



Research Article

## EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) WITH CONVENTIONAL THERAPY VS CONVENTIONAL THERAPY ON GAIT IMPROVEMENT OF SUBJECT WITH SUB-ACUTE STROKE A COMPARATIVE STUDY

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### ABSTRACT

**Background:** A stroke is a sudden, non-conclusive loss of neurological function due to an ischemic or haemorrhagic intracranial vascular event. Stroke is a leading cause of death and a leading cause of serious, long term disability in adults. Three months after stroke, 20% of patients remain wheelchair bound and approximately 70% walk at reduced velocity and capacity. **Aim of the Study:** To find out the effectiveness of proprioceptive neuromuscular facilitation [PNF] with conventional therapy on gait improvement of subject with sub-acute stroke. **Need for the Study:** Apart from the type and duration of PNF treatment, the duration of hemiplegia should be considered a factor affecting functional recovery. There is considerable doubt over the benefit of PNF for patients with hemiplegia of more than 6 months duration. In respect on the nowadays view of evidence based treatment, scientific support of our actions as a physiotherapist is necessary. In case that in our patient management the PNF approach gets a place a search for external support is needed. Further evidence is require for the same as it is lacking still, for which this study is being done. **Methodology: Study Design: Quasi Experimental, Study Type: Comparative, Sample Size: 12, Sampling Method: Simple Random Sampling, Study Setting: Home Based, Study Duration: 3weeks. Inclusion Criteria:** Hemiplegia secondary to cerebrovascular accident with symptom of more than 6, less than 12 months, Brunnstrom stages 4 & 5 of lower limb, Ability to walk at least 18.3 meters or 60 feet without manual assistance, with or without an assistive device, at one's preferential speed, Intact kinaesthesia for the hip, knee & ankle. **Exclusion Criteria:** Patients with symptoms lasting less than 12 months, Previous PNF treatment to the pelvic region, Old case of stroke, Patients with memory disorders, Other neurologic or orthopaedic disorders, Unstable cardiovascular condition, History of psychosis, History of foot deformity, Non co-operative patients, Unstable vital parameters. **Results:** There is statistically significant difference in group –A [PNF with conventional therapy] between pre test and post test of Timed Up and Go test at P<0.05.

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### INTRODUCTION

A stroke is a sudden, non-conclusive loss of neurological function due to an ischemic or haemorrhagic intracranial vascular event. In generally, cerebrovascular accidents are classified by anatomic location in the brain, vascular distribution, and aetiology, age of the affected individual and haemorrhagic or non-haemorrhagic nature. Stroke is a leading cause of death and a leading cause of serious, long term disability in adults. Three months after stroke, 20% of patients remain wheelchair bound and approximately 70% walk at reduced velocity and capacity.

Restoration of walking ability and gait rehabilitation is therefore highly relevant for patients who are unable to walk independently after stroke. The loss of motor skills necessary for locomotion is considered one of the most devastating to the patient. Non-surprisingly, locomotion rehabilitation is one of the important and interesting therapies for stroke researches.

Posture, tone, co-ordination & reciprocal movements are important components that are required for normal gait which are usually impaired in persons with hemiplegia. Gait training itself often is not simple in severely affected stroke patients, has a result of the severity of the disabilities. The success of gait rehabilitation after stroke depends on active exercise, however, the disabling after effects of stroke often make such exercise impossible at the onset of therapy.

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In recent years it has also been shown that higher intensities of walking practice results in better outcomes for patients after stroke. Though proprioceptive neuromuscular facilitation [PNF] is one approach commonly used to improve the gait of patients with hemiplegia in other countries, it is not that common in our country. The PNF concept is an exercise therapy which has its roots in the forties of the last century.

PNF is a motor learning approach used in neuromotor development training to improve motor function and facilitate maximal muscle contraction. Various PNF procedure have been used, depending on the affected site. Among these PNF techniques is facilitation of pelvic motion to improve control of the pelvis. Because the pelvis has been described as “key point of control” for maintaining a gait pattern, techniques designed to affect the pelvis are widely used. Very few studies, however, have documented the therapeutic effects of facilitation of pelvic motion in patients with hemiplegia.

Dr. Kabath and Mrs. Knott developed an exercise therapy concept for polio patients. The exercise therapy, which they proposed, was revolutionary for that time. The basis of the PNF philosophy is the idea that all human beings, including those with disabilities have existing potential.

This use of PNF concept or components of PNF approach is widely spread among physiotherapists all over the world but the use of PNF concept or components in gait is relatively limited.

Systemic review of PNF from Jan 1990 till Aug 2006 relieved there were only 4 publications of PNF approach in gait. Of this only one clinical trial was done on stroke patients. The result of that studies indicates that patients with hemiplegia benefited with the specific PNF techniques. Since there was no control group receiving PNF was included, definite statements were not possible.

Hence in this study, the effectiveness of PNF techniques with conventional therapy with true control group which receive no PNF is included and tested.

**Aim of the Study:** To find out the effectiveness of proprioceptive neuromuscular facilitation [PNF] with conventional therapy on gait improvement of subject with sub-acute stroke. **Need for the Study:** Apart from the type and duration of PNF treatment, the duration of hemiplegia should be considered a factor affecting functional recovery. There is considerable doubt over the benefit of PNF for patients with hemiplegia of more than 6 months duration. In respect on the nowadays view of evidence based treatment, scientific support of our actions as a physiotherapist is necessary. In case that in our patient management the PNF approach gets a place a search for external support is needed. Further evidence is require for the same as it is lacking still, for which this study is being done. **Methodology:** **Study Design:** Quasi Experimental, **Study Type:** Comparitive, **Sample Size:**12, **Sampling Method** :Simple Random Sampling, **Study Setting** :Home Based, **Study Duration** :3weeks

**Inclusion Criteria:** Hemiplegia secondary to cerebrovascular accident with symptom of more than 6, less than 12 months, Brunnstrom stages 4 & 5 of lower limb, Ability to walk at least 18.3 meters or 60 feet without manual assistance, with or without an assistive device, at one's preferential speed, Intact kinaesthesia for the hip, knee & ankle. **Exclusion Criteria:** Patients with symptoms lasting less than 12 months, Previous

PNF treatment to the pelvic region, Old case of stroke, Patients with memory disorders, Other neurologic or orthopaedic disorders, Unstable cardiovascular condition, History of psychosis, History of foot deformity, Non co-operative patients, Unstable vital parameters. **Material Used:** Stop watch, Inch tape, Paper and pencil, Chair, Cone.

#### **Procedure**

Hemiplegic patients fulfilling the criteria were assessed & allocated into two [Group A and Group B], each group consisting of 6 subjects. All the subjects will have to sign a form giving their informed written consent before participating in the study. The diagnosis, age, gender & number of months since onset of hemiplegia was obtained from patient & medical charts and pre-test is taken.

#### **Group – A**

The treatment in this study consists of 10 minutes each of rhythmic initiation, slow reversal & agonistic reversal applied to the pelvic region. These procedures were done to facilitate anterior elevation and posterior depression of pelvic movement in side lying position. Each treatment session lasted 30 minutes with a total of 12 treatment sessions [ 3 weeks]. The elements of PNF such as manual contact, stretch resistance & verbal cueing were incorporated into the treatment scheme.

#### **Elements**

##### **Patterns of movement**

Pelvic anterior elevation – posterior depression of the hemiplegic side.

##### **Subject position**

The subject was positioned side lying on the unaffected side, with both hip flexed to 100 and the knees flexed to 45. The subject's neck was supported by a pillow and flexed 30.

##### **Physical therapist's position**

The therapist kneeled behind the subject and faced toward the direction of the pelvic movement of the subject.

##### **Manual contact**

The therapist's hands were overlapped and placed on the anterior iliac spine of the subject's pelvis for anterior elevation or over the subject's ischial tuberosity for posterior depression. The direction of pressure from the contact is in the direction the therapist wants the subject to move.

##### **Maximal resistance**

Resistance was variable to obtain a smooth and coordinated movement. There can be assistance or resistance, depending on the necessity.

##### **Stretch**

Stretch was applied immediately and gently after the target muscles had been fully lengthened but before the subject started to move.

##### **Appropriate pelvic range of motion**

The pelvic range of motion that was either actively moved by the subject with maximal effort or passively moved by the physical therapist to the limitation of the subject.

##### **Irradiation**

Bending the neck to 30 of flexion actively without resistance throughout the treatment was used for irradiation.

**Verbal visual cuing**

Variable, according to the subject’s need. Commands were specific and timed to maintain the desired movement. For example, “pull up” was used to facilitate pelvic anterior elevation, and “push down” and “sit into my hands” were used to facilitate pelvic posterior depression.

**Techniques**

Techniques used in this study were rhythmic initiation, slow reversal and agonistic reversals. The sequence was rhythmic initiation first for 10 minutes, then slow reversal for an additional 10 minutes, and then agonistic reversal for an additional 10 minutes. An alarm clock was used to measure the time.

**Rhythmic initiation**

1. The command “relax and let me move you” was used first to move the pelvis through the available range of motion of anterior elevation and then to return the pelvis through the posterior depression pattern.
2. When the therapist could not feel resistance during the movements, the command “now help me move you” was used to have the subject assist the movement for three to four repetition.
3. Using the command “pull” as appropriate, the subject was asked to superimpose resistance upon the movement, with the therapist gradually increasing the resistance with the increase in subject’s response. This was repeated for three to four repetitions.
4. The subject moved the pelvis actively through the anterior elevation pattern and return to the starting position passively by relaxing.
5. Sequences c.
6. were repeated for the remaining 10 minutes.

**Slow reversal**

1. The subject’s body part was moved to the lengthened range of the anterior elevation.
2. Using the manual contacts and verbal cues, the therapist had the subject perform a contraction on the internal and external oblique abdominal muscles to anteriorly elevate the pelvis with maximal effort against resistance added by the physical therapist.
3. The therapist switched manual contacts to the posterior depression pattern and had the subject perform a contraction of the contralateral quadratus lumborum and iliocostalis lumborum muscles to posteriorly lower the pelvis against maximal resistance.
4. Sequence b & c were repeated for the total 10 minutes.

**Agonistic reversal**

1. The therapist moved the subject’s body part to the point at which the muscle was lengthened in desired pattern [anterior elevation].
2. Using manual contact and verbal cues, the therapist had the subject perform a concentric contraction of the target muscles to the point at which the muscles are shortened.

3. Using the command “make it hard for me to move you”, the therapist had the subject perform an eccentric contraction of the target muscles, returning to the point at which the muscles are lengthened.
4. Sequences b & c were repeated to fulfil the 10 minute period.

**Group – A & B**

Both the groups will receive conventional physiotherapy for 3 weeks, 30 minutes per session. This includes,

- Trunk stability exercises
- Weight bearing on the paretic leg
- Assistive range of motion exercises
- Stretching and
- Gait training

Following this post-test was taken.

**Out Come Measures**

- Timed up and go test in seconds.
- Gait speed = distance/time.

**Statistical Methods**

**Data Analysis and Interpretation**

**Observation and Analysis**

The collected data were tabulated and analysed using descriptive and inferential statistics.

To assess all the parameters, mean and standard deviation are used.

To find out the changes in Timed Up and Go test, gait speed from pre-test to post test, paired ‘t’ test was adopted.

Independent ‘t’ test was used to compare the mean values of all parameters.

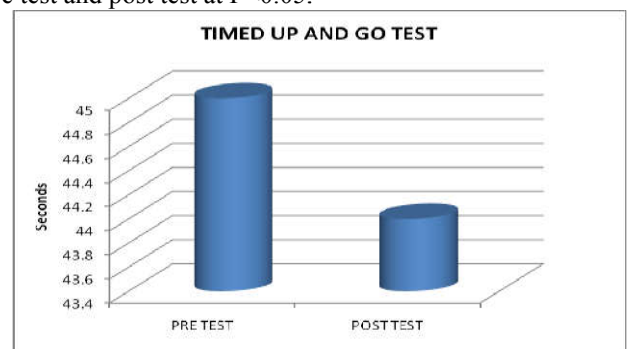
**Paired “T” Test**

The paired “t” test is used to compare the effectiveness of both the treatments in both the groups.

**Table 1** Comparison of Pre Test and Post Test Values of Timed Up And Go Test And Gait Speed In Group A (PNF with Conventional Therapy)

Group A	Mean	N	Standard Deviation	Pair 't' Value	Significant level
Tug pre test	45.7658	6	17.17837	12.962	0.001
Tug post test	44.2508	6	17.09151		
Gait speed pre test	.2763	6	.06642	3.338	0.007
Gait speed post test	.2874	6	.07362		

There is statistically significant difference in group A between pre test and post test at P<0.05.

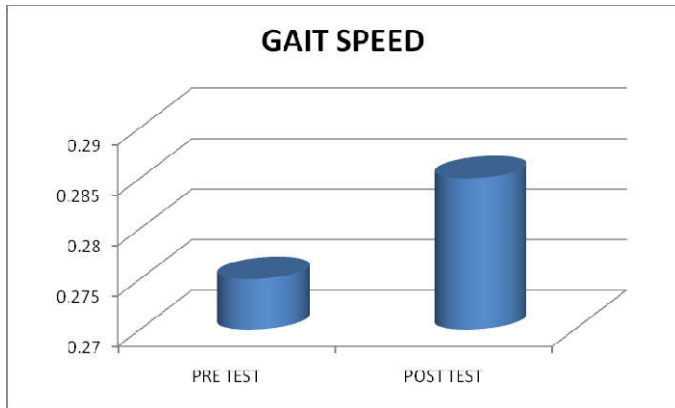


**Graph 1** Comparison of Pre Test And Post Test Values of Timed Up And Go Test In Group A (PNF With Conventional Therapy)

**Table 2** Comparison of Pre Test and Post Test Values of Timed Up and Go Test and Gait Speed In Group B (Conventional Therapy)

Group A	Mean	N	Standard Deviation	Pair 't' Value	Significant level
Tug Pre Test	45.0292	6	16.80440	5.171	0.0001
Tug Post Test	44.1900	6	16.64880		
Gait Speed Pre Test	.2894	6	.08163	2.901	0.014
Gait Speed Post Test	.2947	6	.09135		

There is statistically significant difference in group B between pre test and post test at  $P < 0.05$ .

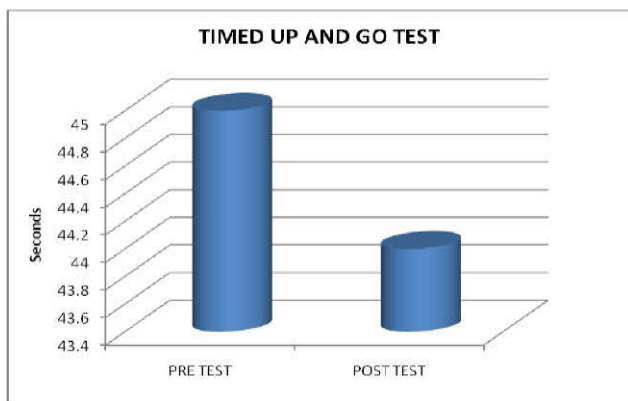


**Graph 2** Comparison of Pre Test And Post Test Values of Gait Speed In Group A (PNF With Conventional Therapy)

**Table 3** Comparison of Pre And Post Test Values of Timed Up And Go Test In Group A (PNF with Conventional Therapy) and Group B (Conventional Therapy)

TUG	Group A		Group B		't' Value	Significan Level
	MEAN	SD	MEAN	SD		
PRE TEST	45.7658	17.17837	44.2255	17.38102	0.214	0.833 NS
POST TEST	44.2508	17.09151	44.1900	16.64860	0.117	0.908 NS

There is no statistically significant difference in group A and group B between pre test and post test at  $P > 0.05$



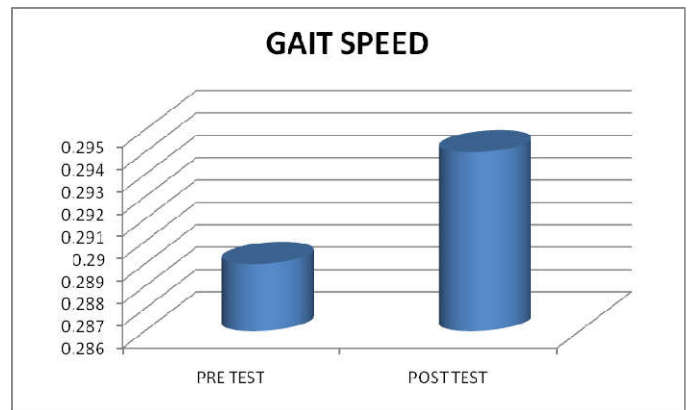
**Graph 3** Comparison of Pre Test and Post Test Values of Timed Up and Go Test In Group B (Conventional Therapy)

**Table 4** Comparison of Pre and Post Test Values of Gait Speed in Group A (Pnf with Conventional Therapy) and Group B (Conventional Therapy)

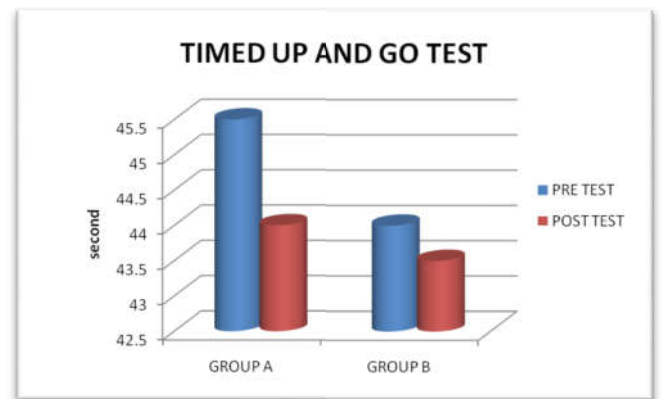
Gait Speed	Group A		Group B		't' value	Significan Level
	Mean	SD	MEAN	SD		
Pretest	0.2763	0.06642	0.2894	0.08613	0.565	0.578
Post	0.2874	0.07362	0.2947	0.09135	0.360	0.723 NS

test

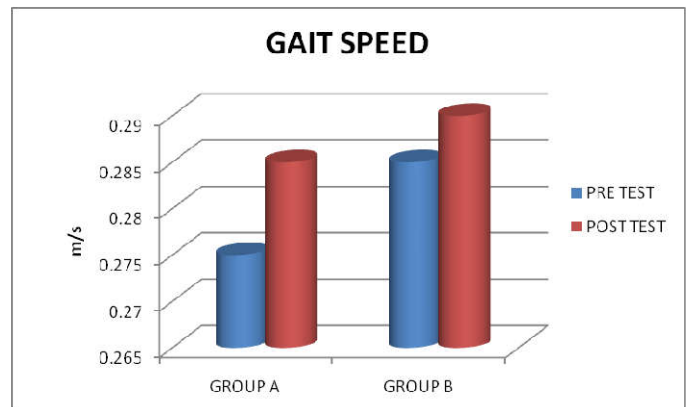
There is no statistically significant difference in group A and group B between pre test and post test at  $P > 0.05$



**Graph 4** Comparison of Pre Test and Post Test Values of Timed Up and Go Test In Group B (Conventional Therapy)



**Graph 5** Comparison of Pre and Post Test Values of Timed Up and Go Test In Group A (Pnf with Conventional Therapy) And Group B (Conventional Therapy)



**Graph 6** Comparison of Pre and Post Test Values of Timed Up and Go Test in Group A (PNF With Conventional Therapy) and Group B (Conventional Therapy)

## RESULTS

According to table -1 the pre test mean value of Timed Up and Go test [group-A] was 45.7658 and post test mean value was 44.2508. There is statistically significant difference in group - A [PNF with conventional therapy] between pre test and post test of Timed Up and Go test at  $P < 0.05$ .

According to table -1 the pre test mean value of gait speed [group - A] was 0.2763 and post test mean value was 0.2947. There is statistically significant difference in Group -A [PNF

with conventional therapy] between pre test and post test of gait speed at  $P < 0.05$ .

According to table -2 the pre test mean value of Timed Up and Go test [group –B] was 45.0292 and post test mean value was 44.1900. There is statistically significant difference in group – B [conventional therapy] between pre test and post test of Timed Up and Go test at  $P < 0.05$ .

According to table -2 the pre test value of gait speed [group – B] was 0.2894 and post test mean value was 0.2947. There is statistically significant difference in group –B [conventional therapy] between pre test and post test of gait speed at  $P < 0.05$ .

According to table -3 the pre test mean value of Timed Up and Go test in group A was 45.7658 and in group B were 44.2255. There is no statistically significant difference in group A [PNF with conventional therapy] and group B [conventional therapy] at  $P > 0.05$ .

According to table -3 the post test mean value of Timed Up and Go test in group A was 44.250 and in group B were 44.1900. There is no statistically significant difference in group A [PNF with conventional therapy] and group B [conventional therapy] at  $P > 0.05$

According to table -4 the pre test mean value of gait speed in group A was 0.2763 and in group B was 0.2894. There is no statistically significant difference in group A [PNF with conventional therapy] and group B [conventional therapy] at  $P > 0.05$ .

According to table -4 the post test mean value of gait speed in group A was 0.2874 group B was 0.2947. There is no statistically significant difference in group A [PNF with conventional therapy] and group B [conventional therapy] at  $P > 0.05$ .

## **DISCUSSION**

A stroke is a sudden death of brain cells in a localized area due to inadequate blood flow. It is anticipated that by 2020, stroke will have moved from the 6<sup>th</sup> leading cause of lost disability adjusted life years [DALY's] to 4<sup>th</sup>. The expected increase in stroke survivors potentially living with disabilities will place a burden on the survivor's family, the community and the healthcare system.

New developments in stroke treatment includes changes in stroke care and the necessity to concentrate this care in specialized, well organized and coordinated medical facilities, hence creating stroke services.

The objective of stroke rehabilitation is to enable individual patients to achieve their full potential and to maximize the benefits from training in order to attain the highest possible degree of physical and psychological performance. The ultimate goals of many stroke patients is to achieve a level of functional independence necessary for returning home and to integrate as fully as possible into community life.

Few studies shows PNF techniques to pelvic region improves gait performance in stroke patients. It is interesting to compare effectiveness of proprioceptive neuromuscular facilitation [PNF] with conventional therapy and conventional therapy on gait improvement of subjects with sub-acute stroke.

Hence the study was designed to determine the effectiveness of proprioceptive neuromuscular facilitation [PNF] with conventional therapy and conventional therapy on gait improvement of subjects with sub-acute stroke.

Trueblood *et al* [1989] found no immediate effects of resisted PNF pelvic exercises on gait speed.

They also have suggested that the reasons for the ineffectiveness may be due to

- The differences in the PNF technique.
- Duration of treatment considered.
- Four of five graded active-resistive pelvic movements was performed.
- The total treatment time was less than 15 minutes.
- Wang [1994], who followed the research, with the following changes came up with the result supporting the effectiveness of PNF on gait speed,
- Used rhythmic initiation, slow reversal and agonistic reversal.
- 30 minutes to facilitate pelvic movements.

This study aimed to add support for the PNF technique, made with the 3 PNF techniques suggested by Wang [1994], conventional therapy with passive stretching, gait training and stabilization exercises were given. The outcome from the study is less promising over the subject group with conventional therapy alone.

The samples for this study were taken based upon the discharge list collected from jayam nursing home and red cross society hospital. 42 stroke cases, who considered for the study, were called over through telephone for appointments. On examination, 36 subjects met the inclusion criteria, among them only 28 subjects consented. These 28 subjects were randomly allocated into 2 groups using simple random sampling. Post test measures are taken for 24 subjects with 2 subjects dropped out from each group during the course of intervention. The mean age of subjects in group A was 54.9 and group B was 50.4.

In this study the majority of subjects showed decreased performance after 1 PNF treatment. This may be due to continuous 30 minutes of PNF session daily, and the patients most likely had been using abnormal gait patterns. All these factors would have contributed to their fatigue.

The slight improvement in gait speed noted in both the groups was due to an increase in cadence. Whether the importance recorded in this study was due to a more efficient limb swing and to be a better single limb balance.

The collected data were tabulated and analysed using descriptive and inferential statistics. To assess all the parameters, mean and standard deviation were used.

To find out the changes within the groups A and B in Timed Up and Go test, gait speed from pre test to post test, paired 't' test was adopted and shows statistical significant difference.

Comparing the pre and post test values of TUG shows a highly statistical significant difference in group A with mean value of 45.76 and 44.25 with t value of 12.96 [ $P < 0.05$ ]. Comparing the pre and post test values of gait speed shows a highly a statistical significant difference in group A with mean value of 0.2763 and 0.2874 with t value of 3.33 [ $P < 0.05$ ]. Comparing

the pre and post test value of TUG shows a highly statistical significant difference in group B with mean value of 45.02 and 44.19 with t value of 5.17 [p<0.05].

Comparing the pre and post test values of gait speed shows a highly statistical significance difference in group A with the mean value of 0.2894 and 0.2947 with the t value of 2.90 [P<0.05]. Independent 't' test was used to compare the mean values of all parameters in between the groups shows no statistical significance.

The post test values of TUG shows a non statistical significant difference in between the groups A and B value of 44.25 and 44.19 with t value of 0.117. The post test values gait speed shows a non statistical significance in between the groups A and B mean value of 0.2874 and 0.2947 with t value of 0.36[P>0.05].

Our results showed that there is no statistically significant difference in gait improving using PNF with conventional therapy when conventional therapy without PNF.

## CONCLUSION

This study comparing proprioceptive neuromuscular facilitation [PNF] with conventional therapy and conventional therapy on gait improvement on subjects with sub-acute stroke shows that both the interventions were equally effective in improving the gait with sub acute stroke. The role of PNF usage in sub-acute stroke for gait improvement is negligent.

**Limitations are** The sample size was small, The variables studied were only sub acute stroke, This study was done only for Brunnstrom motor recovery stages 4 and 5 groups, The study did not include control group, hence the natural recovery in stroke patients were not considered.

**Recommendation are** Can be done on large samples and for longer duration. Can be taken for specific inclusion criteria to be developed that can identify which patients will most benefit from PNF technique. Future study can consider including a control group.

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