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"A Study to Assess The Effectiveness of Trunk Rehabilitation Programme on Trunk Control And Balance in Acute Ischemic Hemiparetic Stroke Patients"

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Abstract
Background & Objectives: *Trunk control and balance impairment are commonly occurring features in post-stroke hemiparetic patients which affects the various abilities to perform activities of daily living.Therefore, the objective of the study was to determine the effectiveness of trunk rehabilitation programme on trunk control and balance and also to assess whether the trunk control is pre-requisite for improving dynamic balance in acute ischemic hemiparetic stroke patients.*
Methods:*A pre and post study design was carried out at Kempegowda Hospital and Research Centres,Bangalore.Total 30 participants (17 male and 13 female)were screened as per inclusion and exclusion criteria and were recruited for the study. All the subjects receivedtrunk rehabilitation programme; i.e. exercises involving upper and lower trunk in supine and sitting position for 6 days a week for 5 weeks with the goal to improve their trunk control and sitting balance. The outcome of the intervention was measured using TrunkImpairment Scale and Sit and Reach Teston day 1 of intervention, at the end of the 3rd week and at the end of 5th week.*
Results:*Subjects showed improvement in trunk control and balance following 5 weeks of trunk rehabilitation programme. The TIS scores improved from pre-intervention mean of 7.9 to post intervention mean of 14.33 with p value<0.05.The SRT scores also improved from pre-intervention mean of 6.79 to post intervention mean of 12.36 with p value <0.05.Results showed better improvement in the early intervention days after stroke and in early age group subjects.*
Conclusion: *Following 5 weeks of trunk rehabilitation programme, the increased scores of TIS and forward reach distance measured using SRT signifies that the trunk control and dynamic sitting balance have been clinically and statistically improved in acute hemiparetic stroke patients.*
Keywords: *Stroke, Trunk control, balance,sitting balance,Trunk Impairment Scale,Sit and reach test, Trunk rehabilitation,Truncal exercises, Trunk training exercise.*

I. Introduction

Like other developing countries,stroke is fast emerging as a major problem and a leading cause of death and disability in India.Therefore, it is one of the commonest life threatening neurological disorder all over the world .[1,2]Stroke is defined as an acute onset of neurological dysfunction due to an abnormality in cerebral circulation with resultant signs and symptoms that corresponds to involvement of focal areas of the brain. WHO defines the clinical syndrome of stroke as rapidly developing clinical signs of focal (or global) disturbances of cerebral function with symptoms lasting 24 hrs or longer or leading to death with apparent cause other than vascular origin.Thus,it is considered as one of the main cause leading to chronic disability which results motor, sensory, balance, speech and perceptual–cognitive deficits.[3,51]

Stroke is a generic term referring to a group of disorders that include cerebral infarction,cerebralhaemorrhage and subarachnoid haemorrhage,all thatdescribing the abrupt and sudden nature of onset.[4,5]Stroke poses long term disability and has potentially enormous emotional and socioeconomic consequences for patients, their families and health services.[6]

It is caused by complete cerebral circulatory arrest resulting in irreversible cellular damage with a core area of focal infarction within minutes. Major Risk factors for stroke are hypertension,cardiovascular disease,diabetesmellitus, arterial diseaseand modifiable risk factors like cigarettesmoking, increased serum cholesterol levels, obesity, sedentary lifestyle, diet, heavy alcohol consumption, stress and many other factors.[7,8]Epidemiological studies in India have found hypertension,diabetes and cigarette smoking as the leading risk factors for stroke.[2,12,13,14].Therefore, various meta-analysis of cohort studies have been done in the literature ,which gives strong evidence that physical activity has a protective effect against stroke. The National guidelines have also recommended at least 30 minutes of moderate intensity physical activity on all days of the week to reduce the risk of stroke.[16]

The clinical features and the effects of stroke are variable. It depends upon site and extent of the lesion.Stroke patients usually present with a history of sudden or rapid onset of focal neurological symptoms. Some patients may have a stepwise or gradual worsening or waxing and waning of symptoms The common clinical signs and symptomsof stroke are cognitive dysfunction, impaired balance, sensorimotor deficit, muscle weakness and abnormal tone in the limbs, trunk muscles, etc. [17]Most typical symptom of stroke is hemiparesis or hemiplegia which ranges from weakness to full paralysis of the body opposite to the side of the lesion in the brain.[3]

Owing to the higher incidence of middle cerebral artery stroke (MCA) where the contralateral voluntary movements are impaired, the upper limb and trunk muscles are frequently more affected than the lower limbs. This is due to the involvement of the premotor area 6 of the primary motor cortex which controls the anticipatory postural changes.[7]

In addition to the limb muscles, the trunk muscles are also impaired in stroke patients.But, in comparision to limb muscle weakness in hemiparesis where themotor weakness affects one side of the body , trunk muscles are impaired on both ipsilateral and contralateral side of body to that of lesion. This is because, the trunk muscles of both sides of the body functions in synchrony.[1] The trunk muscle weakness and the loss of proprioception concerning the affected side can interfere with balance, stability,functional disability and may reduce ability to control posture.[5]

Prognosis and resolving of symptoms depends on type of stroke.Stroke is mainly of two types; ischemic and hemorrhagic. This study was more focussed on patients who suffered ischemic stroke as itisaccountable for 80% of all stroke and predominate over intracerebral hemorrhage in India. It results from blockage of blood and oxygen supply to brain which occurs because of blood clots in an artery to the brain or a narrowing of the arteries (carotid stenosis)blocking or impeding the blood flow.

It is further classified asthrombotic ischemic andembolic ischemicstroke. Thrombotic ischemic is caused as blood clots form throughout the blood vessels causing disruption of blood flow to areas of brain whereas embolic ischemic stroke occurs when blood clots or cholesterol plaques travels through blood stream into the brain .Once it reaches the brain,the clot eventually travels to a small blood vessel to block its passage.[8]

Based on arteries involved there are large vessel disease and small vessel disease. Largevessel involves the common carotids, internal carotids and vertebral arteries of the Circle of Willis. Small vessel disease involves the smaller arteries inside the brain:branches of the Circle of Willis, middle cerebral artery, stem, and arteries arising from the distal vertebral and basilar artery. Diseases that may form thrombi in the small vessels include: lipohyalinosisand fibrinoid degeneration and micro atheroma.[25]

Cardiac problems can also cause stroke: high risk causes are atrial fibrillation, rheumatic disease of the mitral or aortic valve disease,artificial heart valves disease,recent myocardial infarction, dilated cardiomyopathy and coronary artery bypass graft (CABG) surgery.[26]Low risk/potential causes are calcification of the annulus (ring) of the mitral valve, patent foramen ovale (PFO), atrial septal aneurysm, left ventricular aneurysm without thrombus, etc. Systemic hypoperfusion is also one of the major factors causing stroke wherein there is reduction of blood flow to all parts of the body.It is most commonly due to cardiac pump failure from cardiac arrest or arrhythmias, or from reduced cardiac output. Hypoxemia may precipitate the hypoperfusion.

Therefore, in the literature stroke is reported as a common global health-care problem and a major concern of long-term neurological disability in adults (Wolfe, 2000).[17]It is also an important cause of death which can be seen in worldwide population (Strong, Mathers, & Bonita, 2007).[29]Globally ,stroke is the 2nd leading cause of death above the age of 60 years and 5th leading cause of death in people aged 15-59 years.[20]The incidence of stroke was estimated to be about 1.25 times greater in males than females.[30]

According to one of the recent study published in journal of stroke in 2013, the estimated adjusted prevalence rate of stroke ranges between 84-262/100,000 in rural and 334-424/ 100,000 in urban areas and according to the recent population based studies, the incidence rate ranges between 119-145/100,000.[30]

According to the World Health Organization (WHO), about 5.71 million people died from stroke in 2004[4,31], and it is estimated that this number will climb to 6.3 million in 2015 and 7.8 million in 2030.[4,32]Incidence in India according to WHO stud y, which comes ahead of the "World Brain Stroke Day Friday",has quoted the incidence of the disease in India to be around 130 per 100,000 population every year and says about 20% of the heart patients are susceptible to it.[40]The national commission on macroeconomics and health has projected that cases of stroke would increase from 1,081,480 in 2000 to 1,667,372 in 2015.[6]

As the incidence and prevalence rate of stroke reviewed is higher in worldwide population, standard medical care is the foremost requirement in the health care sector for the management of stroke to reduce the impairment and disability caused by it. Simultaneously,rehabilitation should be considered as a part of stroke management.Several decades of scientific research shows that stroke rehabilitation is critical for optimal stroke recovery. By starting rehabilitation immediatelyafter discharge,stroke survivors can maximize their chances of recovery. Studies have shown that rehabilitation is responsible for most of the recovery experienced by patients after stroke and that without it,little or no improvement can be accomplished.[41]

Recovery after stroke depends on the severity and parts of the brain involved. Measurable neurological and functional recovery in stroke occurs in the 1st month after the stroke onset. Late recovery has been reported in

patients with chronic stroke. Therefore,many evidences support that early mobilization prevents stroke and slows the progression caused by disease. Early rehabilitation started within 20 days has been shown to significantly improve functional outcome when compared to late intervention.[7]

This study was aimed at improving one of the most impaired and ignored component i.e.trunk control and dynamic balance in stroke patients during early rehabilitation and patients within 45 days post-stroke were included in this study .

Trunk control is the ability of the trunk muscles to allow the body to remain upright, adjust weight shifts, and perform selective movements of the trunk so as to maintain the centre of mass within the BOS during static and dynamic postural adjustments. Whereas,balance is defined as a complex process involving the reception and integration of sensory inputs, planning and execution of movements, to achieve a goal requiring upright posture.**[44]** Both trunk control and balance component are interconnectedin keeping the body in upright posture.

Trunk control seems particularly important for balance as it stabilizes pelvis and the spinal column.Muscles of the trunk are involved in maintaining the trunk control and balance of the body.Many studies have reported the weakness of trunk flexor, extensor and bilateral trunk rotator muscles after stroke. Further, several authors have asserted the importance of assessing trunk function in order to predict the functional status at discharge of the stroke patients (Bohannon, 1995; Collin & Wade, 1990; Duarte et al., 2002). [45,17]

Clinical experiences by experts suggests that their function is essential in successful rehabilitation of patients with stroke, especially in the acquisition of basic activities of daily living. A recent study on dynamic posturographic analysis stated that trunk movements in person with stroke are executed by upper trunk with very minimal anterior tilt of the pelvis *i.e.* mobility over stability skill is impaired. Therefore, selective trunk muscle exercises play a major role in improving the trunk performance.[45,17]

Similarly, in normal individual,the ability to distribute the body weight evenly (postural symmetry) and to shift weight according to the task required is essential for normal balance.But this ability is also commonly disturbed in individuals with stroke and they frequently show an increased postural sway, decreased dynamic stability and impaired weight-shifting ability onto the paretic side of the body both when sitting and standing. [46]

The recovery of sitting balance is commonly assumed to be essential to obtain independence in vital functions such as reaching, rising to stand,sitting down, showering, toileting and dressing and as well as it involves the ability to reach for a variety of objects located both within and beyond arm's length as personal daily tasks. Sitting is the first upright posture to be restored after stroke. About 93% of patients in the stroke population can achieve 1-minute independent sitting balance within 6 days of stroke onset. Therefore sitting balance has been reported to correlate with mobility and functional outcomes after stroke. Dean et.al in his study of sitting balance, reported that forward reach distance in sitting was positively associated with the magnitude of trunk and upper–arm segmental motion, as well as the active contribution of the lower limbs in healthy persons.[51,52]

In one of the randomized control trial of truncal exercises early after stroke have showed that the additional truncal exercise also transferred to improve standing balance and ambulation .[46]Similary in a cross-sectional study by Verheyden et al. demonstrated that trunk control is related to measures of balance, gait and functional ability in patients with stroke**.** Both the components are inter-related to each other and training of one component has the transfer effect on the other component.[44]

Most of the prior studies of performance after stroke are mainly concerned with the lower or upper extremity. In comparison with limb rehabilitation, trunk and balance recovery is a rather neglected area of stroke rehabilitation. The altered trunk movements are a challenge for the maintenance of the body equilibrium, and restoration of normal movements of the trunk and of the pelvis in patients with stroke.[3]

Despite evidence demonstrating the importance of trunk performance after stroke, studies evaluating therapy aimed at improving trunk functions are limited.[3] The emphasis of poststroke rehabilitation has been mainly to restore independence in gait and arm function but to some extent, this focus may unintentionally bypass the development of good trunk stability in preparation for the performance of daily life skills. In addition, early hospital discharge can result in the use of atypical or compensatory strategies to compensate for trunk instability. Later in recovery, these compensatory patterns may be learned and difficult to reverse.[47]

Various studies have demonstrated the effects of therapeutical approaches used after stroke for example neurophysiologic, motor learning, strengthening exercises of limb muscles etc. But the evidences supporting the effectiveness of trunk focussed exercises and tailored trunk rehabilitation programme is scarce. Many studies in a literature supports that conventional physiotherapy of trunk strengthening and balance training involving the upper limb and lower limb in stroke patient enhances their functional independence but in the past few years many recent studies have shown that emphasizing the trunk control and balance involving focussed truncal exercise interventions is more effective than conventional physiotherapy in improving trunk control and balance in hemiparetic stroke patients. [3]

So this study was aimed at determining the effect of trunk rehabilitation programme on trunk control and balance in acute ischemic hemiparetic strokepatients.

Two outcome measure used in this study are Trunk Impairment Scale and Sit and Reach Test. The Trunk Impairment Scale (TIS) is a tool to measure motor impairment of the trunk after stroke.It has sufficient reliability, internal consistency and validity for use in clinical practice and stroke research.[49,50]Sit and Reach Test (SRT) used in this study is also reliable, simple, and useful clinical tool for quick screening of mobility in patients with acute stroke.The intertrial, intersession reliability of the SRT were rated good, withintraclass correlation coefficients of 0.98 and 0.79,respectively. [52]

Intervention given in this study was trunk rehabilitation programme. It is a set of exercises which is solely focussed on selective strengthening of trunk muscles of stroke patients. These exercises were performed on trunk in supine or sitting, specifically aimed at improving trunk performance and balance(static and dynamic).Supine exercises done with the starting position as making the patient lye down on the treatment table with head and neck in neutral position and keeping both the upper limbs side to the body. Exercises like pelvic bridging, unilateral pelvic bridging (progression with Swiss ball), upper trunk rotation (progression with Forward diagnol flexion rotaion of the trunk) and lower trunk rotations were given.

Sitting exercises done with the starting position as making the patient sit on a stable base of support (chair or treatment couch without back support) with feet apart and then the patient is made to reach forward for the object (progresion by forward diagnoal reach at shoulder height), shuffling forward and backwards on an exercise table, upper trunk lateral flexion, lower trunk lateral flexion. In all these exercises trunk muscles are getting selectively activated. [3, 17, 44] Evidences in the literature shows that the bridging exercise develops trunk and hip extensor control which is a important pre-requisite for bed pan toileting activities, pressure relief, initial bed mobility (scooting), sit to stand transfer. It also develops advanced LE out of synergy control (i.e hip extension with knee flexion),stimulates early weight bearing through the foot.

Further Sitting exercise is progressed by making the patient sit on an unstable base of support using Swiss ball and asked to maintain static sitting posture, movement of the trunk forward and backward, upper trunk rotation on either side, weight shifts, giving perturbations by the therapist. Swiss ball exercises provide greater challenges to the trunk control and dynamic balance. Therefore Swiss ball exercise is superior to ground based exercise in their ability to recruit trunk muscles. [48]

II. Methods

The study protocol was reviewed by the institutional ethical committee of Kempegowda Institute of Physiotherapy .After seeking the approval and ethical clearance, data was collected from the Outpatient Department of Kempegowda Institute of Physiotherapy, Bangalore, Inpatient and Outpatient Medicine Department of Kempegowda Institute Of Medical Sciences Hospital And Research Centre,Bangalore .All the baseline data was collected–demographic details (name, age, gender, hand dominance,type of stroke and duration of the same).Participants included in the study were briefly explained about the nature of the study and the intervention. Then after,a signed informed written consent was taken from each subjects and were assessed for inclusion and exclusion criteria.

Participants were included in the study based on these inclusion and exclusion criteria:age range between 40 to 60 years, both male and female gender, ischemic stroke patients confirmed by the neurologists on the basis of neurological examination and CT Scan/MRI,medically stable patients with first incidence of unilateral stroke less than 45 days, able to understand the verbal commands, able to sit unsupported for at least 1 min. They were also ruled out for any perceptual or cognitive disorders like memory deficit and hemispatial neglect.Patients were excluded if they were medically unstable, suffering from severe cardiopulmonary diseases, if they suffered stroke along with any other neurological disease affecting balance i.e parkinson's disease, vestibular lesion and multiple sclerosis, if they had a history of diagnosed musculoskeletal disorder of trunk and lower limbs affecting motor performance such as fracture, osteoarthritis, ligament injury,deformity in lower limbs and also avascular necrosis of hip joint and motor neuron disease.

Study Design

This study was asingle group interventional study design. The number of patients taken for the study was 30post stroke patients. The duration of the study was limited to 12 months. Patients received the trunk rehabilitation programme for 5weeks.Patients were treated for 60 minutes including the rest periods in each treatment session and they were treated 6 days a week.Sampling method was purposive sampling method.Materials usedin the studywere treatment couch, Swiss ball-55cm and 65cm, stool, measuring tape, informed consent, assessment ,form and pen/pencil.

Participants were evaluated for the trunk control and balance using following outcome measures:*1.Trunk impairment scale* –Each participant in the study wasinstructed to be seated at the edge of a bed or treatment table without back and arm support, knee at 90 degrees and feet flat on the floor. Then the participant was asked to perform 14 items of TIS which consisted of 3 subscales: static sitting balance(3 items),dynamic sitting balance(7 items) and co-ordination (4 items) and was scored from minimum of 0 to a maximum of 23 points.

2. Sit And Reach Test-The participant was instructed to align his/her arm of the non-paretic limb along a tape measure on the wall while he/she sat on an adjustable plinth and reach as far forward as possible without rotating the trunk or losing balance or touching the wall. Distance achieved (difference between initial and final position) from 3 trials were recorded and mean was used.These two assessments were done before, at the end of the 3rd week during intervention period and after the completion of intervention at the end of 5th week.

III. Intervention Protocol

Patients were explained about the intervention program, daily session to be practiced, duration of the intervention and what was expected from the patient during the intervention sessions. Patients were first trained for the supine exercises and were progressed to sitting exercises.

Trunk rehabilitation programmeinvolvingsets of trunk exercises weregiven with respect to the therapist's position, patient's body position, level of assistance, number of repetitions, exercise intensity, rest period, clear instructions and proper demonstration of exercises under the therapist's supervision and assistance.

Supine exercises protocol:Patient lying on the treatment table with head and neck in neutral position and keeping both the upper limbs side to the body.

1. Forward flexion of the trunk: in crook lying position, exercise performed by bringing the clasped hand forward towards the knee and clearing the shoulder blade off the couch.Progression was done by forward diagnol flexion rotation of the trunk (right and left side)by bringing clasped hands forward diagonally and trying to clear the opposite shoulder off the plinth.
2. Upper trunk rotation: performed by bringing clasped hands laterally on either side of the body.
3. Lower trunk rotation:it was made to perform by bringing the patient's knees together at 90 degree with feet together. Patient asked to move their knees on either side (crook-lying) .Progression with flexion rotation of the lower trunk was achieved by bringing the knees diagonally towards the shoulder.
4. Pelvic bridging: patient asked to bend his knee joint at 90 degree and feet resting on the treatment table. Therapist stabilizes the feet and patient was asked to lift the pelvis off the treatment table.
5. Unilateral pelvic bridging:patient made to put his affected leg on the opposite flexed knee(90 degree) of unaffected lower limb in figure of four while maintaining the pelvic bridge position. Progression was done using Swiss ball under the leg.

Sitting exercise protocol:Patient made to be seated on the treatment couch in half sitting position with hips and knee bent at 90° angles and the feet kept flat on the floor.

1. Forwardreach in sitting:patient was instructed to reach a fixed point at shoulder height by forward flexing the trunk at the hips and further progression achieved by forward diagonal reach at shoulder height**.**
2. Selective flexion extension of the lower trunk: flexion and extension of the lumbar part of the spine performed by ante-flexion and retro-flexion of the lower part of the trunk.
3. Upper trunk lateral flexion: patient performsthis by initiating movement from the shoulder girdle so as to bring the elbow towards the treatment table laterally. Therapist supports the hemiparetic upper limb to maintain both the hands on the thigh.
4. Lower trunk lateral flexion: patient performs this exercise by initiating movement from the pelvic girdle so as to lift the pelvis off the treatment table and bring towards the rib cage.
5. Shuffling forwards and backwards on the treatment table: patient instructed to shift his weight from one side of the body to the other and move forwards and backwards on the exercise table.

Sitting on an unstable base of support(Swiss ball exercises) was carried as a progression to sitting exercises:Swiss ball has been considered as a widely used mode of training device in the clinical practice for core stability exercises and further improves the ability to recruit trunk muscles by increasing the stability demand.

1. Static sitting balance: patient made to sit on the Swiss ball and asked to maintain correct back posture and balance keeping the foot flat on the floor.
2. Weight shifts: while sitting on Swiss ball, the patient shifts his/her weight on either side of the body laterally and by moving forward and backward
3. Bending forward and backward: sitting on Swiss ball with support, patient asked to bend his/her trunk forward and backward. (upper limb maintained in clasped position with shoulder in forward flexion at 90 degree).
4. Perturbations: patient sitting on a Swissball, therapist gives perturbation in all direction and patient asked to maintain the sitting balance.
5. Upper trunk rotation in sitting: sitting on a Swiss ball, patient was asked to rotate his/her upper trunk on either side with the upper limb maintained in clasped hand position with shoulder in forward flexion at 90 degree)

IV. Results

Statistical analysis in this study was done using the statistical software SPSS 16.0 .Statistical methods used was descriptive statistics to calculate Mean and SD of the data. Finally results were analysed using repeated measures ofANOVA. Subjects showed statistically significant improvement in trunk control and balance after the trunk rehabilitation programme on both the outcome measures.(i.e.TIS and SRT) in acute hemiparetic stroke patients. Below are the graphical and tabular representation of the characteristics and scores on outcome measures of the subjects.

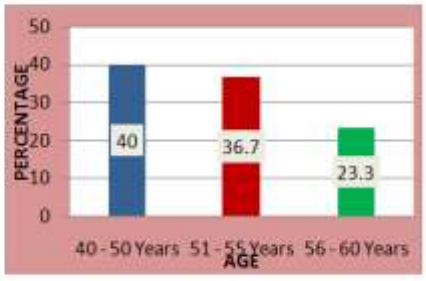
Age distribution of subjects

Table 1: Frequency and percentage distribution of Age

N=30

AGE	Frequency of no. patients	Percentage (%)
40 – 50 Years	12	40
51 – 55 Years	11	36.7
56 – 60 Years	7	23.3
	30	100

Graph. 1 Percentage distribution of Age (years)



Interpretation: Abovetable shows frequency and percentage of age. Overall 40 to 60 years age group subjects participated in the study. Majority i.e.40% of participants were of age group 40-50 years and 36.7% subjects were of 51-55 years age group and 23.3% were of 56-60 years age group.

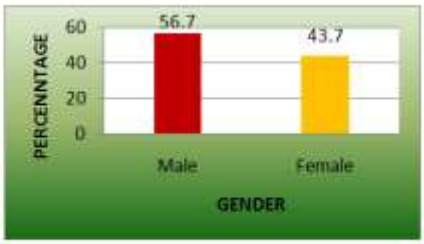
Gender distribution of subjects

Table 2: Frequency and percentage of distribution of gender

N=30

GENDER	Frequency	Percentage (%)
Male	17	56.7
Female	13	43.7
	30	100.4

Graph. 2 Percentage distribution of Gender (%)



Interpretation: Above table shows frequency and percentage distribution of gender. About 56.7% male and 43.7% female participated in the study.

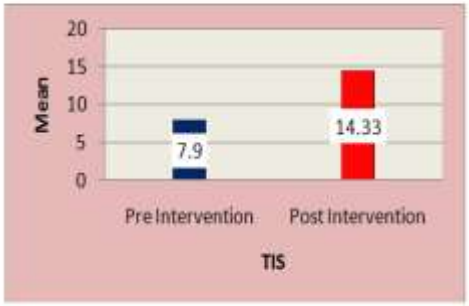
Comparison of Pre-intervention and post intervention TISscores.

Table 3: Paired 't' test to compare pre and post-intervention TIS Score

N=30

TIS	Mean	Mean Difference	't' Value
Pre Intervention	7.9	6.43	23.11
Post Intervention	14.33		

Graph 3. ComparingPre and Post intervention TIS Score



Interpretation: Above table represents the pre and post intervention mean value of TIS scores of the subjects. Hence, these value shows improvement in the post-interventionscores from the pre-Intervention scores with a mean difference of 6.43.

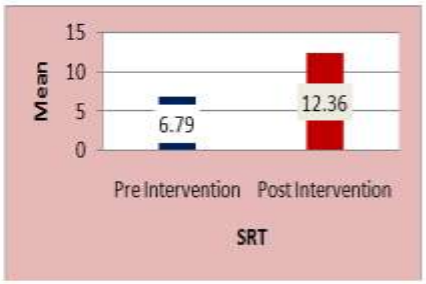
Comparison of Pre-intervention and post intervention SRT score.

Table 4: Paired't' test to compare pre and post intervention SRT Score

N=30

SRT	Mean	Mean Difference	t' Value
Pre Intervention	6.79	5.57	16.74
Post Intervention	12.36		

Graph 4. Comparing Pre and post intervention SRT Score



Interpretation: Above table represents the pre and post intervention mean value of SRT scores of the subjects. Hence, these value shows improvement in the post-intervention scores from the pre-intervention scores with a mean difference of 5.57. By statistical analysis we found thatthere is statistically significant effect of trunk rehabilitation programme on trunk control and balance, and also significant differences between the pre-intervention and post -intervention scores of the TIS and SRT in acute hemiparetic ischemic stroke patients.

V. Discussion

The present study was conducted to analyse the trunk rehabilitation programme in addressing one of the most common impairment after stroke i.e. trunk control and balance impairment. The results of present study are also consistent with other previous studies showing the importance of truncal exercises in the rehabilitation of stroke patients

The outcomes of the intervention in this study was measured using TIS and SRT.For this study 30 subjects with acute hemiparetic stroke were selected. As shown in the table 1 and graph.1, overall 40 to 60 year age group subjects participated in the study. Majority (i.e.40%) of participants were of age group between40-50 years,36.7% participants were of age group between 51-55 years and 23.3% were between 56-60 age group.

As per gender distribution analysed, out of 30 subjects, 56.7% (17) male and 43.7 %(13) female subjects participated in study which shows that the study included more of the male subjects than female subjects.

Subjects who participated in the study were also analysed based on the side of the body involved. Out of 30 subjects ,63% i.e.19 were affected with stroke involving left side of the body and 37% i.e.11 subjects were affected with stroke involving right side of the body .

The duration of the condition in the study was considered from 5-45 days post stroke.The subjects were analysed based on the duration of condition at the time of commencement of the intervention .It showed that most of the subjects started their intervention between 5 to 15th days of post stroke.

Pre-intervention mean and standard deviation of TIS and SRT scores were analyzed. Pre- intervention mean of TIS scores was calculated to be 7.9 and S.D as 4.04 and the pre-intervention mean of SRT was 6.79 and S.D 3.64.

After the intervention was introduced, once again the post intervention mean was calculated to analyse the improvement in TIS and SRT scores. Post intervention mean ofTIS scorewas calculated to be as 14.33 and SRT score as 12.36 respectively.

This study concluded that the trunk control and balance component both were improved statistically while using TIS at the end of 5^{th} week in acute hemiparetic stroke patients compared to day 1 and at the end of 3^{rd} week($p<0.05$)

Similarly , SRT was used as a main clinical tool to assess the patient's sitting balance in this study and further it was concluded that the sitting balance was also statistically improved while using SRT at the end of 5^{th} week in acute hemiparetic stroke patients compared to day 1 and at the end of 3^{rd} week($p<0.05$)

There was a mean change of 6.43 in TIS scores and also increased values on the SRT distances with a mean change of 5.57.This signifies that the anticipatory postural control adjustment of the trunk as well as dynamic sitting balance of the acute hemiparetic stroke patients has improved.

Post intervention mean value of TIS score which was analysed based on the duration of condition at the time of commencement of the intervention showed that the early days interventional scores are better than late day's intervention with trunk rehabilitation programme. Therefore, Intervention introduced during initial days of stroke i.e.5-15th post stroke day showed better TIS score.

Post intervention mean value of Trunk Impairment Scale score with respect to age group, showedthat the early age group interventional scores improved more than older age group subjects. Age group 40-50 years showed significant changes in TIS scores than other older age group subjects included in the study

Similar to the score of TIS, even SRT score were better in early age group subjects and early intervention during the initial days of stroke i.e. 5-15th post stroke day shows significant changes in the post intervention scores following trunk rehabilitation programme.

Finally, analysis was done to compare the improvement from pre-intervention to post intervention score of TIS and SRT score respectively after the implementation of intervention as shown in Graph .3 and 4.

Therefore, these findings suggest that if trunk performance and dynamic sitting balance could be improved early in the rehabilitation process, better functional improvement after stroke might be expected. Trunk rehabilitation exercises also showed a transfer effect on standing balance and ambulation. These findings might be explained by exercises implemented as soon as possible in functional tasks such as reaching and rolling.

In this study, a large portion of trunk rehabilitation programme was focussed on selective trunk muscle strengthening, such as lifting the pelvis or shoulder girdle and rotating of both abdominal and back muscles. Trunk exercises performed under different conditions of manipulation of sensory input for improving balance with an unstable surface as used in the present study (using Swiss ball) indicates that these type of trunk training significantly improves dynamic sitting balance in acute hemiparetic stroke patients.

Therefore, trunk rehabilitation programme emphasizing on the trunk control and balance performance shows statistically significant improvement from 1stDay to 3rdWeek and end of the 5th Week of intervention.

VI. Limitations of the study

This study was carried out on small sample size.No long term follow up was carried out to assess whether subjects retained the gained improvement after 5 weeks of the intervention.No functional improvement in subjects was assessed.No specific tools were used to assess the transfer effect of intervention on standing balance and gait.

VII. Future recommendation

Future randomized controlled studies incorporating trunk rehabilitation with large sample size would provide better insight into the effectiveness and clinical relevance of this intervention. Studies evaluating long-term effects of trunk rehabilitation exercises should be carried out.

VIII. Conclusion

At the end of 5th week of trunk rehabilitation intervention which was implemented to improve trunk control and balance in acute hemiparetic ischemic stroke patients showed clinically and statistically significant improvement in their trunk control and dynamic sitting balance compared from day 1 and at the end of 3rd week($p<0.05$) when assessed using TIS and SRT. It was also observed that early day's intervention after the stroke onset in the subjects showed better TIS score and SRT score. Hence, a 5 week intervention consisting of various trunk exercises in supine and sitting on stable and an unstable BOS proved to be effective in improving trunk control and balance in acute hemiparetic ischemic stroke patients. Trunk rehabilitation exercises from day 1 to end of 5th week also showed the transfer effect in standing balance, gait and ADL as explained subjectively by the patients.

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