EFFICACY OF CONSTRAINT INDUCED MOVEMENT THERAPY TO IMPROVE FUNCTIONAL MOBILITY AND BALANCE ON LOWER LIMB IN SUBJECTS WITH STROKE: AN EXPERIMENTAL STUDY

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INTRODUCTION

Stroke (cerebrovascular disease) according to ICD 11 is divided into various categories such as cerebral ischemic stroke. Which is defined as acute focal neurological dysfunction caused by focal infarction at single or multiple sites of brain or retina, intracerebral haemorrhage which is defined as neurological dysfunction caused by haemorrhage within brain parenchyma or inn ventricular system, subarachnoid haemorrhage caused by subarachnoid haemorrhage.[1] The burden of stroke is increasing in India; stroke is now the fourth leading cause of death and the fifth leading cause of disability. Previous research suggests that the incidence of stroke in India ranges between 105 and 152/100,000 people per year. Studies represented the four cities of Mumbai, Trivandrum, Ludhiana, Kolkata, the state of Punjab, and 12 villages of Baruipur in the state of West Bengal. The total population denominator was 22,479,509 and 11,654 (mean 1294 SD 1710) people were identified with incident stroke. Crude incidence of stroke ranged from 108 to 172/100,000 people per year, crude prevalence from 26 to 757/100,000 people per year, and one-month case fatality rates from 18% to 42%.[2.] According to the global burden of disease study (GBD), although the prevalence of stroke has decreased, the age of those affected, their sex and their geographic location mean that the socio-economic burden of stroke has increased over time.[3] The incidence of stroke increases with age, doubling after the age of 55 years.[4] The occurrence of stroke in men and women also depend upon age, it is higher at younger ages in women. Whereas incidences increase slightly with older age in men, the higher incidence in women is due to factors related to pregnancy issues and hormonal therapies as well as migraine with aura.[5,7]

As noted, earlier stroke incidence varies considerably across the globe.[8] There is a strong inverse relationship between stroke and Socio-economic status. The risk factors for stroke increases with age and doubles over the age of 55 years in both men and women the risk factors are hypertension, coronary artery disease or Hyperlipidaemia. These are of paramount importance, because timely and appropriate medical intervention can reduce the risk of stroke in susceptible individuals. The major modifiable risk factors for stroke are hypertension, diabetes, lack of physical exercise, alcohol and drug abuse, cholesterol, diet management and genetics. Nearly 60% of stroke are in the patients with a history of Transient ischemic attack TIA.[9] Transient ischemic attack is classified as a mini stroke; the underlying mechanism is the same as for full-blown stroke. In TIA, the blood supply to part of the brain is blocked temporarily. It acts as a warning sign before the actual event, providing an opportunity to change lifestyle and commence medications to reduce the chance of stroke.[10]

Two types of brain stroke are haemorrhagic and ischemic. Haemorrhagic stroke, which is due to blood vessel rupture, accounts for 20% of CVAs. Ischemic stroke due to brain vessels occlusion and blockage includes 80%.[11-12] Many studies described various clinical findings especially neurological signs and symptoms, and some of them presented formulas to distinguish stroke types based on clinical evaluations. These characteristics including focal or non-focal symptoms, negative or positive symptoms and sudden or gradual onset result in primary segregation of stroke types in emergency department that leads to early diagnosis and treatment. However, previous studies claimed that neurological signs such as eye gaze and pupil size changes, can be reliable facts to distinguish stroke types.[11-13] In India the rehabilitation is manly cantered on physiotherapist, India like other countries is in the midest of stroke epidemic. There is a huge burden of stroke with significant variations. The government is focusing on early diagnosis, management, infrastructure, public awareness, and capacity building at different levels of health care for all non-communicable diseases including stroke. The effort from both private and government is needed to tackle the burden of stroke.[14]

Constraint induced movement therapy is an evidence-based rehabilitation designed to increase functional use of weaker arm. The intension of the constraint induced movement therapy is to be limiting the normal side using a constraint, which can be bandage or splint, meanwhile when the normal arm is at rest the weaker side is enrolled into an intensive training program. Constraint-induced movement therapy (CIMT) is a family of Neuro-rehabilitation treatments developed at the University of Alabama at Birmingham (UAB).[15]

It involves the application of behaviour-analytic techniques to the improvement of deficits that result from different types of substantial damage to the central nervous system (CNS), such as stroke, traumatic brain injury, spinal cord injury, multiple sclerosis, cerebral palsy, and other paediatric motor disorders (summarized in Taub & Uswatte, 2009; Taub, Uswatte, & Pidikiti, 1999). The deficits are treated mainly motor in nature but also include verbal behaviour in aphasia and phantom limb pain after limb amputation. The first

application of CI therapy was to motor deficit after stroke (Taub et al., 1993), and this continues to be the most frequent application. Its efficacy has been demonstrated by a multisite randomized controlled trial (RCT; Wolf et al., 2006), which is rare for the rehabilitation field, and multiple single-site RCTs.[15] To perform CIMT on the upper limb after stroke, a minimum amount of paretic limb movement is recommended, often defined as 10° finger extension and 20° wrist extension. Therefore, most patients with stroke who undergo CIMT for the upper limb do so in the chronic phase of stroke (at least six months post-lesion), where, in most cases, they display some degree of voluntary movement.[16] For the lower limb, there is no precise definition of the minimum amount of movement required to perform CIMT. However, it is advisable that some movement be present and similar to therapy for the upper limb, most studies on CIMT for the lower limb after stroke involve the chronic phase of the disease .[17]

Theoretically, the idea of constraint to induce movement could also be easily applied to the lower limb, since after stroke and other brain lesions a hemi paretic pattern often develops, also heightening interest in the treatment of this body segment. However, it is difficult to apply CIMT to the lower limb because the predominantly bilateral characteristic of lower limb activities makes it impractical to contain. Nevertheless, it was found that for the upper limb, non-paretic limb restriction seems to be the least important point of this therapy, with intensive practice and functional activities being most relevant.[17] In 1997 Duncan[18], representing E. Taub´s team, published the first manuscript that described the treatment of patients with chronic stroke, using CIMT for the lower limb. Therapy consisted of intensive lower limb activities (for example, treadmill and over ground walking, sitting, and rising, climbing stairs and various balance exercises) using partial body weight support, when necessary, for 7 hours per day with rest breaks, over three consecutive weeks. All treated patients exhibited significant improvements in the parameters measured compared to the control group, which performed general physical conditioning exercises. Taub et al. report that most patients with stroke walk again, albeit with degraded walking patterns learned in the early post-lesion phases. For this reason, they prefer to use "learned misuse" instead of "learned disuse", when referring to activities performed with the lower limbs of these patients. Thus, they suggest that repetitive practice of functional activities can correct inadequate movement patterns acquired after the lesion. The types of constraints (shoe raise, weight bearing on affected limb, splint/Orthosis, weight attached to the participants ankle, and whole leg Orthosis) used in the studies differ sugnificantly.[19] One of the most promising rehabilitation techniques used for recovery of motor function after stroke is Constraint Induced Movement Therapy (CIMT) According to Könönen et al., CIMT results in increased perfusion of motor areas in both the affected and non-affected hemispheres. CIMT facilitates and enhances neuronal cell homeostasis. In animals, this is achieved through improved perfusion of motor areas and brain glucose metabolism; increased expression of BDNF, SDF-1, HIF-1α, VEGF, and GAP-43; increased number of ΔFosB-positive cells; and decreased levels of GABA and p-ERK among others. In humans, there are so far a few studies reporting on improved perfusion, decreased level of GABA, and a potential interaction between increased level of BDNF and motor function; but several studies reported on increased cortical activation and motor map size, increased and decreased Intracortical inhibition, and decreased transcallosal or inter hemispheric inhibition of the ipsilesional hemisphere.[20] This Study was mainly focused on the rehabilitation of stroke population who are disabled with lower limb function due to stroke. The CIMT protocol for lower limb improving balance and functional mobility.

NEED FOR THE STUDY

According to the previous studies, Constraint Induced Movement Therapy (CIMT) is effective at improving upper limb after stroke. The aim of this study to examine the effects of constraint induced movement therapy in lower limb, Also the need of the study is learning the use of affected side regarding the rehabilitation program for the patients with stroke that would help in improving their functional mobility and balance so that they could participate in occupation and community

OBJECTIVES

Primary objective- To see the efficacy of constraint induced movement therapy in lower limb with the subjects with stroke.

Secondary objective- To record the changes in the functional mobility and the balance after rehabilitation protocol.

METHODOLOGY

A Quasi-Experimental Study where we used Convenient Sampling method, and it was 6 months of study where intervention period was kept 4 weeks. A complete enumeration was done, 17

subjects were there both male and female between age group 45-75 years of age. Patients were explained in detail regarding the study and informed the advantages and disadvantages of participation. Inform consent was obtained. Thoron assessment was taken During assessment, the subjects were selected based on inclusion and exclusion criteria. Inclusion criteria was stroke survivors in between the age of 45-75, both male and female, walking deficits, asymmetrical gait stance, ability to stand and walk minimal assistance, patient could walk at at least 3-10 meter independently without walking aids with gait speed less than 0.8m/s, able to identify the motor commands, three months or longer post stroke, Cognitive impairment indicated by score of >24 on MMS. And exclusion criteria were set as unstable heart conditions and other clinical conditions affecting balance or gait, pain/discomfort that impede completion of training, changes in blood pressure, Pre-existing neurological conditions other than stroke or musculoskeletal conditions that would have confounded the training effects, participants who is not able to comprehend the commands, fracture of affected lower limb. Baseline data was collected by using the outcome measures The River mead mobility index (RMI), Brathel index, Berg balance scale. After pre-post data collection the intervention was given for 4 weeks to all the participants. Post-test was done of 15th day and at the end of the intervention 30th.

Intervention for CIMT lower limb in stroke patients

Sr.no	Intervention	Constraint	Procedure	Dosages
1.	Stepping forward, backward, sideward	BRACE	Patient position – Standing. Brace wore on unaffected limb.	20x3 repetitions each exercise.
2.	Ball kicking	BRACE	Patient position – Standing. Brace wore on unaffected limb.	20x3 repetitions each exercise
3.	Stair climbing	WEDGE	Patient position – Standing. wedge wore on unaffected limb in sole posterior and lateral border.	10x3 repetitions each exercise.
4.	One leg standing	WEDGE	Patient position – Standing. Wedge wore on unaffected limb in sole posterior and lateral border and weight bearing is done on affected limb.	
5.	Sit to stand	WEDGE	During sit to stand transfer belt is used and wedge is worn in unaffected limb	10x3 repetitions
6.	Obstacle walking	WEDGE	Obstacles are used for walking barrier and wedge is worn in unaffected limb.	100 meters
7.	Reach outs -standing in all directions	BRACE	Balance exercises – ball passing, reach out activities, which uses affected limb for weight bearing	20x3 repetitions.

Fig: 1 Brace

Figure 2 Man with BRACE on Right Leg, forward stepping, Ball Kicking

RESULT

The statistical analysis was done by the software SPSS version 24. ANOVA test was used that shows significant value of follow up 1 RMMI is P<0.001, follow up 2 RMMI is p<0.31. For BI the significant value for follow up 1 is p<0.000, follow up 2 BI is P<0.000, follow up 1 for BBS is P>0.000 and follow up 2 BBS p<0.003 and F value for RMMI follow up 1 is 12.105 and RMMI follow up 2 is 3.915. The f value of BBS follows up 1 is 149.513 and BBS follow up 2 is 17.108. The f value of BI follows up 1 is 2692.664 and BI follow up 2 is 12.889. Further analysis is explained below via tabulation form.

MEAN, AND STANDARD DEVIATION

	N	Mean	Std. Deviation	Std. Error Mean
preRMMI	17	8.0000	3.39116	.82248
followup1RMMI	17	9.8235	2.72110	.65996
Followup2RMMI	17	11.2353	2.43745	.59117
preBBS	17	33.8824	7.12287	1.72755
followup1BBS	17	36.6471	5.86239	1.42184
Followup2BBS	17	39.5294	5.91732	1.43516
PreBI	17	71.1765	9.92620	2.40746
followup1BI	17	71.5294	10.23546	2.48246
followup2BI	17	76.1765	8.75525	2.12346

		Pre RMMI	followup1 RMMI	Followup 2 RMMI	Pre BBS	followup1 BBS	Followup2 BBS	Pre BI	Follow Up 1 BI	followup 2 BI
preRMMI	Pearson Correlation	1	.874**	.733**	.748**	.739**	.729**	.761**	.762**	.610**
	Sig. (2-tailed)		.000	.001	.001	.001	.001	.000	.000	.009
	N	17	17	17	17	17	17	17	17	17
followup1 RMMI	Pearson Correlation	.874**	1	.930**	.792**	.815**	.748**	.760**	.780**	.600*
	Sig. (2-tailed)	.000		.000	.000	.000	.001	.000	.000	.011
	N	17	17	17	17	17	17	17	17	17
Followup2 RMMI	Pearson Correlation	.733**	.930**	1	.765**	.776**	.732**	.659**	.669**	.499*
	Sig. (2-tailed)	.001	.000		.000	.000	.001	.004	.003	.042
	N	17	17	17	17	17	17	17	17	17
preBBS	Pearson Correlation	.748**	.792**	.765**	1	.973**	.968**	.678**	.677**	.564*
	Sig. (2-tailed)	.001	.000	.000		.000	.000	.003	.003	.018
	N	17	17	17	17	17	17	17	17	17
followup1 BBS	Pearson Correlation	.739**	.815**	.776**	.973**	1	.953**	.663**	.674**	.538*
	Sig. (2-tailed)	.001	.000	.000	.000		.000	.004	.003	.026
	N	17	17	17	17	17	17	17	17	17
Followup2 BBS	Pearson Correlation	.729**	.748**	.732**	.968**	.953**	1	.712**	.707**	.590*
	Sig. (2-tailed)	.001	.001	.001	.000	.000		.001	.002	.013
	N	17	17	17	17	17	17	17	17	17
PreBI	Pearson Correlation	.761**	.760**	.659**	.678**	.663**	.712**	1	.993**	.900**
	Sig. (2-tailed)	.000	.000	.004	.003	.004	.001		.000	.000
	N	17	17	17	17	17	17	17	17	17
followup1 BI	Pearson Correlation	.762**	.780**	.669**	.677**	.674**	.707**	.993**	1	.903**
	Sig. (2-tailed)	.000	.000	.003	.003	.003	.002	.000		.000
	N	17	17	17	17	17	17	17	17	17
followup2 BI	Pearson Correlation	.610**	.600*	.499*	.564*	.538*	.590*	.900**	.903**	1
	Sig. (2-tailed)	.009	.011	.042	.018	.026	.013	.000	.000	
	N	17	17	17	17	17	17	17	17	17

**correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

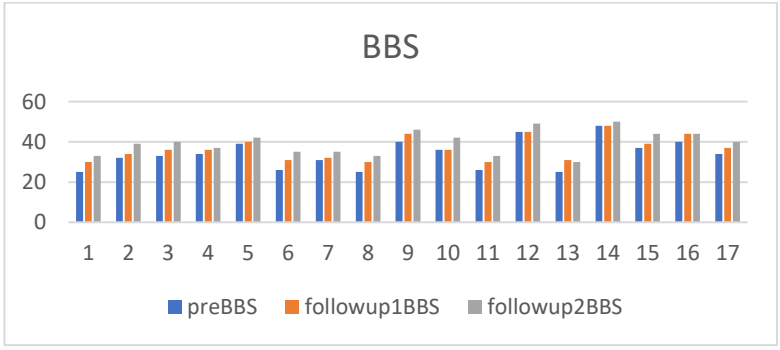

Fig: 3

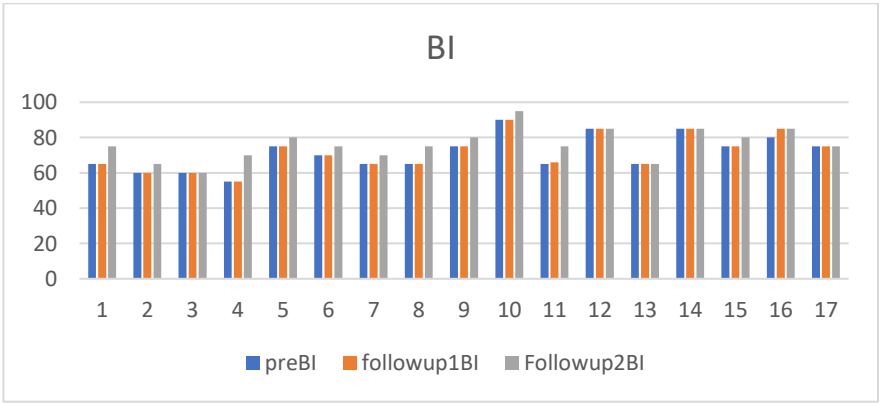

Fig 4

DISCUSSION

This study concluded that constraint-induced movement therapy is effective at improving lower limb functions the components as balance and functional mobility were taken. The outcome measure used were berg balance scale, Rivermead mobility index and Barthel index. The results showed very significant positive effects in improving balance and functional mobility but there is no significant difference in Barthel index of patient with stroke. The intervention of 4 weeks was given, the constraint used in this study was full knee orthosis (brace) and wedge (insole). The wedge constraint showed improvement in subjects with asymmetry of gait patterns and the constraint brace was proved to learn the non-use of non-affected limb in subjects with stroke and learned the use of affected limb for doing the daily living activities. According to Naima Aliyu Umar and Auwal Abdullahi use of number of repetitions is more effective than hours of practice their aim of the study is lower limb treatment for CIMT will involve intensive training of affected lower limb based on task - oriented approach that emphasizes repetitive practice of functional activities and behavioral shaping.[21]

In this study the total no repetitions was given to be quite effective. For further improvement and changes in components like balance and functional mobility the 4-week intervention is not sufficient, there should be more follow up to determine the result effectiveness. According to Katja Kallio in their experimental study they included 3 subjects and divided into experimental AB design with 3 months, follow up the treatment was divided into the baseline period of 2 week with 6 measurements and in group B 2 hours each weekday with 8 measurements. A whole leg orthosis was used as a constraint the result showed significant improvement in the components like balance and motor function with patients with stroke in elderly person.[24] S.Dos Anjos in their perspective study explained the protocol and its effectiveness, this protocol consists of supervised movement therapy using shaping for 6 hours daily for consecutive workdays over 2-week period.[30] Studies in various laboratories showed changes of some elements of lower limb constraint induced movement therapy protocol with subjects with stroke, changes in balance, walking speed, kinetic and kinematic assessments, and range of motion. Upper extremity Constraint Induced Movement Therapy was first established in 1993 and since then it has been studied and research were done to improve functions of upper limb using the same protocol strategy. The lower limb CIMT protocol was developed to improve the gait and balance in patients with lower limb impaired motor function. Studies have reported brain changes after the application of UE-CIMT. Investigations of potential Neuroplasticity changes as result of LE intervention is needed.[30]

LIMITATIONS

1)During intervention same exercises were explained to the patient so that he/she can do at home, but the trunk stability was important to be taken care the stabilization is must for some exercises like sit to stand and transfers So patient couldn't do these without help of therapist or care giver.
2) Less duration of intervention and sample size
3) There should be follow up sessions after the intervention.
4) If the follow up were designed after sessions like 3 months than the effectiveness of LE-CIMT would be defined more clearly.

CONCLUSION

Four weeks Program of CIMT (constraint induced movement therapy) in lower limb has showed the significant in improving functions like balance and functional mobility.

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