“COMPARATIVE EFFECT OF CONSTRAINT-INDUCEDMOVEMENT THERAPY AND MUSCLES ENERGY STROKESURVIVORWITHSPASTICITY”TECHNIQUEFOR UPPER LIMB FUNCTION IN CHRONIC

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INTRODUCTION

Stroke is a neurological disorder characterized by blockage of blood vessels. Clots form in the brain and interrupt blood flow, clogging arteries and causing blood vessels to break, leading to bleeding. Rupture of the arteries leading to the brain during stroke results in the sudden death of brain cells owing to a lack of oxygen. Stroke can also lead to depression and dementia. Stroke is the second leading cause of death globally. It affects roughly 13.7 million people and kills around 5.5 million annually. Approximately 87% of strokes are ischemic infarctions, a prevalence which increased substantially between 1990 and 2016, attributed to decreased mortality and improved clinical interventions. Primary (first-time) hemorrhages comprise the majority of strokes, with secondary (second-time) hemorrhages constituting an estimated 10–25% [1, 2].Stroke is one of the leading causes of mortality and morbidity in adults in most countries. [3, 4, 5]

Age-specific stroke is the incidence of stroke increases with age, doubling after the age of 55 years. However, in an alarming trend, strokes in people aged 20–54 years increased from 12.9% to 18.6% of all cases globally between 1990 and 2016. Nevertheless, age-standardized attributable death rates decreased by 36.2% over the same period [2, 6,7]. The occurrence of stroke in men and women also depends on age. The higher risk for stroke in women is due to factors related to pregnancy, such as preeclampsia, contraceptive use and hormonal therapy, as well as migraine with aura. Both brain infarction and intracerebralhemorrhage (ICH) are common in men, but cardio embolic stroke, a more severe form of stroke, is more prevalent among women.[7, 8, 9].

For men, the most common causes of stroke are tobacco smoking, excessive alcohol consumption, myocardial infarction and arterial disorders [10]. Ischemic occlusions contribute to around 85% of casualties in stroke patients, with the remainder due to intracerebral bleeding. Ischemic occlusion generates thrombotic and embolic conditions in the brain [11]. In thrombosis, the blood flow is affected by narrowing of vessels due to atherosclerosis. The build-up of plaque will eventually constrict the vascular chamber and form clots, causing thrombotic stroke. In an embolic stroke, decreased blood flow to the brain region causes an embolism; the blood flow to the brain reduces, causing severe stress and untimely cell death (necrosis). Necrosis is followed by disruption of the plasma membrane, organelle swelling and leaking of cellular contents into extracellular space [12] and loss of neuronal function. Other key events contributing to stroke pathology are inflammation, energy failure, and loss of homeostasis, acidosis, increased intracellular calcium levels, excitotoxicity, free radical-mediated toxicity, cytokine-mediated cytotoxicity, complement activation, impairment of the blood–brain barrier, activation of glial cells, oxidative stress and infiltration of leukocytes. [13, 14, 15, 16]

The movement impairments following neurological illness such as stroke and spinal cord injury are caused by disturbances in descending commands, although the precise mechanisms by which disrupted commands affect voluntary function are uncertain. However, several mechanisms including abnormal muscle recruitment, weakness and spasticity have been suggested as contributing factors [17,18]. Spasticity is a motor disorder associated with lesions at different levels of the nervous system. It can directly or indirectly change mechanical properties of the

neuromuscular system, particularly in chronic patients, and has been linked to impaired voluntary movement through different mechanisms [19,20].

For many stroke survivors, spasticity can be one of the most frustrating and misunderstood aspects of rehabilitation and recovery with little to no effective treatment at times. All forms of spasticity can present a wide range of variables in which the stroke survivor may encounter symptoms such as pain or discomfort related to tightness, decreased coordination, or involuntary movements when attempting volutional use of the arm.[23]

Synergy and spasticity are similar words that have slightly different meanings and are used to describe an abnormal state of an individual's muscle tone and movement patterns after stroke as a result of the damaged pathways in the brain and spinal cord. As spasticity increases, the risk of soft tissue shortening is heightened. This may lead to a cycle of spasticity (tightness and resistance to stretch). Spasticity often lends to soft tissue shortening due to an over recruitment of shortened muscles because of increased stretch reflexes. This pattern of tightness is called a "synergy."[23]

It is defined as "disordered sensory-motor control, resulting from an upper motor neuron lesion, presenting as intermittent or sustained involuntary activation of muscles"[24]. It can range from mild muscle stiffness to severe, painful, and uncontrollable muscle spasm Bobathapproach, proprioceptive neuromuscular facilitation (PNF) [29],constraint-induced movement therapy (CIMT) [30], and mobilization and stimulation of neuromuscular tissue [31]. However, the choice of the appropriate method at a specified stage of recovery varies among practitioners. CIMT is a neurological rehabilitation technique that can be applied at both acute and chronic stages of stroke and different levels of impairments. It can be administered in hospital and home settings.

The term Constraint-Induced Movement Therapy (CIMT) describes a package of interventions designed to decrease the impact of a stroke on the upper-limb (UL) function of some stroke survivors.[32] It is a behavioural approach to neurorehabilitation based on "Learned-Nonuse".[33] CIMT is typically performed for individuals following a cerebrovascular accident (CVA) as between 30-66% of CVA survivors will experience some functional loss in their impaired limb.[34] Furthermore, CIMT has also been performed for individuals with cerebral palsy (CP), traumatic brain injury (TBI) and multiple sclerosis (MS). The aim of CIMT is to improve and increase the use of the more affected extremity while restricting the use of the less affected arm.

Muscle energy technique (MET) is a type of osteopathic manipulative medicine (OMM) developed by Fred Mitchell, Sr, D.O., in 1948, designed to improve musculoskeletal function through mobilizing joints and stretching tight muscles and fascia, to reduce pain, and to improve circulation and lymphatic flow.[35,36] These methods are unique in OMM as they are "active" techniques, requiring the patient to perform isometric contractions.[37] MET is contraindicated in individuals with poor energy, fractures, significant joint disease, or recent surgery.[38] MET is characterized by a patient-induced skeletal muscle contraction against an operator's resistance in a controlled direction and position.[35]More specifically, isometric MET entails the following steps:

Repeat steps 1 to 4 as tolerated until physiologic pain sufficiently relieved and/or the achievement of the desired range of motion

METHODOLOGY

It is a comparative study. In which 30 patients are participated. Patient were recruited into two group randomly. One group received the MET and the other group of people received the CIMT. The treatment were given to the patients for 12 week(45minutesperday,4daysinaweek.)

OUTCOMEMEASURES:

- Modified Ashworth scale wasused. It is a 6-point scale, with scores rangingfrom 0 to 4, where lower scores represent normal muscle tone and higherscores stand for Spasticity or increased resistance to passive movement [41].Modified Ashworth scale is a reliable scale for the assessment of post-strokeelbow flexor spasticity [42,43]. There is patient selected on the basis of less than2point of MAS value.

- The upper extremity section of the Fugal-Meyer assessment (FMA) scale wasalso used to measure the pre- and post intervention recovery level. The FMAscaleisa226-pointmulti-itemLikert-typescaledevelopedasameasureto evaluate recovery from hemiplegic stroke. It is divided into 5 domains: motorfunction, sensory function, balance, joint range of motion, and joint [44]. FMAis a reliable and valid scale for recovery evaluation after stroke. There is 126point for upper extremity & only 0-66 point were used for the upper extremityrecoveryevaluation[45]inchronicstrokepatients

INCLUSIONCRITERIA

a) Chronic stroke patient

b) BothMale and femalepatients.

c) Age groupof35-70years

d) MAS value<2

d) Cerebral infarction

e) Follow command

EXCLUSIONCRITERIA

a) Traumatic brain injury

b) Below the 35yr andabove75year age

c) Shoulder dislocation

d) Shoulder subluxation

e) MAS value>2

PROCEDURE

All patients were informed about the purpose and procedure of the study as well as the right to refuse to take part or quit from the study at any moment. A total of 41patients consented to participate in the study but only 30 met the inclusion criteria and were recruited (Figure 1). The participants were recruited consecutively and randomly assigned into 2 groups: A and B (**MET** and **CIMT** group, respectively), each of **15subjects**. The assessments were conducted at baseline by a rater and at 6th week of intervention by another rater. The raters were trained physiotherapists not involved in the administration of the study interventions and not aware of the group a participant belong **Interventions**

Group A received **MET** for 45 minutes. The intervention was conducted 4 times a week for a period of 12 weeks. MET was administered in a sitting position, with the hand on the support of pillow performing MET technique used context-specific tasks,inthisgroupwereperformedinthefirstoftheupperlimbflexorandextensormuscles group of elbow joint. Should hold subject spastic upper limb in hand and askpatienttoflexher/hiselbowsoherebicepswillisometricallycontractedfor5second& opposite muscles group triceps will be relaxed. Here smooth passive stretch should be performed after the every 5sec hold and it will be repeated 10 times. And after the10 repetition 1 minute take a rest and should check there movement of the affected limb.

For elbow joint

Muscles involved biceps and triceps (agonist&antagonist)

- **Therapist position**-Standingor sitting at sideoftested limb.
- **Patient position**-Either supine and sitting
- **Technique-**

Muscles energy technique (MET) apply, tested limb should be hold by the therapist. Tested limb forearm and elbow supported by the therapist hand & then ask to patient move the elbow inside so biceps will be contracted for the 5sec and after that passive stretch apply to extend the elbow so it will be repeated 10 times in one session and 10session is taken for each muscles group. (Image 1 & 2 show the improve the elbow extension and inhibition of flexor of elbow) That same techniques is applied for the shoulder flexors-extensors, elbow supinators-Pronators, wrist flexor-extensors and fingers flexors-extensors to relieve the spasticity

Group B received CIMT intervention administered for 45 minutes to the upper limb 4times a week for a period of 12 weeks. Context-specific tasks which included the use of spoons, cups and combs repeated. The tasks were broken down into smaller components, starting with grasping the objects, and progressed until the task was completed. The exercises were performed at home while sitting such as the ones practiced in the hospital.

DATAANALYSIS

Descriptive statistics of mean, standard deviation, frequencies, and percentages were used to summarize the demographic characteristics of the participants. Paired t-testwasusedtocomparebaselinedatawithpost-interventionscoresofupperlimbfunction within the groups and unpaired t-test served to compare the post-intervention effects between the groups. The statistical analysis was conducted with the **Statistical Package for the Social Sciences (SPSS)**, version 16.0; the p value of 0.05 was applied to determine statistical significance.

Arithmatic Mean: It simply involves taking the sum of a group of numbers, then dividing that sum by the count of the numbers used in the series.

$$\bar{X} = \frac{(\Sigma x)}{n}$$

Standard Deviation Formula

The population standard deviation formula is given as**: σ =1N∑I= 1N(Xi−μ)2**

Here,

σ= Population standard deviation

N= Number of observations in population

Xi= ith observation in the population

μ = Population mean

Similarly, the sample standard deviation formula is:

s= 1n−1∑I=1n (xi−x—)2

Here,

s= Sample standard deviation

n = Number of observations in sample

xi = observation in the sample

x—= Sample mean

RESULTS

A total of 30 participants of hemiplegic with spasticity (mean duration: 32.87 ± 5.54weeks) completed the study. The mean age of participants was 57.8 ± 9.15 years in group A and 56.93 ± 8.81 years in group B. There was an equal distribution of males and females with right hemiplegic as the most frequently occurring (60%) in the study. The results showed that there was slight significant difference in FMA scores between the 2 groups, which means that the groups were comparable, as presented in Table 1.The study revealed a significant improvement in the upper limb function on the basis of pre and post intervention FMA scale value within the MET group. On the same vein, a significant improvement was reported in the upper limb function on the basis of pre- and post-intervention MAS scale value within the CIMT group, asshown in Table 2. Furthermore, a significant post-intervention difference

was shownbetweenthe2groups,withabetterimprovementintheMETgroup,asshowninTable 3. When the upper limb function was compared across genders, there was slightsignificantdifferencein thegroups, as presented in Table 4.

Table1:Demographic andclinicalcharacteristicsof participants.

Characteristic	MET group(*n*= 15) (mean± *SD*)	CIMT group(*n*= 15) (mean±*SD*)	Df	T Value	Pvalue
Age(years)	57.8±9.15	56.93±8.81			
Males,*n* (%)	8(50.07)	7(49.3)			
Females,*n*(%)	7(49.3)	8(50.07)			
Righthemiplegic *n*(%)	8(53.33)	10(66.67)			
Lefthemiplegic *n*(%)	7(46.67)	5(33.33)			
MASscore	1.6±0.50	1.53±0.51	28	0.379	0.707
FMAscore	39.13±3.71	42.46±4.71	28	2.15	0.0402

MET-Musclesenergytechnique, CIMT –constraint-induced movementtherapySD– Standarddeviation, df –degreeof freedom

MAS-Modifiedashworthscale,FMA–Fugl-Meyer assessment

Table2:Comparison of upperlimbFMAscoresin theMETandCIMTgroups.

Score	Mean ±SD	Df	t value	p value
MET				
Pre	39.13±3.71			
Post	55.13±2.64	28	13.60	.0001
CIMT				
Pre	42.46±4.71			
Post	54.53±3.02	28	8.35	.0001

***Significant**

GRAPH1

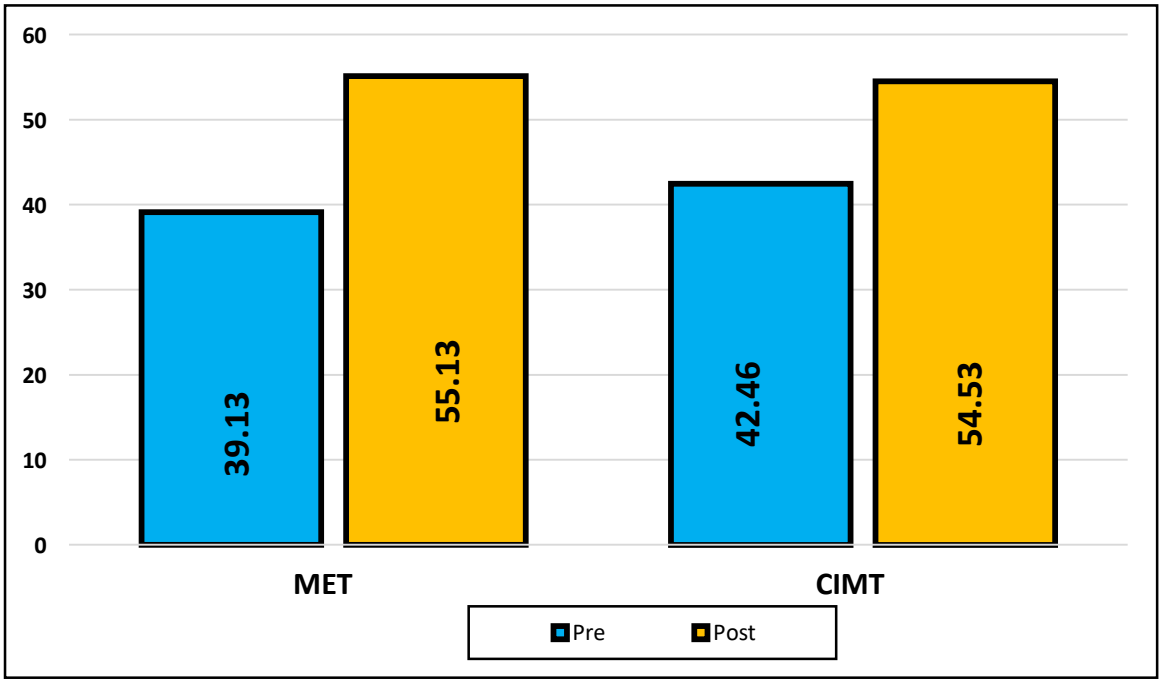


Table 3 :Comparison of upper limb FMA Scale Post Intervention recovery inthestudy group.

Group	Mean±SD	Df	t value	p value
MET	55.13±2.64	28	0.965	0.3425
CIMT	54.13±3.02			

****Significant

GRAPH2

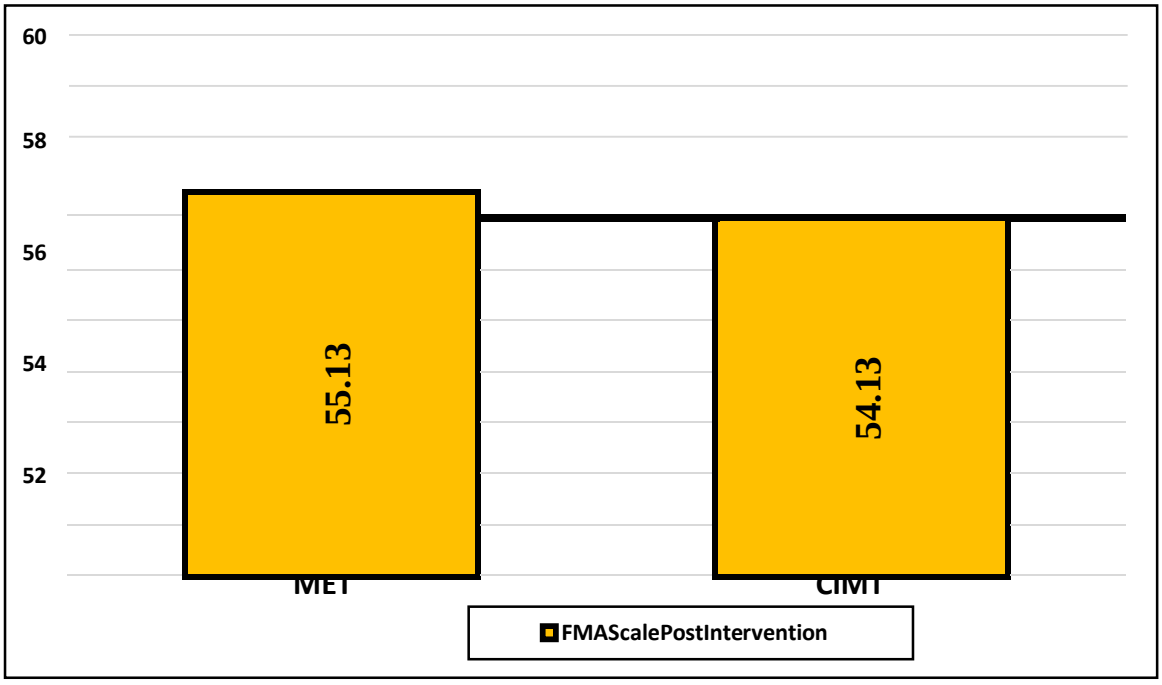


Table 4 :Comparison of upper limb post-intervention recovery between thegroupsacross genders

GENDER	N	MEAN±SD	Df	tVALUE	pVALUE
MET					
MALE	8	54.75±2.81	13	0.586	0.567
FEMALE	7	55.57±2.57			
CIMT					
MALE	7	54±3.41	13	0.626	0.541
FEMALE	8	55±2.77			

****Significant

GRAPH3

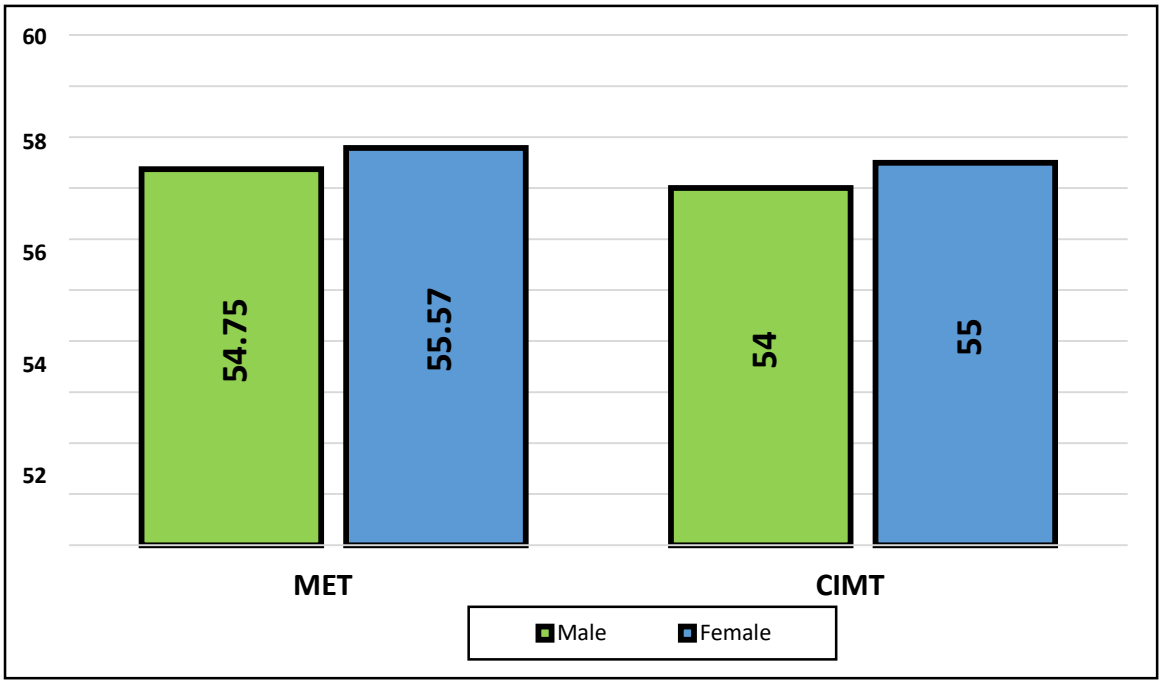
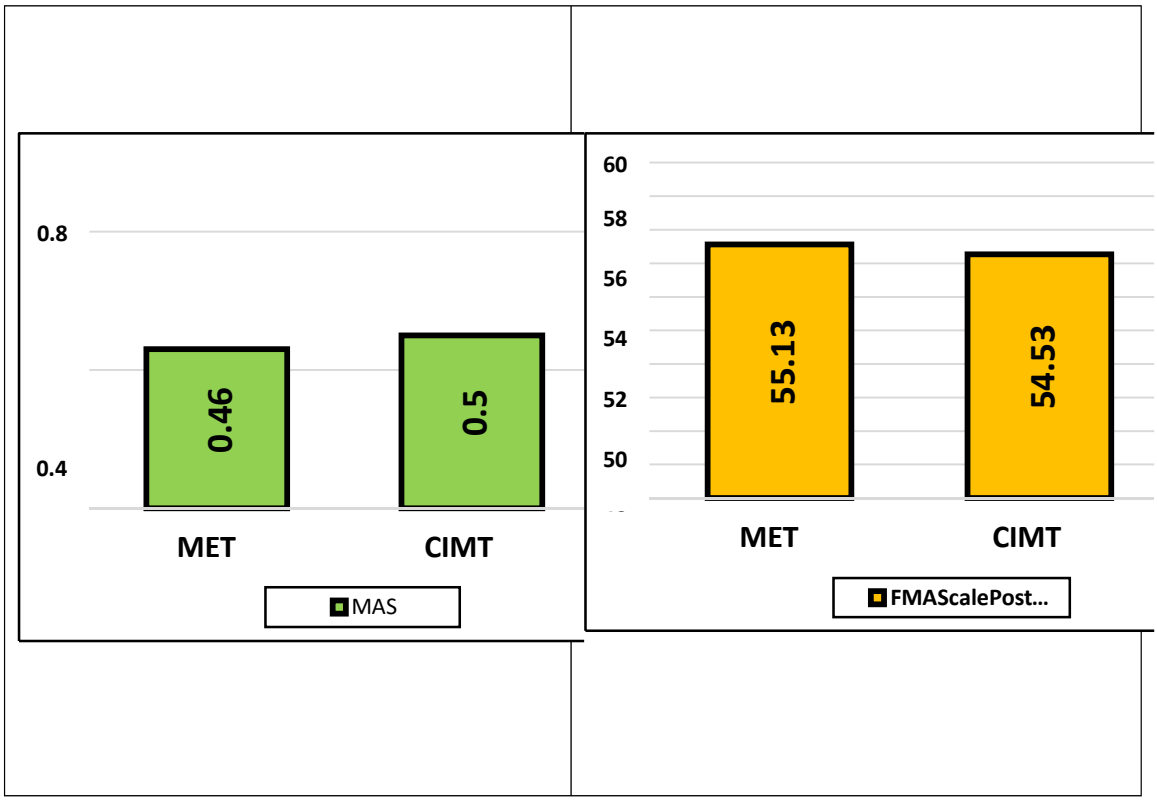


Table 5 : Comparison in Post intervention of MAS and FMA for MET andCIMTgroup.

Characteristic (Scale)	MAS (Mean±SD)	FMA (Mean±SD)	Df	t value	p value
MET	0.46±0.51	55.13±2.64	28	78.74	0.0001
CIMT	0.50±0.25	54.13±3.02	28	68.54	0.0001

****Significant

GRAPH



DISCUSSION

This study compared the effectiveness of CIMT and MET in upper limb post-stroke recovery. The observation that no significant difference existed in the baseline scores of upper limb function implies that the participants in the 2 groups were comparable (Table 1). Therefore, any difference in upper limb post-intervention function can be attributed to the effect of the intervention in the groups. The study revealed significant post-intervention improvement in upper limb function in the CIMT group (Table 2). The clinical implication of this finding is that upper limb treatment with CIMT after stroke can lead to significant recovery of the ability to properly use the affected limb. This is line with the finding of De Moraes et al. [37], who observed a significant improvement of upper limb function in stroke survivors after 12 weeks of CIMT intervention. Similarly, the results of this study showed a significant post-intervention improvement in upper limb function in the MET group (Table 2). This implies that MET is an intervention that can significantly improve the function of the affected upper limb in stroke patients. There is better recovery was observed in upperlimbfunctionafterMETinchronicstrokepatients.Inthisstudy,the participants in the MET group had significantly better scores of upper limb function than those in the CIMT group (Table 3). The finding is observed a better post-intervention performance in the MET group when compared with CIMT Functional approach. The difference in outcome between the MET and CIMT groups after the intervention can be associatedwiththefactthatCIMTrequiresspecialhandlingascomparedtoMETbyaphysiotherapist, and a correct application of the technique by the participants at home may be minimal. Nevertheless, limb function recovery is not dependent only on rehabilitation intensity but also on other factors ,such as socioeconomic status and type of stroke, which this study has not taken into consideration. On the other hand, the results of this study have shown no significant difference in recovery in terms of gender (Table 4). This contradicts the findings, who observed better recovery in males than in females. Alawieh et al. also stated that females usually presented lower pre-stroke physical functioning than males. The contradiction with the previous studies may be a result of the difference in the characteristics of the participants. Our subjects were relatively younger than those in the study and as such would have functioned better, which could equate females' results with those of males. The study provided information on the effectiveness of 2 interventions on upper limb post-stroke function.

MET turned out to result in a more favorable outcome on stroke in the subjects. The choice of intervention between CIMT and MET will be at the discretion of the clinicians. There is both scale MAS and FMA was used and result will be more favorable to the MET group and it take a less time and perfectly technique was used. The MET create instant energy so upper limb was performed bitterly.

CONCLUSION

The study revealed that both MET and CIMT were effective in the management of upper limb post-stroke function; however, MET might be the preferred technique forupperlimbfunctionrecovery.Furthermore,slightgender-relateddifferencewasobserved in upper limb function post-intervention outcome among chronic strokesurvivors.Furtherstudiesshouldbeconductedtodeterminethelong-termeffectoftheinterventions.

LIMITATIONS

The study limitations include lack of a control group and the inability to assess long-term effects for retention. Another limitation is that the affected part of the brain was not evaluated with radiological investigations.

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