EFFECTS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) NECK PATTERN OVER TRUNK SPECIFIC EXERCISES ON TRUNK CONTROL AND BALANCE IN PATIENTS WITH CHRONIC STROKE -AN EXPERIMENTAL STUDY

Dissertation submitted to

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COIMBATORE – 641044

CERTIFICATE

This is to certify that the dissertation work entitled **"Effects of Proprioceptive Neuromuscular Facilitation (PNF) Neck Pattern Over Trunk Specific Exercises on Trunk Control and Balance in Patients with Chronic Stroke"-An Experimental Study** was carried out by the candidate bearing the **Register No. 271620001 (May 2018)** in College of Physiotherapy, SRIPMS, Coimbatore, affiliated to the Tamil Nadu Dr. M.G.R Medical University, Chennai towards partial fulfillment of the **Master of Physiotherapy (Physiotherapy in Neurology).**

Prof. B. SANKAR MANI, MPT (Sports).,MBA.,
Principal
College of Physiotherapy
SRIPMS
Coimbatore – 641044

Place: Coimbatore

Date:

CERTIFICATE

This is to certify that the dissertation work entitled **"Effects of Proprioceptive Neuromuscular Facilitation (PNF) Neck Pattern Over Trunk Specific Exercises on Trunk Control and Balance in Patients with Chronic Stroke"-An Experimental Study** was carried out by the candidate bearing the **Register No. 271620001 (May 2018) i**n College of Physiotherapy, SRIPMS, Coimbatore, affiliated to the Tamil Nadu Dr. M.G.R Medical University, Chennai towards partial fulfillment of the **Master of Physiotherapy (Physiotherapy in Neurology)** under my direct supervision and guidance.

Prof. R.M SINGARAVELAN, M.P.T. (Neuro)
Guide
College of physiotherapy
SRIPMS
Coimbatore – 641044

Place: Coimbatore

Date:

CERTIFICATE

This is to certify that the dissertation work entitled **"Effects of Proprioceptive Neuromuscular Facilitation (PNF) Neck Pattern Over Trunk Specific Exercises on Trunk Control and Balance in Patients with Chronic Stroke" An Experimental Study** was carried out by the candidate bearing the **Register No. 271620001 (May 2018)** College of Physiotherapy, SRIPMS, Coimbatore affiliated to The Tamilnadu Dr. M.G.R Medical University, Chennai towards partial fulfillment of the requirements for the degree of **Master of Physiotherapy (Physiotherapy in Neurology)** was evaluated.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

Place:

Date:

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ABBREVIATIONS

PNF	-	Proprioceptive Neuromuscular Facilitation
TIS	-	Trunk Impairment Scale
BBS	-	Berg Balance Scale
CVA	-	Cerebrovascular Accident
WHO	-	World Health Organization
FRT	-	Functional Reach Test
TUG	-	Time Up and Go test
FMA	-	Fugl Meyer Assessment
LOS	-	Limit Of Stability
DEMMI	-	De Mortor Mobiliy Index
STE	-	Selective Trunk Exercises

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ABSTRACT

Title:

Effects of Proprioceptive Neuromuscular Facilitation (PNF) Neck Pattern Over Trunk Specific Exercises On Trunk Control and Balance in Patients With Chronic Stroke

Aim:

The aim of the study was to find out the effects of Proprioceptive Neuromuscular Facilitation neck pattern over trunk specific exercises on trunk control and balance in patients with chronic stroke

Methods:

A total of 30 subjects were selected and randomly divided into group A of 15 subjects, who received the proprioceptive neuromuscular facilitation neck pattern exercise along with Trunk specific exercises and group B of 15 subjects, who received Trunk specific exercises. Trunk impairment scale and Berg Balance Scale were used to measure the outcomes.

Data Analysis:

The trunk impairment scale test data .The standard deviation for trunk impairment scale of group A is 13.33 and the standard deviation for trunk impairment scale of group B is 11.26 the calculated 't' value is 3.45 where the table value was 2.048 and finally the p value is 0.001795. The standard deviation for Berg Balance scale of group A is 33.36 and the standard deviation of group B is 30.7 .The calculated 't' value is 3.45 where the table value was 2.048 and finally the 'p' value is 0.001795 and the calculated 't' value is 2.5 where the table value is 2.048 and finally the' p' value is 0.001795.

Result :

The result shows significant difference between the pre and post therapy scores when evaluated with Trunk Impairment and Berg Balance Scale .A statistically significant improvement was obtained in group A on trunk control and balance in patients with chronic stroke.($P < 0.05$).

Conclusion:

The study concluded that there is a significant effects of Proprioceptive Neuromuscular Facilitation Neck pattern over trunk specific exercises on trunk control and balance.

Keywords : Trunk control, PNF Neck Pattern, Balance.

1. INTRODUCTION

Cerebral vascular accident provides a base for modern researchers to implement their ideas to bring a resolution in this field and enhance the quality of life in patients. Stroke is a leading cause of death and disability in low and middle-income countries including India, largely driven by demographic changes and enhanced by the increasing prevalence of the key modifiable risk factor. The poor are increasingly affected by stroke, because of both the changing population exposures to risk factors and most tragically, not being able to afford the high cost for stroke care. Majority of stroke survivors continue to live with disabilities, and the costs of on-going rehabilitation and long term-care are largely undertaken by family members, which impoverish their families[36.] Like other developing countries, stroke is a fast emerging major problem and a leading cause of death and disability in India. Therefore, it is one of the common life threatening neurological disorder.

Stroke is a generic term referring to a group of disorders that include cerebral Infarction, cerebral haemorrhage and subarachnoid haemorrhage, all that describing the abrupt and sudden nature of onset. WHO defines the clinical syndrome of stroke "as rapidly developing clinical signs of focal (or global) disturbances of cerebral function with symptoms lasting 24 hours or longer or leading to death with no apparent cause other than of vascular origin". Thus, it is considered as one of the main cause leading to chronic disability which results in motor, sensory, balance, speech and perceptual–cognitive deficits. It poses long term disability and has potentially enormous emotional and socioeconomic consequences for patients, their families and health services[34].

It is commonly seen among males than females. The incidence of stroke increases dramatically with age, doubling in a decade after 65 years of age[7]. According to W.H.O (2011) Approximately 700,000 individuals in United States are affected each year. About 500,000 are new strokes and 200,000 are recurrent strokes. The incidence of stroke in India was 130/100,000 individuals every year. The Indian Council of Medical Research estimates that among the non-communicable disease, Stroke contributes for 41% of deaths and 72% of disability adjusted life years[21]. The estimated adjusted prevalence rate of stroke range is 84-262/100,000 in rural and 334-424/ 100,000 in urban areas. The incidence rate is 119-145/100,000 based on recent population based studies. The population-based study covering 258,576 people in and around Vellore was undertaken during the late 1960s and early 1970s.In the first phase (1968-1969), the number of hemiplegia cases was detected, in the second phase, this population was kept under surveillance for the next two years to record all cases of hemiplegia. This study revealed an incidence of 13/100,000 person/year and a point prevalence of 42/100,000. The second study was conducted at Rohtak, Haryana, North India (1971-1974). Eighty-two cases of stroke were recorded yielding an annual incidence of 33/100,000 person/year.[21.]

The neurological deficits resulting from stroke vary according to the location of the vascular injury, time of inadequate perfusion and the existence of collateral circulation. Thus, these events may result in loss of strength, sensitivity, ability to move and control of several corporal areas resulting in disorders of speech, loss of control of the anal and visceral sphincters, visual disturbances, and loss of

balance or coordination[8]. These patients also show loss of motor control at one side of the body, leading to typical disability in moving the limbs, spasticity, stereotype synergies of motion with sensorial deficit and loss of balance reactions and protection[8].

It also produces a decrease in thickness of muscle fibres and motor unit firing as well as shrinkage of muscle fibres that result in weakness of muscles. This affects the stability of the trunk, coordination of movement and balance[4]. Trunk stability is often an essential component of balance and necessary for coordinated use of extremities for daily functional activities. Trunk stability requires appropriate muscle strength and neural control as well as adequate proprioception to provide a stable foundation for movement[5]. The patients would have difficulty in moving the trunk in relation to gravity, regardless of the type of muscle activity required. The absence of proximal stabilization profoundly influence the upper and lower limb movements and can only be moved by spastic synergy and distal spasticity will increase as the patients attempt to compensate the loss when it attempts to move against gravity[8].

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. In addition to the limb muscles, the trunk muscles are also impaired in stroke patients. But, in comparison to limb muscle weakness in which only one side of the body is affected, trunk muscles are impaired on both the

ipsilateral and contralateral sides of the body to that of lesion. This is because, the trunk muscles of both sides function in synchrony. 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[34].

On treating stroke patients, the complex motor patterns are reduced to their basic movements and develop the fundamental skill of trunk control, stability, and coordinated mobility. These basic motor skills are built upon by progressing to less stable postures and more complex functional activities. Each movement and posture learned is reinforced by repetition through an appropriately demanding and intense training program.

Trunk exercises provided in the past, based on literature are the sensory input tactile feedback, sitting and standing balance including static and dynamic, anterior and posterior shifts, lateral shifts, trunk rotation exercises, postural control training and functional reach-outs.

Proprioceptive neuromuscular facilitation is a dynamic approach to the evaluation and treatment of neuromuscular dysfunction with emphasis on the trunk. This neuromuscular approach looks beyond the classical diagnosis by identifying their habitual pattern of posture and movement including dynamic strength, flexibility, coordination and specific recruitment and motor control of the affected region[9].PNF techniques are mainly based on stimulation of proprioceptors to increase demand on the neuromuscular mechanism to simplify and obtain their response[8]. The goal of the PNF approach is to facilitate an optimal structural and neuromuscular state. This helps to reduce the symptoms, to improve the distribution

of forces through-out the affected region and to reduce the inherent functional stresses caused by poor neuromuscular control. The principles of PNF are based upon the sound Neurophysiological and kinesiological principles and clinical experiences. Each component of the approach provide the basis for developing consistency throughout the evaluation and treatment process. Through applying these basic principles, the patient's postural responses, movement patterns, strength and endurance can be assessed and enhanced[9].

1.1 STATEMENT OF PROBLEM

To maintain balance and for the activities of daily living, trunk control is an essential component. Patients with stroke experience a loss of balance due to a loss of muscular support and control, especially of the trunk. Literature acknowledges the effect of trunk specific exercises, but training trunk control by implementing PNF neck pattern is yet to be established.

1.2 NEED FOR THE STUDY

Patients with impaired trunk stability and imbalance have limitation in their daily living activities. Studies are available on the fact that trunk specific exercises and the proprioceptive neuromuscular facilitation trunk pattern would improve trunk balance and stability and proprioceptive neuromuscular facilitation neck pattern would bring neck control in patients with stroke.

But only limited studies are available in the literature focussing on the impact of Proprioceptive Neuromuscular Facilitation neck pattern exercise in improving trunk control and balance.

1.3 AIM OF THE STUDY

The aim of the study was to find out the effects of Proprioceptive Neuromuscular Facilitation neck pattern over trunk specific exercises on trunk control and balance in patients with chronic stroke.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study were as follows:

- Primary objective of the study was to find out the effects of Proprioceptive Neuro Muscular Facilitation(PNF)Neck pattern on improving trunk control and balance in patients with chronic stroke
- Secondary objective of the study was to find out the effects of Proprioceptive Neuro Muscular Facilitation (PNF) Neck pattern along with trunk specific exercises on improving trunk control and balance in patients with chronic stroke

1.5 RESEARCH HYPOTHESIS

Null Hypothesis (H_0):

There is no significant effect of Proprioceptive Neuromuscular Facilitation neck pattern over trunk specific exercises on trunk control and balance in patients with chronic stroke.

Alternate Hypothesis (H_1):

There is a significant effect of Proprioceptive Neuromuscular Facilitation neck pattern over trunk specific exercises on trunk control and balance in patients with chronic stroke.

2. REVIEW OF LITERATURE

- **PIL NEO HWANGBO** et al., (2016) proposed a study to investigate the effects of proprioceptive neuromuscular facilitation neck pattern exercise on the ability to control the trunk and balance in chronic stroke patients. A total of 30 subjects were randomly divided into two groups, an experimental group of 15 subjects, who received the proprioceptive neuromuscular facilitation neck pattern exercise and a control group of 15 subjects who received traditional rehabilitation treatment. The result of the study shows that there is a significant change in all the items of the Trunk Impairment Scale and the Berg Balance Scale in both the experimental and the control group. The study summarized that the Proprioceptive neuromuscular facilitation neck pattern exercise was shown to have a positive effect on increasing the ability to control the trunk and maintain balance in chronic stroke patients**.**

Journal of Physical therapy Science (2016), **Volume 28, pages 850–853**

- **KYOCHUL SEO** et al., (2015) conducted a study to examine changes in dynamic balance ability through stair gait training using proprioceptive neuro muscular facilitation in stroke patients; 30 stroke patients were randomly allocated to experimental group (received exercise treatment for thirty minutes and stair gait training where PNF is given for thirty minutes) and control group (received exercise treatment for thirty minutes and ground gait training where PNF was given for thirty minutes. During 4 weeks of experiment, each group received training three times a day /week for thirty minutes, outcomes were measured using Berg Balance Scale, timed up and go test (TUG) test and functional reach test (FRT). The study

summarized that the stair gait training group to which PNF was applied have shown improvements in the balance ability and good results can be expected in further studies.

Journal of Physical Therapy Science, (2015), Volume 27, page 1459-1462

- **KAREN ROCHA DE MORES**, et.al. (2014) proposed a study to investigate the effect of proprioceptive neuro muscular facilitation method on hemiplegic patients with brachial predominance after stroke. Twenty patients with brachial hemiplegia were randomly divided into an intervention and control group. The intervention group received thirty minutes of conventional physical therapy and another thirty minutes of upper limb PNF exercise while the control group received thirty minutes of conventional physical therapy. Both groups received a total number of 12 sessions of 60 minutes each performed for two days/week for six weeks. Functional Independence Measure (FIM) and Fugl-Meyer Assessment (FMA) where used to interpret the result. The conclusion was that PNF method can produce a remarkable prognosis, thus PNF is an effective method for functional rehabilitation of upper limb in hemiplegic patients after stroke and can be alternatively used in physiotherapy sessions.

Neurological research, a therapeutics (aperito online publishing) (2014) Volume 1.

- **KIM K** (2015) conducted a study to investigate the effect of coordination movement using the Proprioceptive Neuromuscular Facilitation pattern underwater on balance and gait of stroke patients. Twenty stroke patients were randomly assigned to an experimental group and a control group (n =10 each). Both the groups

underwent neurodevelopmental treatment and the experimental group performed coordination movement using the Proprioceptive neuromuscular facilitation pattern underwater. Balance was measured using the Berg Balance Scale and Functional Reach Test, and gait was measured using the 10-Meter Walk Test and Timed Up and Go Test. The study concludes that coordination movement using the Proprioceptive Neuromuscular Facilitation pattern underwater has a significant effect on the balance and gait in stroke patients**.**

Journal of Physical Therapy Science, 2015, Dec27 Volume 12, Pages 3699-701.

- **SI EUN PARK** et al., (2016) organised a study to identify the effect of trunk stability exercise using proprioceptive neuro muscular specialisation with changes in chair heights on the gait of stroke patients. Eleven stroke patients were randomly assigned into an intervention and control group. The interventional group received trunk stability exercises using PNF with different chair heights (fifty, sixty and seventy cm). The control group received conventional physiotherapy. The subject wore a G-censor (mobile analyse system that measures gait velocity cadence, stride, length and gait cycle).These exercises were performed five days /week for six weeks. The study points out that trunk stability exercise PNF with chair heights were more effective in improving gait velocity gait cycle, cadence and stride length on the effected side in stroke patients**.**

***Journal of Physical Therapy science, (2016), V*olume 28, pages 850–853**

- **CHAO-CHUNG LEE** et al.,(2001) did a study to compare the therapeutic effects of PNF and conventional therapy on balance and mobility performance in patients with chronic stroke.16 out patients with hemiparesis were randomly

assigned into an experimental and control group. The experimental group received 30 minutes PNF treatment 2 days/week for a total of 12 sections and control group received conventional therapy for the same duration. The outcomes were measured using Berg Balance Scale, gait, speed, limit of stability(LOS), the study summarized that goal oriented PNF approach resulted in a better improvement than conventional therapy on balance and functional mobility in patients with stroke.

Preliminary report institute of physical therapy, Page25-38

- **CHAE-GIL LIM** et al., (2014) conducted a study to assess the effects of proprioceptive neuro muscular facilitation (PNF) exercise using sprinter and skater on balance and gait in stroke patients. 22 subjects were randomly assigned to experimental group (PNF pattern exercise using sprinter skater for 15 minutes and conventional physical therapy for 35 minutes) control group (conventional physical therapy for 15 minutes). Both groups received the treatment for 5 days/week for a period of 4 weeks. Outcomes are measured using functional reach test (FRT) and berg balance scale (BBS). The study summarized that PNF pattern using sprinter and skater can be used to improve balance and gait therapeutic intervention in stroke rehabilitation.

Journal of Korean Society of physical therapy, Volume 26, page 249-256

- **LUCIANA DAHIA GONTIJO** et al., (2012) performed a study to find out the presence of irradiated dorsiflexion and plantar flexion and the existing strength generated by them during application of PNF trunk motions. The study was conducted on 30 sedentary female volunteers, the PNF motions of trunk flexion, and extension with the foot (right and left) positioned on a developed equipment

coupled to the load cell, which measured strength. The result of the study state that most of the volunteers irradiated dorsal flexion in the performance of the flexion and plantar flexion during the extension motion. Conclusion was that distal irradiation in lower limbs became evident, as a reinforcement of the therapeutic actions to the PNF trunk motions.

Rehabilitation Research, (2012), Volume, page1-6

- **KRISHNA SHINDE** et al., (2014) did a study to find out the effectiveness of trunk proprioceptive neuro muscular facilitation technique to improve trunk control in stroke patients. 75 patients were aligned in four studies. The intervention groups received PNF technique, trunk impairment was assed using trunk impairment scale. The study concluded that trunk PNF techniques can improve trunk control and balance in acute and sub-acute stages of stroke.

National journal of medical and allied sciences, (2004), Volume-3, issue 2, page 29-34.

- **DILDIP KHAN** al et al.,(2013) conducted a study to investigate the effectiveness of pelvic proprioceptive neuro muscular facilitation technique on facilitation of trunk movement in hemi paretic stroke patients.30 hemi paretic stroke patients were randomly divided into two groups the experimental group which received pelvic PNF while control group received conventional physiotherapy consisting of trunk excises for 30 minutes and both received regular physiotherapy for tonal management and range of motion exercises for the effected limbs for 30 minutes once in a day for 5 days /week for 4 weeks. Outcomes were measured using trunk impairment scale, Tinetti test, trunk lateral flexion Range of motion. The

study concluded that the experimental group showed significant improvement in trunk performance, range of motion, balance, and gait than the control group.

Journal of dental and medical science (2013) Volume 3, issue 6, page29-37.

- **CLARISSA BARROS DE OLIVERIA** et al., (2008). Reviewed the most common balance abnormality in hemi paretic patients with stroke and to find out the main tool for diagnosing them. Stroke patients can be affected with different functions either independently or in combination of heterogeneous neurological impairments. Different tools for balance assessment (motor, sensory, cognitive aspect) have been validated and should be chosen according to the characteristic of stroke patients. The result of the study was that further studies are necessary to investigate particular tool of functional activity**.**

Journal of Rehabilitation and Research and Development, Volume 45, page1215-1226.

- **TED J. STEVENSON** et al., (1996) conducted a study to examine concurrent validity of Berg Balance Scale (BBS) using laboratory measurements of balance (centre of pressure and electromyographic activity).The validity of performance was determined through repeated measurements from 13 subjects. The result of the study concluded that the berg balance scale appears to reflect different abilities to tolerate internally produced perturbation to stand with balance and thus can be used as a valid tool.

Archives of Physical Medicine Rehabilitation, Volume77, page no 656-662.

- **KARATAS M** et al., (2004) conducted a study to evaluate trunk muscle strength in uni hemispheric stroke patients and to assess its relation to body balance and functional disability. The study comparatively investigated isometric and isokinetic reciprocal trunk flexion and extension at angular velocity among 38 uni-hemispheric stroke patients and with 40 healthy volunteers. The outcomes were measured using Berg balance scale. The findings of the study states that trunk flexion and extension muscle weakness can interfere with balance, stability and functional disability in uni hemispheric stroke patients.

Journal of Physical Medicine Rehabilitation, Volume 83, (2004) page no81-87

- **HYUNG-KUI KANG** et al., (2011) did a study to examine the effect of treadmill training with optic flow on the functional recovery of balance and gait in stroke patients. 30 patients with stroke were divided randomly into treadmill with optic flow group (n=10), treadmill group (n=10) and control group (n=10). The experimental group wore a head-mounted display to receive speed modulated optic flow during treadmill training for 30 minutes, the other 2 groups received treadmill training and regular therapy for the same type, 3 times a week for 4 weeks. The data was collected using timed up-and-go test, functional reach test and six-minutes' walk test and the study concluded that treadmill using optic flow speed modulation improves balance and gait significantly in patients with stroke.

Clinical Rehabilitation, Volume-26, page 246-256

- **BHAMINI K. RAO** (2011) et al., to determine the role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke. Fifteen subjects (post-stroke duration (3.53 ± 2.98) years) who had the ability to

walk 10 meters independently with or without a walking aid; on Trunk Impairment Scale (TIS), participated in a selective trunk muscle exercise regime, consisting of 45 minutes training per day, four days a week, and for four weeks duration in an outpatient stroke rehabilitation centre. The study concluded that the exercises consisting of selective trunk movement of the upper and the lower part of trunk had shown larger effect size index for trunk control and balance than for gait in patients with chronic stroke.

Neuroscience & Medicine, 2011, pages2, 61-67

- **RAJRUPINDER KAUR RAI** (2014) et al., evaluated the effect of trunk rehabilitation and balance training on trunk control, balance and gait in post stroke patients. Based on inclusion and exclusion criteria patients were selected from the OPD of University College of Physiotherapy, Faridkot. Patients were equally divided into two groups based on randomization Group A (n=15) and Group B (n=15). Patients in Group A (Experimental Group) received trunk rehabilitation, balance training and conventional physiotherapy. Patients in Group B (Control Group) received conventional physiotherapy only. Duration of treatment was 5 weeks with treatment session for 4 days a week. .Trunk Impairment Scale, Berg Balance Scale and 10 meters distance walk test were used for assessment. The study concluded that trunk rehabilitation exercises and balance training are effective on improving trunk control, balance and gait in post stroke hemiplegic patients. **Journal of Nursing and Health Science.** ***2014, Volume 3, Issue 3 (Ver. III), PP 27-31.***

- **S. KARTHIKBABU** et al., (2011) Organised a study to examine the effects of trunk exercises performed using the physio ball against plinth on trunk control and functional balance in acute stroke patients. 30 acute stroke patients who had first onset of unilateral haemorrhagic or ischaemic lesion. The experimental group performed task-specific trunk excises on unstable purpose (physio ball) while control group performed on stable surfaces (plinth),both group underwent one hour of trunk exercise a day , 4 days , a week for 3 weeks. Trunk impairment scale and Brunel balance assessment scales were used to measure the variable. The study concluded that trunk excises perform on the physio ball are more effective than those performed on the plinth in improving both trunk control and functional balance in stroke patients.

Clinical rehabilitation year (2011) Volume25, Page (709-719)

- **SUSAN RYESON** et al., (2008) proposed a study to determine whether trunk position sense is impaired in people with post stroke hemiparesis. 20 subjects with chronic stroke and 21 non-neurologically impaired subjects also took part in the study. Trunk repositioning error during sitting forward flexion movements was assessed using an electromagnetic movement analysis system. Clinical measures were evaluated using Berg balance scale for balance and postural assessment scale for stroke and Fugl Meyer assessment scales were used. The result showed that subjects with post stroke hemiparesis exhibit greater trunk repositioning error than age-matched controls**.**

Journal of Neuro Physical Therapy, Volume 32, page 14-20

- **STELLA MARIS MICHAELSE** et al. (2006) performed a study with a goal to determine whether task-specific training with trunk-restraint (TR) produces greater improvements in arm impairment and function than training without TR in patients with chronic hemiparesis.Double-blind randomized control trial of a therapist-supervised home program (3 times per week, 5 weeks) in 30 patients with chronic hemiparesis stratified by arm impairment level (Fugl-Meyer) was done. Intervention group (TR group) received progressive object-related reach-to-grasp training with prevention of trunk movements. Control group (C) practiced tasks without TR. Main outcome measures were upper limb impairment (Fugl-Meyer Arm Section) and function (TEMPA) and movement kinematics (trunk displacement, elbow extension; Optotrak, 10 trials) of a reach-to-grasp movement. Evaluations were repeated before, immediately after, and 1 month post intervention by blind evaluators. Thus the study concluded that the treatment should be tailored to arm impairment severity with particular attention to controlling excessive trunk movements if the goal is to improve arm movement quality and function.

Stroke. 2006, Volume 37, pages 186-192

- **KYOUNGSIM JUNG** et al. (2014) investigated the effects of weight-shift training (WST) on an unstable surface in sitting position on trunk control, proprioception, and balance in individuals with chronic hemiparetic stroke. Eighteen participants with chronic hemiparetic stroke were recruited and were allocated to either WST or control group. The WST group received a weight-shift training program for 30 min and then received a conventional exercise program for 30 min, while the control group received conventional exercise program for 60 min,

five times a week for four weeks for both groups. In this randomized control study, we used three outcome measures: trunk reposition error (TRE), Trunk Impairment Scale (TIS), and Timed Up and Go (TUG) test. TRE was measured by each participant's reposition error to the target angle during his/her active trunk movement. TIS and TUG were examined for trunk control abilities and dynamic balance abilities, respectively. The study indicates that weight-shift training is beneficial for improving trunk control and proprioception in patients with chronic hemiparetic stroke.

Tohoku Journal Experimental Medicine, 2014 March, no 232(3), Pages 195-199

- **HANAN HELMY** et al.,(2014) conducted a study to evaluate trunk control in chronic stroke patients , and to determine to what extent it affects balance abilities and functional performance of those patients. Another aim was to detect the best clinical measure that can be used to test trunk muscle control and may predict functional recovery. Forty adult post-stroke ambulant patients participated in this study. The testing protocol included assessment of trunk control by Trunk Impairment Scale (TIS), evaluation of balance ability by Biodex Balance System, and assessment of the functional performance by Functional Independence Measure (motor subscale). The trunk performance is still impaired in most of chronic stroke patients and it strongly affects their balance and functional abilities. The study concluded that the dynamic sitting balance component of the TIS is a reliable clinical indicator of balance and functional recovery**.**

Egypt Journal of Neurology, Psychiatry and Neurosurgery, 2014, Volume 51, no3, pages 327-331.

- **SEUNG-HEON et al.,** (2016) performed a study to examine the effects of mobility, balance, and trunk control ability through selective trunk exercise (STE) in patients with chronic stroke. A randomized pre-test and post-test control group design was initially used, with subjects randomly assigned to the STE group (n=15) and a control group (n=14). All groups underwent physical therapy based on the neuro-developmental therapy (NDT) for 30 minutes a day, five times per week for four weeks. Additionally, the STE group did the trunk exercise for 30 minutes a day, three times per week for four weeks. The timed up and go test (TUG), Berg balance scale (BBS), and trunk impairment scale (TIS) were used for assessment. The study concludes that the combined STE and NDT program showed improvements in measures of mobility, balance and trunk control in chronic stroke patients. These results suggest that STE should be considered to be included in the treatment program for patients with chronic stroke.

Journal Korean Social Physical Medicine, 2017, Volume 12, no 1, pages 25-33

- **G VERHEYDEN** et al., (2004) examined the clinometric characteristics of the trunk impairment scale (TIS). The study was designed with two physiotherapists to observe 88 patients simultaneously but score independently. The tests –retests and inter observer reliability for TIS total score was 0.96 and 0.99 and the content validity was defined. The spear correlations with the Barthel index and trunk control test were used to examined construct and concurrent validity, respectively. The study concludes that the analysis of different clinometric parameters support the use of TIS in both clinical use and future stroke research.

Clinical Rehabilitation, 2004, Volume 18, Pages 326-334.

- **SUZANNE S KUIS** et al., 2014 conducted a paper report on concurrent validity of the balance out come measures for elder rehabilitation of acute care. 44 adults (30) females were admitted in the hospital consented to participate in this study. Outcomes of balance were measured using the BOOMER and the Berg Balance Scale (BBS), De Mortor mobility Index (DEMMI) for mobility assessment and Activities specific Balance Confidence (ABC) scale was used to assess the confidence in balance. The study concludes that the concurrent validity of the BOMMER, BBS and DEMMI was established, supporting that this tools can be used to measure the balance and mobility of patients during acute care.

Research report, New Zealand Journal of physiotherapy Volume-42, pages 16-21.

- **GEERT VERHEYDEN** et al., (2007) conducted a systemic review of clinical measurement scale used to assess the trunk performance after stroke. A total of 458 articles were used for data based research and 32 articles were eligible for inclusion. Three clinical tools were available to specifically evaluate the trunk performance after stroke; trunk control test and trunk impairment scales. The study summarized that assessing psychometric properties of the trunk control test and two trunk impairment scales could determine the measure of choices when assessing trunk performance after stroke.

Clinical Rehabilitation (2007) Volume21, Page 387-394.

3. MATERIALS AND METHODOLOGY

3.1 SOURCE OF DATA

The source of data was gathered from Sri Ramakrishna Hospital.

3.1.1 Research Design

The study design was an experimental study design.

3.1.2 Study Setting

The study was conducted at the Department of Physiotherapy and neurology ward, Sri Ramakrishna Hospital under the supervision of the guide, college of physiotherapy, SRIPMS.

3.1.3 Population

The population of the study consisted of chronic stroke patients who were referred for physiotherapy and were selected according to the inclusion criteria.

3.2 METHOD OF DATA COLLECTION

3.2.1 Sampling Technique

Convenient sampling method to assign the subjects into two groups of 15 each.

3.2.2 Sample Size

A total number of 30 chronic stroke subjects were assigned into two groups with 15 subjects in each group.

Group A- Receives PNF neck pattern and Trunk specific exercises

Group B- Receives Trunk specific exercises

3.3 CRITERTIA FOR SAMPLE SELECTION

3.3.1 Inclusion Criteria

- Patients who are diagnosed to have stroke by the neurologist
- Patients should have language and comprehension[7]
- Patients with good cognition (Mini-mental scale of score 24 or above[3)]
- Muscle tone score of 2 (Modified Ashworth scale) [6]
- Patient able to perform timed Get Up and Go test with or without support of walking aids
- Age between 45-60years
- Middle Cerebral Artery stroke

3.3.2 Exclusion Criteria

- Uncontrolled hypertension (160/95 mm Hg)[7].
- Had undergone any fracture or orthopaedic surgeries (cervical or trunk region)
- Osteoporosis[7]
- Psychosocial disorders like depression, anxiety
- Recurrent stroke
- Spinal deformities like kyphosis, scoliosis and lordosis
- Chronic Neck pain

3.4 TOOLS FOR DATA COLLECTION

Variables

- Response Variable : Balance, Trunk control
- Intervening variable: PNF neck pattern

3.5 PARAMETERS ASSESSED USING

Balance, Trunk control were assessed using scales such as Berg Balance Scale (BBS), Trunk Impairment Scale (TIS).

3.6 STATISITICAL TOOL

Standard deviation

$$S=\sqrt{\frac{\sum((X_1-X_1')^2+\sum((X_2-X_2')\mathbf{2}}{n_1+n_2-2}}$$

Independent 't' test was calculated using the formula

$$t=\frac{(X_2-X_2')\mathbf{2}}{S}\quad\sqrt{\frac{n_1n_2}{n_1+n_2}}$$

3.7 MATERIALS USED

3.8 STUDY DURATION:

The study duration was 1 year (2016-17)

3.9 INTERVENTION:

Treatment Duration: Both groups received 35 minutes of treatment duration per day in which trunk specific exercises were given for 20 minutes per session. Group A received an additional 15 minutes of PNF whereas group B received an extra duration of Trunk specific exercises, 5 days per week, for 8 weeks.

PROCEDURE

Both groups received conventional physiotherapy including exercises for upper limb, lower limb.

GROUP- B

Trunk specific exercises consist of selective movements of upper and lower part of trunk which includes:

- Trunk Flexion and Extension Exercises
  - a) Picking a ball from the floor
  - b) Lifting a cup of water from the bucket.
  - c) Keep a Swiss ball in front of the patient then instruct the individual to move the Swiss ball forward and backward.
- Trunk rotation exercises
  - a) Bend towards one side as if attempting to touch the floor`
  - b) Picking object from the both sides of the body.
  - c) Tie a Thera band to a stand at the level shoulder and the individual is asked to pull the Thera band in opposite direction with the hands.
- Lateral flexion exercises
  - a) Passing and getting the ball from both sides.
  - b) Keep the Swiss ball in front of the patient then instruct the individual to move the ball in diagonally on the bed.
- Reach Out exercises:
  - a) Picking up objects at different levels.

GROUP -A

PNF Neck Pattern

The proprioceptive Neuromuscular facilitation for neck pattern, both for 15 minutes.

a) Neck flexion pattern

b) Neck extension pattern

a) Neck flexion pattern

- Patient will be seated on a mat of knee height and hands placed on knee.
- The therapist will stand behind the patient's right side.
- Put the right finger below the chin of the patient and left hand on the left top of the head diagonally.
- The therapist pulls the patients chin lifted and extended thus the neck will be tilted and rotated towards the right side.
- The patient is then asked to "pull his chin in and look at his left hip".
- The therapist gives resistance against left flexion, left rotation and lateral flexion by providing traction to the chin.

b) Neck extension pattern

- Patient is instructed to follow the same procedure as before and the therapist will stand behind the patient's right side.
- The therapist put's his right thumb on the right side of the patients chin and places his left hand slightly at the right top of the patients head in a diagonal direction.

- The patient assumes the preparation position in which the chin was pulled, the neck is flexed, and the head is rotated and tilted to the left.
- The therapist will instruct the patient to “lift your chin” and then “lift your head to look above”.
- Hence, the patients head, Neck, and upper thoracic spine had complete extension, right rotation, and right lateral flexion.
- Resistance is given by the therapist against right rotation, extension and lateral flexion during the exercise in order to induce strong muscle contractions.

FIGURE NO: 1

FIGURE NO:2

FIGURE NO : 3

FIGURE NO: 4

4. DATA ANLYSIS AND INTERPRETATION

TRUNK IMPAIRMENT SCALE

The trunk impairment scale test data analysis is done by taking the pre-test and post test scores that is X_1 the mean for both pre-test and post-test were taken. The mean of post-test is taken as X_1.The post test score of each individual is subtracted from the mean of the post-test mean that is X_1-X_1'.the square root of the X_1-X_1' is take for each individual as the total mean of the scores are take and these data are presented in a bar graph. The standard deviation for trunk impairment scale of group A is 13.33 and the standard deviation for trunk impairment scale of group B is 11.26 the calculated 't' value is 3.45 where the table value was 2.048 and finally the' p' value is 0.001795.

TABLE NO:1

TIS Scores of Group A (PNF Neck Pattern and Trunk Specific Exercises)

SL.No	PRE-TEST	POST-TEST (X_1)	(X_1-X_1')	(X_1-X_1')^2
1	9	13	-0.33	0.1089
2	7	14	0.67	0.4489
3	10	12	-1.33	1.7689
4	12	14	0.67	0.4489
5	9	13	-0.33	0.1089
6	8	11	-2.33	5.4289
7	9	12	-1.33	1.7689
8	11	15	1.67	2.7889
9	10	13	-0.33	0.1089
10	12	15	1.67	2.7889
11	6	10	-3.33	11.0889
12	8	13	-0.33	0.1089
13	9	14	0.67	0.4489
14	11	15	1.67	2.7889
15	10	16	2.67	7.1289
TOTAL	**141**	**200**		**37.3335**

GRAPH NO: 1

TIS Scores of Group A (PNF Neck Pattern and Trunk Specific Exercises)

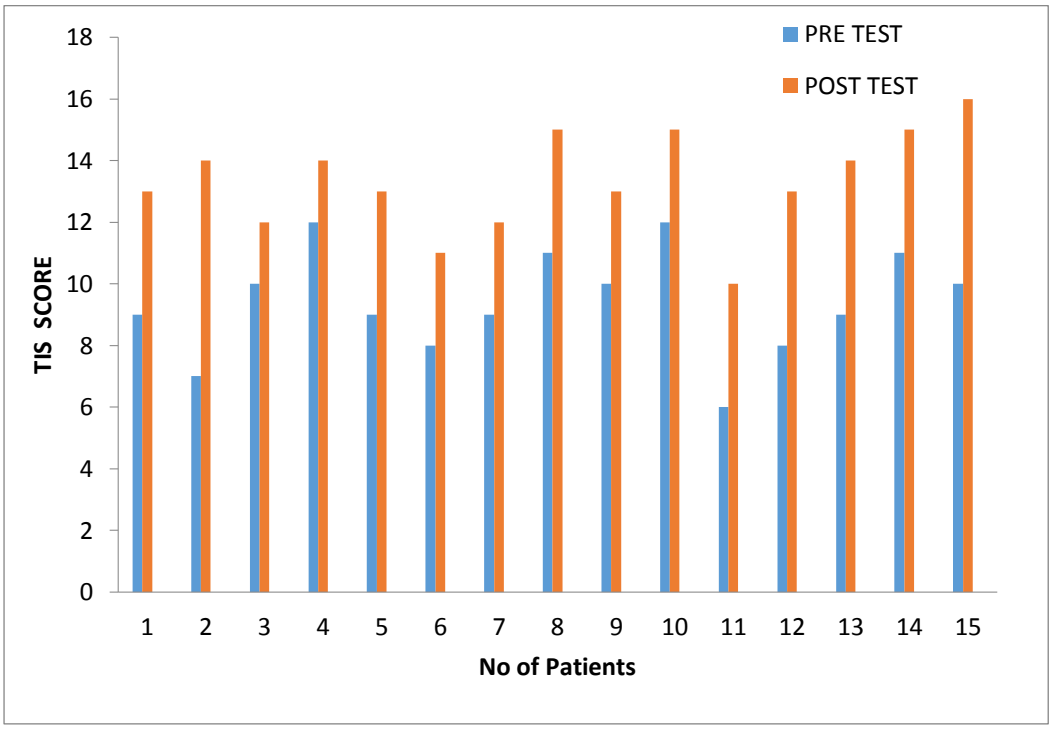


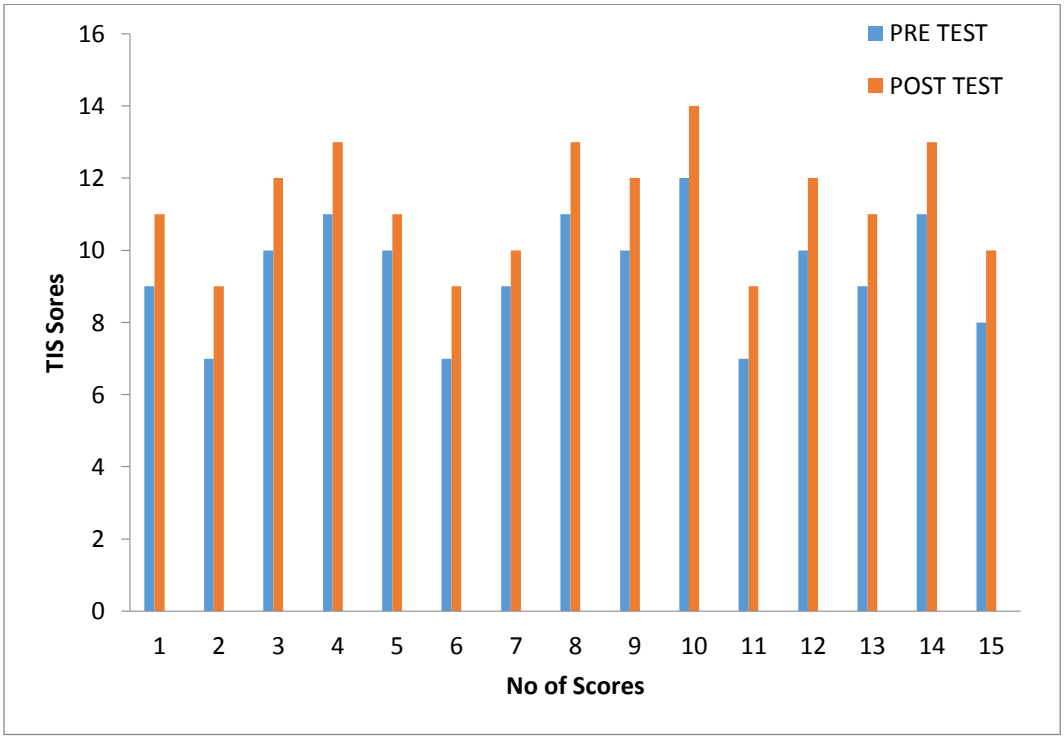
TABLE NO:2

TIS Scores of Group - B (Trunk specific Exercises)

SL.No	PRE-TEST	POST-TEST (X_2)	(X_2-X_2')	(X_2-X_2')^2
1	9	11	-0.27	0.0729
2	7	9	-2.27	5.1529
3	10	12	0.73	0.5329
4	11	13	1.73	2.9929
5	10	11	-0.27	0.0729
6	7	9	-2.27	5.1529
7	9	10	-1.27	1.6129
8	11	13	1.73	2.9929
9	10	12	0.73	0.5329
10	12	14	2.73	7.4529
11	7	9	-2.27	5.1529
12	8	12	0.73	0.5329
13	9	11	-0.27	0.0729
14	11	13	1.73	2.9929
15	8	10	-1.27	1.6129
TOTAL	**139**	**169**		**36.9335**

GRAPH NO:2

TIS Scores of Group - B (Trunk specific Exercises)



BERG BALANCE SCALE

The Berg Balance scale test data analysis is done by taking the pre-test and post test scores that is $\boldsymbol{X_2}$ then the mean for both pre-test and post-test were taken. The mean of post-test is taken as $\boldsymbol{X_2}$.The post test score of each individual is subtracted from the mean of the post-test mean that is$\boldsymbol{X_2}$-$\boldsymbol{X_2'^2}$ the square root of the $\boldsymbol{X_2}$-$\boldsymbol{X_2'}$ ^{2}is take for each individual and the total mean of the scores are take and these data are presented in a bar graph. The standard deviation for Berg Balance scale of group A is 33.36 and the standard deviation of group B is 30.7 .The calculated t value is 3.45 where the table value was 2.048 and finally the p value is 0.001795 and the calculated t value is 2.5 where the table value is 2.048 and finally the p value is 0.001795.

TABLE NO:3

BBS Scores of Group – A (PNF neck pattern and trunk specific exercises)

SL.No	PRE-TEST	POST-TEST (X_1)	(X_1-X_1')	(X_1-X_1')^2
1	30	37	3.6	12.96
2	26	34	0.6	0.36
3	29	38	4.6	21.16
4	23	34	0.6	0.36
5	32	39	5.6	31.36
6	25	35	1.6	2.56
7	27	38	4.6	21.16
8	24	33	-0.4	0.16
9	23	30	-3.4	11.56
10	26	34	0.6	0.36
11	25	34	0.6	0.36
12	20	28	-5.4	29.16
13	24	32	-1.4	1.96
14	22	27	-6.4	40.96
15	20	28	-5.4	29.16
TOTAL	**376**	**501**		**203.6**

GRAPH NO:3

BBS Scores of Group – A (PNF neck pattern and trunk specific exercises)

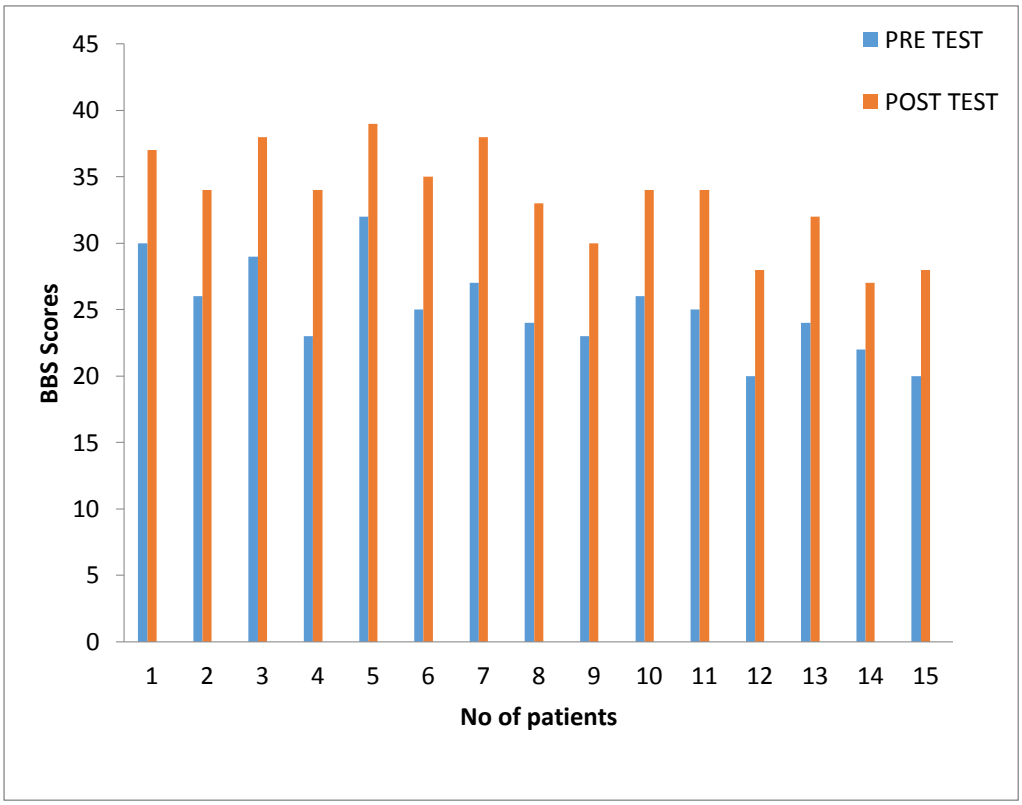


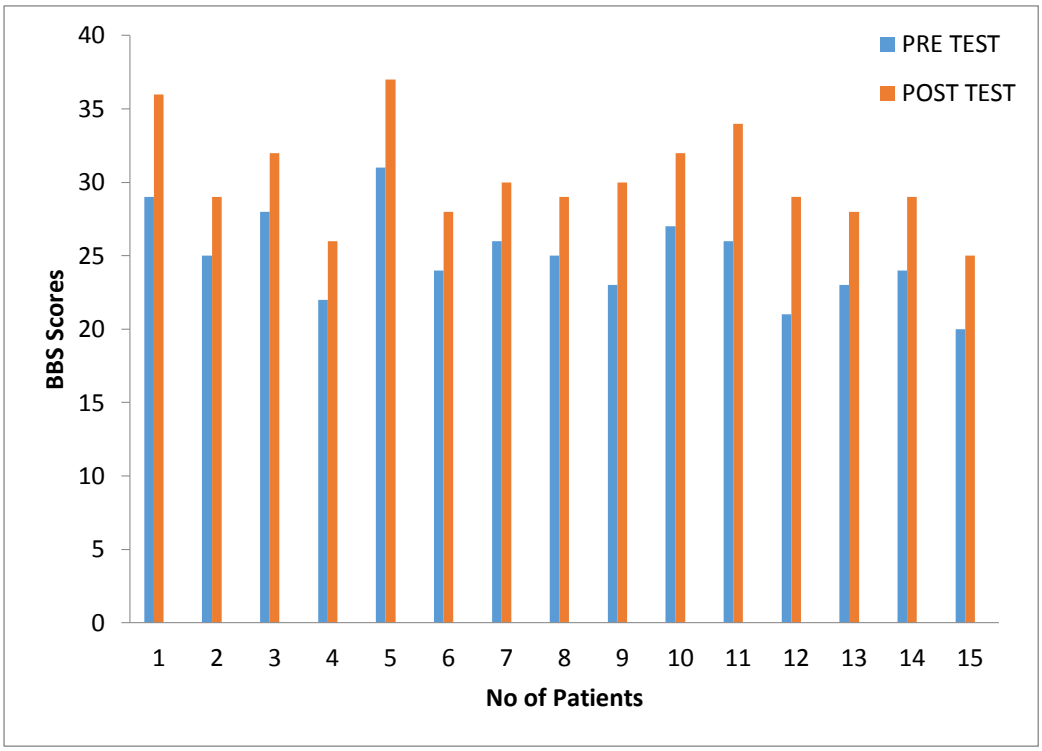
TABLE NO:4

BBS Scores of Group - B (Trunk specific Exercises)

SL.No	PRE-TEST	POST-TEST (X_2)	(X_2-X_2')	(X_2-X_2')^2
2	25	29	-1.07	1.1449
3	28	32	1.93	3.7249
4	22	26	-4.07	16.5649
5	31	37	6.93	48.0249
6	24	28	-2.07	4.2849
7	26	30	-0.07	0.0049
8	25	29	-1.07	1.1449
9	23	30	-0.07	0.0049
10	27	32	1.93	3.7249
11	26	34	3.93	15.4449
12	21	26	-4.07	16.5649
13	23	28	-2.07	4.2849
14	24	29	-1.07	1.1449
15	20	25	-5.07	25.7049
TOTAL	**374**	**451**		**176.9335**

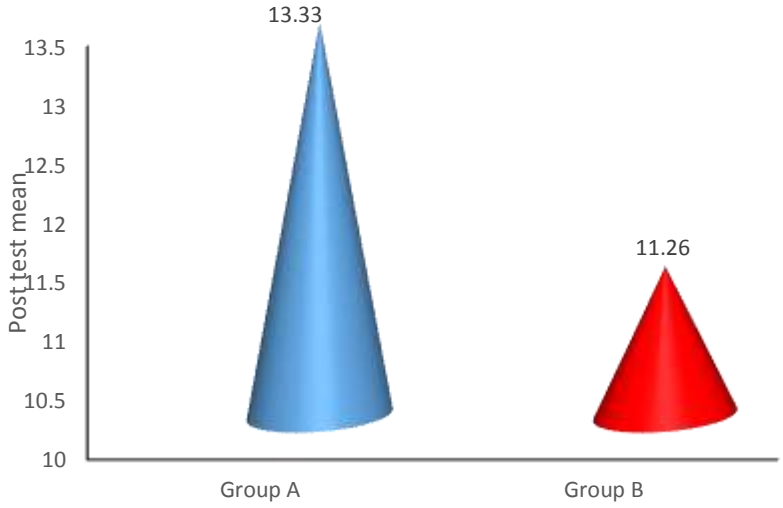
GRAPH NO:4

BBS Scores of Group - B (Trunk specific Exercises)



GRAPH NO: 5

COMPARISON OF POST TEST MEAN (TIS)



GRAPH NO: 6

COMPARISON OF POST TEST MEAN (BBS)

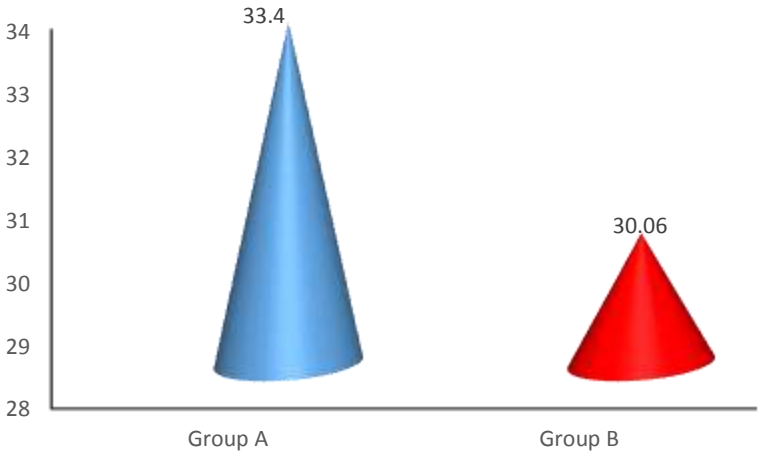


TABLE NO:5

Comparison of Post mean values of scales between Group A and Group B

Scales	Post Test Mean (Group A)	Post Test Mean (Group B)	SD Standard Deviation	Calculated 't' value	Table value	'P' Value (< 0.05)
BBS Scale	33.3	30.07	3.7	2.5	2.048	0.018551
TIS Scale	13.33	11.26	1.63	3.45	2.048	0.001795

5. RESULT

The result shows significant difference between the pre and post therapy scores when evaluated with Trunk Impairment and Berg Balance Scale .A statistically significant improvement was obtained in group A on trunk control and balance in patients with chronic stroke.($P < 0.05$).

6. DISCUSSION

The impact of the neck muscle training on trunk rehabilitation is rather neglected nor unfocused area in the stroke rehabilitation research. Hence, this study is aimed to investigate the effects of Proprioceptive Neuromuscular Facilitation (PNF) neck pattern on trunk control and balance in chronic stroke patients.

In this study both the group's showed improvement in terms of balance and trunk control when assessed by Trunk Impairment Scale and Berg Balance scale. However, the overall improvement in the group A, who received PNF neck pattern, was greater than group B who received trunk exercises along with conventional physiotherapy, common for both groups.

The muscles of the neck and trunk are activated and controlled by the nervous system, which is influenced by peripheral and central mechanism in response to fluctuating forces and activities. Basically the nervous system coordinates the response of muscles to the expected and unexpected forces at the right time and by the right amount by modulating stiffness and movement to match the various imposed forces.

The central nervous system activates the trunk muscles in anticipation of the load imposed by limb movement to maintain stability in the spine through feed forward mechanism. Research has demonstrated that there are feed forward mechanisms that activate postural response of all trunk muscles preceding activity in muscles that move the extremities and that anticipatory activation of the transverse abdominis and deep fibres of the mutifidus is independent of the direction or speed of the disturbance. The more superficial trunk muscles vary in

response depending on the direction of the arm and leg movement, reflective of their postural guy wire function (global muscle function), which controls displacement of the centre of mass when the body changes configuration[32].

Among the PNF's principles, irradiation is a useful aspect for patients with muscle weakness in areas that cannot be directly worked (strengthened).This principle is based on fact that stimulation of strong and preserved muscle groups produces strong activation of injured and weak muscles, facilitating muscle contraction. So, these weak muscles can develop an increase in the duration and/or intensity by the spread of the response to stimulation or by the synergistic muscle inhibition. Some studies have investigated the presence of irradiation, but type of muscle (agonist or antagonist) which receives irradiation is not consistent in the literature[29]. Facilitation resulted from use of particular movement patterns and use of maximal resistance in order to induce irradiation. Gellhorn and Loofbourroe showed that when a muscle contraction is resisted, that muscles response to cortical stimulation increases. The use of particular movement patterns also causes changes in spinal and supraspinal level[30,31].

The work of **Sir Charles Sherrington** was important in the development of the PNF procedures and techniques. The main principle evident in the study can be defined from the work irradiation. According to him irradiation is a spread and increased strength of a response. It occurs when either the number of stimuli or the strength of the stimuli is increased the response may be either excitation or inhibition. This response can be served as increased facilitation (contraction) or hibition (relaxation) of the synergistic muscles and pattern of movements. The

response increases depending on the stimuli intensity or duration (Sherrington 1947) kobat (1967) wrote that it is resistance to motions that produces irradiation, the muscular activity will occur in specific patterns. All these facilitatory techniques might help to facilitate control and stability, and treat trunk indirectly through irradiation thus enhancing the motor control and motor learning thereby improving performance of participants in the experimental group[9].

There are many reasons to exercise the neck patterns. An optimal head control and a correct positioning provide a better mobility of cervical spine for almost all activities of daily living. Movement of head and neck helps to guide trunk motions. Resistance to neck motions provides irradiation for trunk muscle exercise. Stability of head and neck are essential for most everyday activities. Movement of the head and eyes reinforce each other. The range of neck motion will be limited if the patient does not look in the direction of the head movement. Conversely movement of the head in the appropriate direction facilitates eye motions. When the neck is strong and pain free the neck can be used as a handle to exercise the trunk muscle. Both static and dynamic techniques work well. In Neck flexion patterns, the main component is traction. With extension patterns, gentle compression through the crown of the head will facilitate the trunk elongation with the extension[30].

The statistical analysis showed a mean improvement in PNF neck pattern on trunk as compared to the group B. The independent t value for BBS is t=2.048 and for TIS is t= 3.45.Both were significant at the alpha level of 0.05,$p<0.05$.Thus alternative hypothesis is accepted and null hypothesis rejected.

7. CONCLUSION

The study concluded that there is a significant effects of Proprioceptive Neuromuscular Facilitation Neck pattern over trunk specific exercises on trunk control and balance. Hence the null hypothesis is rejected and the alternate hypothesis is accepted which states that “there is a significant effect of Proprioceptive Neuromuscular Facilitation neck pattern over trunk specific exercises on trunk control and balance in patients with chronic stroke”.

LIMITATIONS OF THE STUDY

1. Patients from a single setting were only evaluated
2. Patients with age limit of 45-60 years
3. The study was done only on 30 individuals (Small sample size)
4. Duration of study was small.

RECOMMENDATIONS FOR FUTURE STUDY

1. PNF neck and PNF trunk can be combined and compared
2. EMG analysis of trunk muscle activation can be included as a outcome measures
3. Extremity patterns can be applied to determine its effects on trunk control

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APPENDIX -I

SCREENING QUESTIONNAIRE

Name :

Age :

Sex :

Occupation :

1. Can you understand where are you, who are with you and taking care of you?

   Yes ☐ No ☐

2. Were you affected by stroke for the past 6 months?

   Yes ☐ No ☐

3. Do you experience any numbness or loss of sensation in your legs?

   Yes ☐ No ☐

4. Do you find any difficulty on moving your limbs on your own because of any muscle tightness?

   Yes ☐ No ☐

5. Do you have more difficulty in moving your arms than your legs?

   Yes ☐ No ☐

6. Did you have ever experienced any of the following?

☐ Visual problems

☐ If yes, Brief: -.....

☐ Hearing problems

☐ If yes, Brief: -.....

☐ Bowel/bladder problems

☐ If yes, Brief: -.....

7. Do you feel dizziness during any activity after you were admitted in the hospital on any occasion?

Yes ☐ No ☐

8. Do you ever lose balance during transfer from bed to chair?

Yes ☐ No ☐

9. Can you balance on your own or need assistance during

Sitting - Yes ☐ No ☐

Standing - Yes ☐ No ☐

Walking- Yes ☐ No ☐

10. Are you able to walk:-

☐ By yourself

☐ With assistance of any walking aids

☐ By minimal assistance of your attendee

☐ By any brace or artificial support

11. Do you have hypertension?

Yes ☐ No ☐

12. If you have hypertension, how long were you having it?

Yes ☐ No ☐

13. Is your blood pressure under control?

Yes ☐ No ☐

14. How long you were taking medications for hypertension?

Yes ☐ No ☐

15. Do you have diabetes mellitus?

Yes ☐ No ☐

16. If you have diabetes, how long you were having it?

Yes ☐ No ☐

17. Is your diabetes under control?

Yes ☐ No ☐

18. How long were you taking medications for Diabetes?

Year's☐ Months☐

19. Have you undergone any surgery on your neck or back region?

Yes ☐ No ☐

20. Do you take any medication daily? List of meditation you are taking?

Yes ☐ No ☐

21. How long were you taking these drugs?

Year's ☐ Months☐

22. Are you able to get support and cooperation from your family members?

Yes ☐ No ☐

Patient's signature	**Primary Investigator's signature**	**Guide's signature**

APPENDIX-II

Berg Balance Scale

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research. The BBS has been evaluated in several reliability studies. A recent study of the BBS, which was completed in Finland, indicates that a change of eight (8) BBS points is required to reveal a genuine change in function between two assessments among older people who are dependent in ADL and living in residential care facilities.

Description:
14-item scale designed to measure balance of the older adult in a clinical setting.

Equipment needed: Ruler, two standard chairs (one with arm rests, one without), footstool or step, stopwatch or wristwatch, 15 ft walkway

Completion:

Time: 15-20 minutes

Scoring: A five-point scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Total Score = 56

Interpretation: 41-56 = low fall risk
21-40 = medium fall risk
0 –20 = high fall risk

A change of 8 points is required to reveal a genuine change in function between 2 assessments.

Berg Balance Scale

Name: Date:

_____ _____

Location: Rater:

_____ _____

ITEM DESCRIPTION SCORE (0-4)

Sitting to standing _____

Standing unsupported _____

Sitting unsupported _____

Standing to sitting _____

Transfers _____

Standing with eyes closed _____

Standing with feet together _____

Reaching forward with outstretched arm _____

Retrieving object from floor _____

Turning to look behind _____

Turning 360 degrees _____

Placing alternate foot on stool _____

Standing with one foot in front _____

Standing on one foot _____

Total _____

GENERAL INSTRUCTIONS

Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- the time or distance requirements are not met
- the subject's performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hand for support.

( ) 4 able to stand without using hands and stabilize independently

( ) 3 able to stand independently using hands

( ) 2 able to stand using hands after several tries

( ) 1 needs minimal aid to stand or stabilize

( ) 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on.

( ) 4 able to stand safely for 2 minutes

( ) 3 able to stand 2 minutes with supervision

( ) 2 able to stand 30 seconds unsupported

( ) 1 needs several tries to stand 30 seconds unsupported

( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL INSTRUCTIONS: Please sit with arms folded for 2 minutes.

( ) 4 able to sit safely and securely for 2 minutes

( ) 3 able to sit 2 minutes under supervision

( ) 2 able to able to sit 30 seconds

( ) 1 able to sit 10 seconds

( ) 0 unable to sit without support 10 seconds

STANDING TO SITTING

INSTRUCTIONS: Please sit down.

( ) 4 sits safely with minimal use of hands

( ) 3 controls descent by using hands

( ) 2 uses back of legs against chair to control descent

( ) 1 sits independently but has uncontrolled descent

( ) 0 needs assist to sit

TRANSFERS

INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.

( ) 4 able to transfer safely with minor use of hands

( ) 3 able to transfer safely definite need of hands

( ) 2 able to transfer with verbal cuing and/or supervision

( ) 1 needs one person to assist

( ) 0 needs two people to assist or supervise to be safe

STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

( ) 4 able to stand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed 3 seconds but stays safely

( ) 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER INSTRUCTIONS: Place your feet together and stand without holding on.

( ) 4 able to place feet together independently and stand 1 minute safely

( ) 3 able to place feet together independently and stand 1 minute with supervision

( ) 2 able to place feet together independently but unable to hold for 30 seconds

( ) 1 needs help to attain position but able to stand 15 seconds feet together

( ) 0 needs help to attain position and unable to hold for 15 seconds

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)

( ) 4 can reach forward confidently 25 cm (10 inches)

( ) 3 can reach forward 12 cm (5 inches)

( ) 2 can reach forward 5 cm (2 inches)

( ) 1 reaches forward but needs supervision

( ) 0 loses balance while trying/requires external support

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS: Pick up the shoe/slipper, which is in front of your feet.

( ) 4 able to pick up slipper safely and easily

( ) 3 able to pick up slipper but needs supervision

( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently

( ) 1 unable to pick up and needs supervision while trying

( ) 0 unable to try/needs assist to keep from losing balance or falling

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. (Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.)

( ) 4 looks behind from both sides and weight shifts well

( ) 3 looks behind one side only other side shows less weight shift

( ) 2 turns sideways only but maintains balance

( ) 1 needs supervision when turning

( ) 0 needs assist to keep from losing balance or falling

TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

( ) 4 able to turn 360 degrees safely in 4 seconds or less

( ) 3 able to turn 360 degrees safely one side only 4 seconds or less

( ) 2 able to turn 360 degrees safely but slowly

( ) 1 needs close supervision or verbal cuing

( ) 0 needs assistance while turning

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds

( ) 3 able to stand independently and complete 8 steps in > 20 seconds

( ) 2 able to complete 4 steps without aid with supervision

( ) 1 able to complete > 2 steps needs minimal assist

( ) 0 needs assistance to keep from falling/unable to try

STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)

( ) 4 able to place foot tandem independently and hold 30 seconds

( ) 3 able to place foot ahead independently and hold 30 seconds

( ) 2 able to take small step independently and hold 30 seconds

( ) 1 needs help to step but can hold 15 seconds

( ) 0 loses balance while stepping or standing

STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding on.

( ) 4 able to lift leg independently and hold > 10 seconds

( ) 3 able to lift leg independently and hold 5-10 seconds

( ) 2 able to lift leg independently and hold ≥ 3 seconds

( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.

( ) 0 unable to try of needs assist to prevent fall

TOTAL SCORE (Maximum = 56)

Validity and Reliability: Clarissa Barros de Oliveira et al., Balance control in hemi paretic stroke patients: Main tool for evaluation, Journal of Rehabilitation Research and Development, Vol 45, No.8, (2008), Pages 1215-1226.

APPENDIX-III

TRUNK IMPAIRMENT SCALE

Starting position for all items: sitting, thighs horizontal and feet flat on support, knees 90° flexed, no back support, hands and forearms resting on the thighs. The subject gets 3 attempts for each item. The best performance is scored. The observer may give feedback between the tests. Instructions can be verbal and nonverbal (demonstration).

	Task Description	Score Description	Score	Remarks
	Static Sitting Balance			
1.	Keep starting position for 10 s	Falls or needs arm support	0	If 0, total TIS score is 0
		Maintains position for 10 s	2	
2.	Therapist crosses strongest leg over weakest leg, keep position for 10 s	Falls or needs arm support	0	
		Maintains position for 10 s	2	
3.	Patient crosses strongest leg over weakest leg	Falls	0	
		Needs arm support	1	
		Displaces trunk 10 cm or assists with arm	2	
		Moves without trunk or arm compensation	3	
	Dynamic Sitting Balance			
1.	Touch seat with right elbow, return to starting position (task achieved or not)	Does not reach seat, falls, or uses arm	0	If 0, items 2 3 are also 0
		Touches seat without help	1	

2.	Repeat item 1 (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 3 is also 0
		Appropriate trunk movement (shortening	1	
		right side, lengthening left side)		
3.	Repeat item 1 (compensation strategies	Compensation used (arm, hip, knee, foot)	0	
	used or not)	No compensation strategy used	1	
4.	Touch seat with left elbow, return to	Does not reach seat, falls, or uses arm	0	If 0, items 5 6 are also 0
	starting position (task achieved or not)	Touches seat without help	1	
5.	Repeat item 4 (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 6 is also 0
		Appropriate trunk movement (shortening	1	
		left side, lengthening right side)		
6.	Repeat item 4 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensatory strategy used	1	
7	Lift right side of pelvis from seat, return to starting position (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 8 is also 0
		Appropriate trunk movement (shortening	1	
		right side, lengthening left side)		
8.	Repeat item 7 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensation strategy used	1	
9.	Lift left side of pelvis from seat, return to	No appropriate trunk movement	0	If 0, item 10 is also 0

	starting position (evaluate trunk movement)	Appropriate trunk movement (shortening	1	
		left side, lengthening right side)		
10.	Repeat item 9 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensation strategy used	1	
	Coordination			
1.	Rotate shoulder girdle 6 times (move each shoulder 3 times forward)	Does not move right side 3 times	0	If 0, item 2 of also 0
		Asymmetric rotation	1	
		Symmetric rotation	2	
2.	Repeat item 1, perform within 6 s	Asymmetric rotation	0	
		Symmetric rotation	1	
3.	Rotate pelvis girdle 6 times (move each knee 3 times forward)	Does not move right side 3 times	0	If 0, item 4 is also 0
		Asymmetric rotation	1	
		Symmetric rotation	2	
4.	Repeat item 3, perform within 6 s	Asymmetric rotation	0	
		Symmetric rotation	1	
		Total Trunk Impairment Scale	**/23**	

APPENDIX – IV

Information to participants and consent form

PROTOCOL NO:

INVESTIGATOR:

Title: EFFECTS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) NECK PATTERN OVER TRUNK SPECIFIC EXERCISES ON TRUNK CONTROL AND BALANCE IN PATIENTS WITH CHRONIC STROKE"

-AN EXPERIMENTAL STUDY

You are invited to take part in this research study. The information in this document is meant to help you decide whether or not to take part. Please feel free to ask, if you have any queries or concerns

You are asked to participate in this study conducted in the department of physiotherapy and neurology ward, Sri Ramakrishna Hospital under the supervision of the guide, college of physiotherapy, SRIPMS, Coimbatore ,because you satisfy our eligibility criteria which are:

i. Patient who diagnosed as stroke by neurologist

ii. Patient should have language and comprehension[7]

iii. Patients with good cognition (Mini-mental scale of score 24 or above[3)]

iv. Muscle tone score 2 (Modified Asworth scale) [6]

v. Patient able to perform time Get Up and Go test with or without support of walking aids.

vi. Age between 45-60years

vii. Stroke with Middle Cerebral Artery.

What is the purpose of Research?

Stroke patients also shows loss of motor control at one side of the body, leading to typical disability to move the upper limb, spasticity, stereotype synergies of motion with sensorial deficit and loss of balance reactions and protection[8]

Trunk stability is often essential core component of balance and coordinated extremity use for daily functional activities. Trunk stability requires appropriate muscle strength and neural control as well as adequate proprioception to provide a stable foundation for movement[5]

Stroke also produces a decrease in thickness of muscle fibres and production of motor unit firing as well as shrinkage of muscle fibres that result in weakness of muscles. This affects stability of the trunk, coordination of movement and balance[4].

You will be one of the thirty participants we plan to recruit in this study. We want to test the effectiveness of the PNF neck pattern exercises over trunk control on this condition. This intervention has been found to possess good benefits in earlier studies.

In the present study, we plan to see the Effect of PNF Neck pattern exercises on trunk control among patients with chronic stroke.

Information obtained from this study would be beneficial to other patients with the same complaint. We have obtained the permission of the ethical Committee on conducting this study. This is how the study will be carried out-after your suitability for the study based on the selection criteria has been determined. Your baseline assessment will be done in terms of Berg Balance Scale, Trunk impairment Scale scores. Once you are a part of the study, treatment will be given to you with

the aim of maximum benefit to you. The treatment duration will last from 35-40 minutes once in a day per week for 8 weeks and will be given in our department. Patients are given with a exercise scoring sheet and asked to fill the sheet after completion of exercises at home and will be reviewed on alternate days of the week or weekly once and in case if increasing symptoms during the time of treatment, it should be stopped immediately and mention what are the symptoms experienced by them in the exercises scoring sheet, and continue the exercises after the symptoms reduced.

Possible risks to you

There are no known adverse effects of the study intervention. There may be some signs of giddiness, blurring of vision, headache , fluctuation in hearing, pain or discomfort in neck or back.

Possible benefits to you

You are not expected to get any benefit from being on this research study, other that the treatment benefits.

Possible benefits to other people

The results of the research may provide benefits to the society in terms of advancement of knowledge and therapeutic benefits to future patients.

The alternatives you have

If you do not wish to participate, have the alternative of getting the standard treatment for your condition.

Confidentiality of the information obtained from you

You have right to confidentiality regarding the privacy of your medical information (personal details, results of physical examinations, investigations, and your medical history). Signing this document, you will be allowing the research team investigators, other study personnel, institutional ethics committee and any person or agency required by law to view your data, if required. The results of clinical tests and therapy performed as part of this research may be included in your medical record. The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

How will your decision to not participate in the study affect you?

Your decision not to participate in this research study will not affect your medical care or you're your relationship with the investigator or the institution. Your doctors will still take care of you and you will not lose any benefits to which you are entitled.

Can the investigator take you off the study?

You may be taken off the study without your consent if you do not follow instructions of the investigator or the research team or if the investigator thinks further participation may cause you harm.

Right to new information

If the research team gets any new information during this research study that may affect your decision to continue participating in the study, or may raise some doubt, you will told about that information.

Contact person

For further information/questions**,** you can contact us at the following address;

Principal investigator:

PARTICIPANT INFORMED CONSENT FORM

I Mr/Mrs _____ of my own free will of choice, hereby give m consent to be included in the study "Effects of Proprioceptive Neuromuscular Facilitation (PNF) Neck Pattern over Trunk Specific Exercises on Trunk Control and Balance in Patients with Chronic Stroke"- An Experimental Study

I have been clearly informed to my satisfaction the purpose of the study and thus, I agree to fully corporate and participate in the study.
I have been informed that no part of my information shall be revealed except the data which will be used for the study and adequate secrecy will be maintained.

Also, no part of the information will be used against me.

I am also aware of my right to opt out at any time and prevent my data to be utilized at any phase of the study if I desire.

Signature _____

I, confirm that I have explained the purpose of the study and answered all the questions related to my study.

Therapist Signature _____

INVESTIGATOR CERTIFICATE

I certify that all the elements including the nature, purpose all possible risks of the above study as described in this consent document have been fully explained to the subject. In my judgement, the participant possess the legal capacity to give informed consent to participate in the research and voluntarily and knowingly giving informed consent to participate.

Signature of the Investigator_____ Dated_____

Name of the Investigator: _____

APPENDIX-IV

NEUROLOGICAL ASSESSMENT PERFORMA

SUBJECTIVE EXAMINATION

- Name
- Age/ sex
- Occupation
- Address
- Date of admission
- Date of assessment
- Handedness
- Chief complaints
- History
    - Present medical history
    - Past medical history
    - Personal history
    - Surgical history
    - Family history
    - Social history
- Associated problems

OBJECTIVE EXAMINATION

- General examination
  - Vitals: BP: Temperature: PR: HR:
- On observation
  - Body built
  - Attitude of limb
  - Swelling, redness
  - Deformity
  - Posture
  - Gait
  - External appliances
- On palpation
  - Muscle firmness
  - Swelling
  - Warmth
  - Tenderness

NEUROLOGICAL EXAMINATION

- Higher mental function
  - Level of consciousness
  - Attention
  - Orientation

- Memory
- Language
- Calculation
- Judgement
- Proverb interpretation

➢ Cranial nerve examination

➢ Sensory examination

- Superficial
    - Touch
    - Pain
    - Temperature
    - Pressure
- Deep
    - Joint position
    - Kinesthetic sensation
    - Vibration
- Cortical
    - Touch localization
    - Two point discrimination
    - Stereognosis
    - Baragnosis

- Motor examination
    - Muscle tone
    - Muscle power
    - Reflexes
        - Superficial
            - Plantar reflex
            - Abdominal reflex
            - Anal reflex
            - Bulbo cavernous reflex
            - Cremasteric reflex
        - Deep
            - Upper extremity: biceps, triceps, supinator, fingers.
            - Lower extremity: quadriceps, hamstrings, achilles tendon.
- Muscle girth
- Range of motion
    - Active ROM
    - Passive ROM
- Coordination
- Posture
- Balance
- Gait
- Activity of daily living

INVESTIGATION

- Blood test
- CSF examination
- Other medical investigation
- Structural investigations: X-Ray, CT scan, MRI
- Functional investigations: NCV, EMG, SD Curve

DIFFERENTIAL DIAGNOSIS

PROVISIONAL DIAGNOSIS

FUNCTIONAL DIAGNOSIS

- Impairment
    - Structural
    - Functional
- Activity limitation
- Participation restriction
- Contextual factors: Positive:

  Negative:

APPENDIX-V
TRUNK SPECIFIC EXERCISES

FLEXION AND EXTENSION EXERCISES

The patient was in a sitting position with feet on the floor. The patient was then asked to flex and extend the trunk.

FIGURE NO: 4 **FIGURE NO :5**

TRUNK ROTATION EXERCISES

- Patient was in sitting position with feet on the floor.
- Hands were clasped and the patient was asked to move the hands towards left and right alternatively.

FIGURE NO: 6 **FIGURE NO: 7**

LATERAL FLEXION EXERCISES

- Upper trunk lateral flexion was done by initiating movement from shoulder girdle and brings the elbow towards the plinth.

FIGURE NO:8

FIGURE NO: 9

- Lower trunk lateral flexion was done by moving the pelvic girdle so as to lift the pelvic off the plinth towards the rib cage.

FORWARD REACH EXERCISES

- This exercise was performed by asking the patient to reach a fixed point at the shoulder height from a sitting position.

FIGURE NO:10

LATERAL REACH EXERCISES

- This was performed by reaching out for a fixed point at shoulder height so as to elongate the trunk on the weight bearing side and shorten the trunk on the non -weight bearing side from a sitting position.

FIGURE NO.11

APPENDIX -VI

MASTER CHART

S.no	Age(years)	Group	Sex (m/f)	Aff Side	Ht (cm)	Wt (kg)	BBS		TIS	
							Pre test	Post test	Pre test	Post test
1	46	A	F	R	156	49	30	37	9	13
2	55	A	F	R	165	59	26	34	7	14
3	50	A	M	R	171	53	29	38	10	12
4	49	A	F	L	166	47	23	34	12	14
5	58	A	M	R	159	51	32	39	9	13
6	46	A	F	R	155	55	25	35	8	11
7	50	A	F	L	164	49	27	38	9	12
8	52	A	M	R	174	51	24	33	11	15
9	56	A	F	R	158	48	23	30	10	13
10	59	A	F	L	143	55	26	34	12	15
11	51	A	F	L	155	43	25	34	6	10
12	55	A	F	R	160	56	20	28	8	13
13	52	A	M	L	171	54	24	32	9	14
14	66	A	F	L	164	55	22	27	11	15
15	58	A	F	L	156	45	20	28	10	16
16	57	B	M	R	170	47	25	29	9	11
17	65	B	F	L	153	54	28	32	7	9
18	59	B	F	R	161	55	22	26	10	12
19	57	B	M	R	169	45	31	37	11	13
20	60	B	F	L	152	60	24	28	10	11
21	65	B	F	L	161	49	26	30	7	9
22	57	B	M	L	169	55	25	29	9	10
23	64	B	F	R	154	46	23	30	11	13
24	53	B	M	L	170	58	25	29	10	12
25	58	B	M	L	155	54	28	32	12	14
26	55	B	M	L	169	46	22	26	7	9
27	63	B	M	R	159	59	31	37	8	12
28	59	B	M	L	171	47	24	28	9	11
29	64	B	M	L	169	54	26	30	7	9
30	60	B	M	L	170	51	25	29	10	12