**

Blood Pressure:

Heart rate:

Pulse rate:

Temperature:

**ON EXAMINATION:**

Higher mental function:

Cranial nerve examination:

Motor examination:

Muscle tone:

Reflexes:

Superficial reflex:

Abdominal:

Plantar:

Deep:

Biceps:

Brachioradialis:

Triceps:

Knee:

Ankle:

Jaw:

Sensory Examination:

Superficial sensation:

Pain

Light Touch:

Temperature:

Pressure:

Deep:

Kinesthetic sensation:

Proprioceptive sensation:

Vibratory sensation:

Cortical sensation:

Tactile localization:

Two point discrimination:

Stereognaosis:

Barognosis:

Grasphesthesia:

Recognition of texture:

Double simultaneous stimulation:

Co-ordination:

Non equilibrium test:

Equilibrium test:

Balance:

Siting:

Standing:

Balance reaction:

Gait:

Posture:

Functional assessment:

Diagnosis:

Problem list:

Short term goal:

Long term goal:

# ANNEXURE III

# ETHICAL CLEARANCE CERTIFICATE

**P.P.G COLLEGE OF PHYSIOTHERAPY**

(A Unit of P. Perichi Gounder Memorial Charitable Trust)
(Affiliated to the The Tamilnadu Dr. MGR Medical University)
9/1, Keeranatham Road, Saravanampatti, Coimbatore - 641 035
Phone : +91 422 2669562 Cell : 97877 30200
E-mail : ppgphysiotherapy@ppg.edu.in ❖ Website : www.ppg.edu.in

PPG PHYSICAL THERAPY

MS. N. KALAIVANI,
PPG College of Physiotherapy,
Affiliated to the TN DRMGR Medical University,
9/1, Keeranatham Road, Saravanampatti,
Coimbatore – 641 035

DATE: 14TH NOV 2016

Ref: Your dissertation synopsis entitled, **"AN EXPERIMENTAL STUDY ON EFFECTIVENESS OF CONVENTIONAL PHYSIOTHERAPY VERSUS FUNCTIONAL ELECTRICAL STIMULATION TO IMPROVE UPPER EXTREMITY GROSS MANUAL DEXTERITY AMONG SUBJECTS WITH SUB ACUTE ISCHEMIC MIDDLE CEREBRAL ARTERY STROKE "** submitted to the PPGIEC for approval.
Sub: Approval for conducting the referred study.

Dear MS. N. Kalaivani,

The PPG college of Physiotherapy Institutional Ethical Committee (PPGIEC) has reviewed your above mentioned dissertation synopsis, we are pleased to inform you that after due delegations, the PPGIEC has approved your study to be conducted in the presented manner.

The PPG College of Physiotherapy Institutional Ethical Committee expects to be informed about the progression of the study every 3 months, any Serious Adverse Event (SAE) occurring in the due course of the study, and if any changes are made in the protocol or patient information or informed consent. These information should be informed to the PPG IEC in advance and additional permission should be taken from the committee members. The PPGIEC also requires you to submit a copy of the final study report before the given time.

14/11/16

**Prof. K. Raja Senthil,**
Member Secretory,
PPG College of Physiotherapy Institutional Ethical Committee.

www.ppg.edu.in

# ANNEXURE – IV

## MASTER CHART

### ❖ FUGL-MEYER ASSESSMENT SCALE

| FUGL-MEYER ASSESSMENT SCALE (UE) | | | | | |
|---|---|---|---|---|---|
| Control Group | | | Experimental Group | | |
| S. No | Pre Test | Post Test | S. No | Pre Test | Post Test |
| 1 | 23 | 34 | 1 | 22 | 44 |
| 2 | 22 | 33 | 2 | 24 | 45 |
| 3 | 24 | 35 | 3 | 24 | 46 |
| 4 | 22 | 35 | 4 | 25 | 44 |
| 5 | 23 | 36 | 5 | 23 | 45 |
| 6 | 21 | 35 | 6 | 23 | 44 |
| 7 | 23 | 36 | 7 | 24 | 43 |
| 8 | 23 | 33 | 8 | 24 | 45 |
| 9 | 25 | 34 | 9 | 23 | 45 |
| 10 | 24 | 36 | 10 | 24 | 46 |

**MASTER CHART NO: 1:** Pre and post score values of the fugl-meyer assessment scale (upper extremity) in both the groups

## ❖ JEBSEN AND TAYLOR HAND FUNCTION TEST:

| HAND WRITING | | | | | |
|---|---|---|---|---|---|
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S. NO | PRE TEST | POST TEST | S. NO | PRE TEST | POST TEST |
| 1 | 19 | 19 | 1 | 20 | 15 |
| 2 | 20 | 18 | 2 | 21 | 16 |
| 3 | 21 | 19 | 3 | 23 | 16 |
| 4 | 20 | 19 | 4 | 21 | 14 |
| 5 | 21 | 18 | 5 | 22 | 14 |
| 6 | 19 | 17 | 6 | 20 | 14 |
| 7 | 23 | 20 | 7 | 23 | 15 |
| 8 | 22 | 21 | 8 | 21 | 14 |
| 9 | 20 | 19 | 9 | 19 | 14 |
| 10 | 21 | 19 | 10 | 22 | 15 |
| SIMULATED PAGE TURNING | | | | | |
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S.NO | PRE TEST | POST TEST | S.NO | PRE TEST | POST TEST |
| 1 | 14 | 12 | 1 | 15 | 9 |
| 2 | 13 | 11 | 2 | 14 | 8 |
| 3 | 15 | 12 | 3 | 16 | 10 |
| 4 | 14 | 11 | 4 | 15 | 8 |
| 5 | 15 | 12 | 5 | 13 | 9 |
| 6 | 16 | 12 | 6 | 14 | 8 |
| 7 | 14 | 11 | 7 | 14 | 7 |
| 8 | 13 | 11 | 8 | 15 | 8 |
| 9 | 14 | 12 | 9 | 16 | 9 |
| 10 | 14 | 12 | 10 | 16 | 10 |

| PICKING UP SMALL COMMON OBJECTS | | | | | |
|---|---|---|---|---|---|
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S.NO | PRE TEST | POST TEST | S.NO | PRE TEST | POST TEST |
| 1 | 15 | 12 | 1 | 15 | 8 |
| 2 | 16 | 13 | 2 | 15 | 7 |
| 3 | 14 | 12 | 3 | 16 | 9 |
| 4 | 15 | 12 | 4 | 14 | 7 |
| 5 | 16 | 13 | 5 | 16 | 8 |
| 6 | 14 | 12 | 6 | 15 | 6 |
| 7 | 14 | 11 | 7 | 14 | 7 |
| 8 | 16 | 12 | 8 | 16 | 7 |
| 9 | 15 | 12 | 9 | 14 | 7 |
| 10 | 14 | 11 | 10 | 15 | 6 |
| SIMULATED FEEDING | | | | | |
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S.NO | PRE TEST | POST TEST | S.NO | PRE TEST | POST TEST |
| 1 | 12 | 10 | 1 | 14 | 10 |
| 2 | 13 | 11 | 2 | 13 | 9 |
| 3 | 14 | 11 | 3 | 14 | 9 |
| 4 | 14 | 12 | 4 | 12 | 8 |
| 5 | 13 | 12 | 5 | 13 | 9 |
| 6 | 12 | 11 | 6 | 14 | 10 |
| 7 | 13 | 11 | 7 | 12 | 8 |
| 8 | 13 | 12 | 8 | 13 | 9 |
| 9 | 13 | 12 | 9 | 14 | 9 |
| 10 | 14 | 11 | 10 | 12 | 9 |

| STACKING CHECKERS | | | | | |
|---|---|---|---|---|---|
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S.NO | PRE TEST | POST TEST | S.NO | PRE TEST | POST TEST |
| 1 | 13 | 11 | 1 | 14 | 9 |
| 2 | 12 | 10 | 2 | 13 | 8 |
| 3 | 11 | 10 | 3 | 12 | 8 |
| 4 | 13 | 10 | 4 | 11 | 7 |
| 5 | 11 | 9 | 5 | 13 | 9 |
| 6 | 12 | 10 | 6 | 13 | 8 |
| 7 | 13 | 10 | 7 | 12 | 7 |
| 8 | 13 | 11 | 8 | 13 | 8 |
| 9 | 11 | 10 | 9 | 14 | 8 |
| 10 | 11 | 10 | 10 | 11 | 7 |
| PICKING UP LARGE LIGHT OBJECTS | | | | | |
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| S.NO | PRE TEST | POST TEST | S.NO | PRE TEST | POST TEST |
| 1 | 15 | 13 | 1 | 15 | 7 |
| 2 | 14 | 12 | 2 | 16 | 6 |
| 3 | 13 | 12 | 3 | 14 | 6 |
| 4 | 14 | 12 | 4 | 13 | 6 |
| 5 | 15 | 13 | 5 | 14 | 7 |
| 6 | 16 | 13 | 6 | 15 | 7 |
| 7 | 13 | 11 | 7 | 15 | 7 |
| 8 | 14 | 12 | 8 | 16 | 6 |
| 9 | 14 | 12 | 9 | 14 | 6 |
| 10 | 15 | 13 | 10 | 14 | 7 |

| PICKING UP LARGE HEAVY OBJECTS | | | | | |
|---|---|---|---|---|---|
| CONTROL GROUP | | | EXPERIMENTAL GROUP | | |
| **S.NO** | **PRE TEST** | **POST TEST** | **S.NO** | **PRE TEST** | **POST TEST** |
| 1 | 15 | 14 | 1 | 16 | 8 |
| 2 | 14 | 13 | 2 | 14 | 6 |
| 3 | 16 | 13 | 3 | 15 | 7 |
| 4 | 15 | 13 | 4 | 15 | 6 |
| 5 | 14 | 13 | 5 | 16 | 7 |
| 6 | 15 | 12 | 6 | 14 | 6 |
| 7 | 16 | 13 | 7 | 14 | 6 |
| 8 | 16 | 12 | 8 | 15 | 6 |
| 9 | 15 | 12 | 9 | 16 | 8 |
| 10 | 15 | 13 | 10 | 17 | 8 |

**MASTER CHART NO: 2:** Pre and post score values of the Jebsen and Taylor Hand Function Test in both the groups