

“EFFECTIVENESS OF PNF APPROACH Vs BRUNNSTROM APPROACH ON IMPROVING HEMIPLEGIC UPPER LIMB FUNCTION IN PATIENTS WITH CHRONIC STROKE.”- A Comparative study.

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Abstract

BACKGROUND- Every year, stroke survivors, related death, and disability-adjusted life-years are increasing. Spasticity is one of the positive feature of stroke. Various conventional and contemporary approaches have been used to rehabilitate the hand of post stroke. However evidence for their effectiveness is still limited. Proprioceptive neuromuscular facilitation(PNF) is widely used in rehabilitation practice. The Technique of PNF are composed of both rotational and diagonal exercise patterns. Brunnstrom movement therapy uses reflexes to develop movement behaviour through sensory stimulation.

OBJECTIVE- To find the effectiveness of PNF approach & Brunnstrom approach on improving hemiplegic upper limb function in patient with chronic stroke and also to compare the effectiveness of PNF approach and Brunnstrom approach on improving hemiplegic upper limb function in patient with chronic stroke.

METHOD- Total 30 subjects were selected and assigned in to two group. Group A (n=15) & group B (n=15). Subject in group A were given PNF Technique with conventional approach and in Subject with group B were given Brunnstrom approach with conventional approach. All the participants were assessed with Fugl- Meyer Upper Extremity scale & Modified Ashworth Scale before the intervention and after the intervention.

RESULT- After the data analysis, the result were found to be significant improvement in Fugl Meyer upper extremity scale (FMUE) scores & Modified ashworth scale (MAS) Score

CONCLUSION- Result reveals that both PNF Brunnstrom was effective for both the group but PNF Was more effective than Brunnstrom on improving hemiplegic upper limb function in patient with chronic stroke

Keywords: Stroke, Proprioceptive Neuromuscular Facilitation, Brunnstrom approach, conventional approach, Fugl-Meyer Upper Extremity scale, Modified Ashworth Scale

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Introduction

Stroke is a global health care problem that is common ,serious and disabling. In most countries, stroke is the 2nd or 3rd most common cause of death and one of the main cause of acquired adult disability.(1)Stroke is particularly prevalent in older people and the effect of stroke can be profound. Not only are the ability to stand, balance and walk are affected, but also the ability to use upper limb and hand in its diversity of function in everyday life.Loss of independence of upper limb function contribute enormously to functional disability affecting quality of life and independence in basics (washing, grooming, feeding, dressing etc).(2)Understanding upper limb impairment after stroke is essential to planning therapeutic effort to restore function. Multiple impairments may be present simultaneously i.e, a patient may present with weakness

of arm and hand immediately after a stroke, which may not have resolved when spasticity sets in a few weeks or month later. Hence there may be a layer of impairments over time making it difficulty to decide what to treat first.(3)Spasticity was first described by Lance in 1980 as ‘a motor disorder characterized by a velocity dependent increase in tonic stretch reflex(muscle tone)with exaggerated tendon jerk, resulting from hyperexcitability of stretch reflex as one component of upper motor neuron syndrome.Spasticity following stroke occur in about 30% of patients. A study by Wissel et al , showed that 25% of patient with stroke suffers from spasticity within first 6 weeks of event.They also observed that spasticity primarily affect the elbow(79% of patient), the wrist(66%) and ankle(66%). In the upper limb, the most frequent pattern of arm spasticity is internal rotation,

adduction of shoulder coupled with flexion at the elbow, wrist and fingers.(4)Proprioceptive Neuromuscular Facilitation(PNF) was first developed by Margeret Knott PT and Herman Kabat MD in the 1940s to treat neurological dysfunction.(5)

PNF is a neurophysiological approach in which impulses from the periphery are facilitated to the central nervous system through the stimulation of sensory receptors present on muscles and around the joints by stretch, resistance, traction, approximation and audiovisual command to the patient. The goal of PNF is to promote functional movement through facilitation, inhibition, strengthening and relaxation of muscle group by using concentric, eccentric and static muscle contraction. Technique of PNF include- Rhythmic initiation(RI), Rhythmic Stabilization(RS), Hold Relax(HR), Stabilizing reversals, Replication(Hold relax active motion HRA), Dynamic reversals, Contract Relax(CR), Contract relax active contraction(CRAC), Resisted Progression(RP), Rhythmic Rotation(RRo), Mixture of isotonics (Agonist reversals AR).(6)Brunnstrom approach is one form of neurological exercise therapy in the rehabilitation of stroke. Uses primitive synergistic patterns in training in attempting to improve motor control through central facilitation. Patients are taught to use voluntary control the motor pattern available to them at a particular point during the recovery process(example- Limb synergies) enhance specific synergies through use of cutaneous / proprioceptive stimuli, central facilitation.(7)Brunnstrom approach was developed by Swedish Physical therapist Sign Brunnstrom, and emphasizes the synergistic pattern of movement which develops during recovery.(8)

Principle of Brunnstrom Approach:

- Facilitate the patients progress throughout the recovery stages
- Stimulation of Skin over the muscle produces contraction.
- Offer resistance to facilitate contraction.
- Treatment progress developmentally. When no motion exist, movement is facilitated using reflexes, associated reaction, proprioceptive facilitation and or exteroceptive facilitation to develop muscle tension in preparation for voluntary movement.
- Resistance (Proprioceptive stimulus) promote a spread of impulse to produce a pattern response while tactile stimulation facilitate only the muscle related to stimulated area.
- When voluntary effort produces or contributes to a response, patient is asked to hold the contraction (Isometric) if successful, an eccentric (contracted lengthening) is performed and finally a concentric (Shortening) contract is done.
- Correct movement once elicited is repeated.

Effect and Uses of Brunnstrom approach:

- Increase Muscle strength.
- Stretch tight muscles

- Regain motor control.
- Recover voluntary movement.
- Improving Functional tasks such as reaching, grasping and hand to mouth.

The Modified Ashworth Scale is the most widely clinical scale used to measure the increase in muscle tone(Spasticity). In 1964, Bryan Ashworth published the Ashworth scale as a method of grading spasticity while working with multiple sclerosis patients, while performing a study to exam inter rater reliability of manual tests of elbow flexor muscle spasticity, Bohannon and smith modified the Ashworth scale by adding 1+ to the scale to increase sensitivity. since its modification, the modified Ashworth scale(MAS),has been applied in clinical practice and research as a measure of spasticity (9,10) The Fugl-Meyer upper Extremity(FMUE) scale is a widely used highly recommended stroke- specific ,performance-based measure of impairment. It is designed to assess reflex activity, movement control and muscle strength in the upper extremity of people with post stroke hemiplegia . The FMUE scale comprises 33 items, each scored on a scale of 0 to 2, where 0= can not perform, 1= performs partially and 2= performs fully. (11)

The Mini Mental State Examination(MMSE) was developed in 1975 as a brief test for quantitative assessment of cognitive impairment in adults. It has since been widely used by physicians throughout the world. Its main use is for screening for cognitive impairments. The MMSE examines orientation, immediate and short- term memory, attention, and calculation, language and praxis. An MMSE Score of <or =23 or less is generally accepted as indicating cognitive impairment and associated with the diagnosis of dementia in at least 79% of cases.(12)

Need of the Study:

Stroke is one of the common conditions occurring in middle age and old age persons. After stroke, the brain forgets to establish normal movement pattern and adopts New, abnormal ones which are largely dictated by spasticity.Both motor unit and muscle exhibit changes. Number of functioning motor units decreases to 50%, impaired firing rate and reduce force production, increase effort occurs.Many Physiotherapy technique along with conventional therapy are used in improving upper limb functions.Studies have shown that PNF and Brunnstrom approach are mostly used for stroke rehabilitation.(7,13) Since both PNF and Brunnstrom approach are mostly used for rehabilitation, this present study is to analyze whether there is any effective difference within these approaches.So the study will be done with an objective to analyze the effectiveness of Brunnstrom and PNF approach in improving hand function in hemiplegic patients and to compare both the results and interpret which approach is more effective.

Objectives:

Objective of the study:

Effectiveness Of Pnf Approach Vs Brunnstrom Approach On Improving Hemiplegic Upper Limb Function In Patients With Chronic Stroke.”- a Comparative Study.

- To find the effectiveness of PNF approach on improving hemiplegic upper limb function in patient with chronic stroke.
- To find the effectiveness of Brunnstrom approach on improving hemiplegic upper limb function in patient with chronic stroke.
- To compare the effectiveness of PNF approach and Brunnstrom approach on improving hemiplegic upper limb function in patient with chronic stroke.

Hypothesis:

Null Hypothesis(H₀)- There is no significant difference between PNF and Brunnstrom approach on improving hemiplegic upper limb function.

Alternative Hypothesis(H₁)- There is a significant difference between PNF and Brunnstrom approach on improving upper limb function.

Materials and Method:

Source of Data-

Data were collected from patient suffering from stroke ,patient from Sacred Heart Palliative care, DPRC, Palon Rewalk and Pratiksha Hospital Guwahati.

Population:

Post Stroke patient in Guwahati.

Sample:

Stroke patients.

Sampling Technique:

Convenience Sampling Technique.

Sample Size:

Post stroke patients.

Inclusion Criteria for Sampling:

- Subject diagnosed with Stroke confirmed by clinical assessment, CT scan/MRI.
- Patient with both left and right hemispheric involvement.
- Brunnstrom stage 3.
- Age group- 45 to 70 years
- Both male and female
- Willing to participate in exercise programme

- Mini- Mental state examination questionnaire (MMSEQ) scores more than 24.

Exclusion criteria for samling-

- Demyelinating and degenerative disease of the brain
- Myelopathy,
- Spinal Cord Injury
- Myopathy
- Traumatic head injury
- Intracranial tumour
- Recent fracture
- Arthritis
- Acute cardiorespiratory diseases
- Hearing and visual deficit

Instruments used

- Paper
- Pencil
- Fugl- Meyer Scale Assessment scale for physical performance.
- Modified Ashworth Scale.
- Mini-Mental state examination Questionnaire.

Data collection method:

In this study, firstly study procedure were explained to the subjects and 30 subjects included who fulfil the inclusion and exclusion criteria. An informed written consent were taken from the subject. screening for selection of patients was done by MMSEQ.

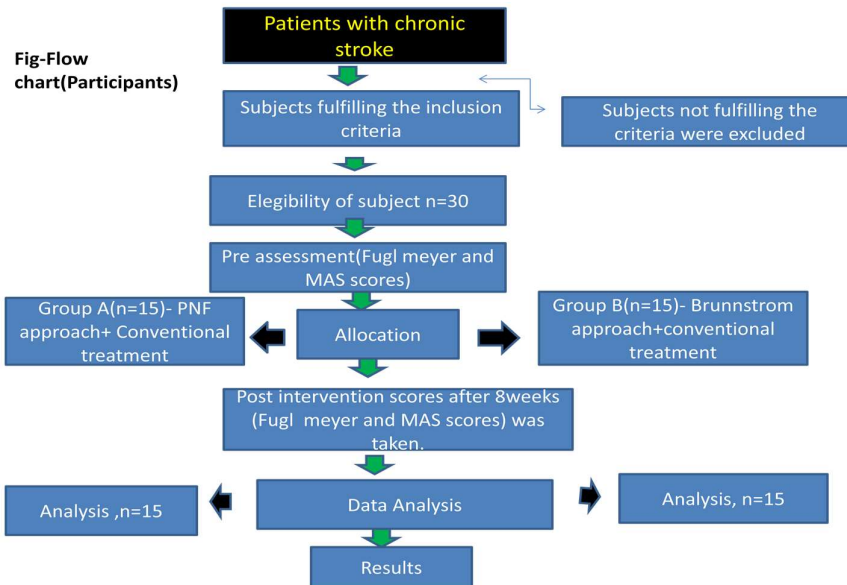
After getting informed consent, pre assessment scores of Fugl- Meyer upper extremity scale and Modified Ashworth scale were taken from the subjects

After the pre assessment scores, the subjects were randomly assigned into 2 groups A(n=15) and B(n=15) respectively.

A group was given PNF approach technique along with conventional Physiotherapy Approach and B group was given Brunnstrom Approach Technique along with conventional Physiotherapy approach respectively.

After completion of 8 weeks of exercise programme, post assessment scores of Fugl- Meyer upper extremity scale and Modified Ashworth scale were taken.

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Intervention method:

In A group, subjects had given PNF approach which includes- Rhythmic initiation, Rhythmic rotation, Hold relax, contract relax.

Group A was received the intervention alternatively in each week for half an hour for a period of 8 weeks.

In B group, subjects had given Brunnstrom technique-

- In stage 3,the synergies or their components are present and minimal voluntary movement is possible.
- Facilitation is provided through resistance to voluntary motion, verbal commands,tapping and cutaneous stimulation.
- Actively or passively raising the affected limb on above the horizontal causes the finger to extend and abduct. This is Souqe's Phenomenon.(For flexor synergy).

- Resistance to abduction or adduction of unaffected lower limb result in a similar response in the opposite affected leg. This is Raimiste's Phenomenon.
- Hold after positioning technique (starting at end range).
- Task oriented activities(Devise strategies to introduce new combination
- of movements that are outside synergy to progress the patient).

Group B was received the intervention alternatively in each week for half an hour for a period of 8 weeks.

Both A and B groups will receive Conventional Physiotherapy approaches along with their respective approach. Conventional therapy will include(Passive Range of motion Exercises(PROM), Stretching, weight bearing exercises, Functional reaching activities etc).

PNF approach



Fig. 1-Hold-relax



Fig.2-Rhythmic rotation



Fig.3-Contract- relax



Fig 4-Rhythmic initiation

Brunnstrom approach



Fig 5-Hold after positioning technique



Fig 6-Bilateral rowing





Fig.7-Task oriented activities



Fig. 8-Wrist stabilization exercise



Fig. 9-Soque,s phenomenon

DATA ANALYSIS AND RESULTS

- Statistical analysis was done using SPSS Software version25
- Test of normality-shapiro-wilk test, kolmogorov smirnov.
- Parametric test –paired and unpaired sample test
- Statistical significance was set at $p < 0.05$
- $p < 0.001$ is considered highly significance.

Table 1-NORMALITY TEST

Tests of Normality								
	Kolmogorov-Smirnova				Shapiro-Wilk			
	Statistic	df	Sig.	Remark	Statistic	df	Sig.	Remark
Pre value of Fugl Meyer Score_group A	.213	15	.064	NS	.926	15	.241	NS
Post value of Fugl Meyer Score_group A	.187	15	.168	NS	.959	15	.681	NS
Pre value of Fugl Meyer Score_group B	.213	15	.064	NS	.926	15	.241	NS
Post value of Fugl Meyer Score_group B	.173	15	.200*	NS	.898	15	.089	NS

NS-Not Significant

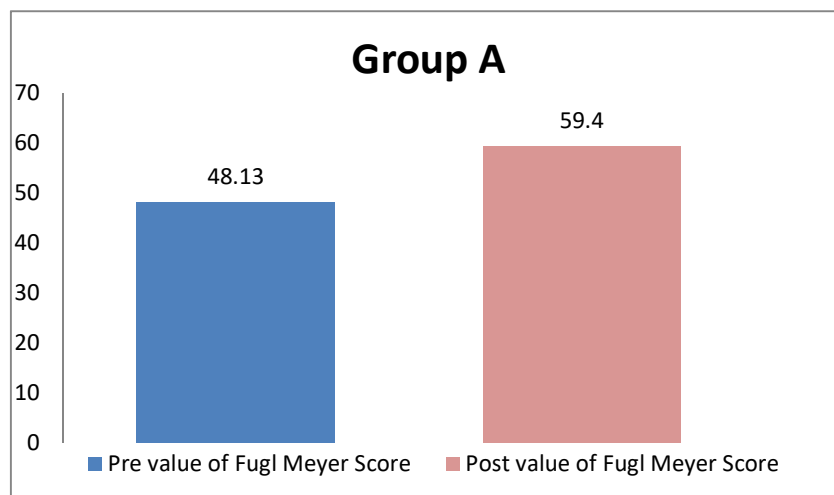
Here we see that for both the groups the pre post values of Fugyl Meyer scale Score are not checked because that is nominal data.

Table 2- GENDER DISTRIBUTION:

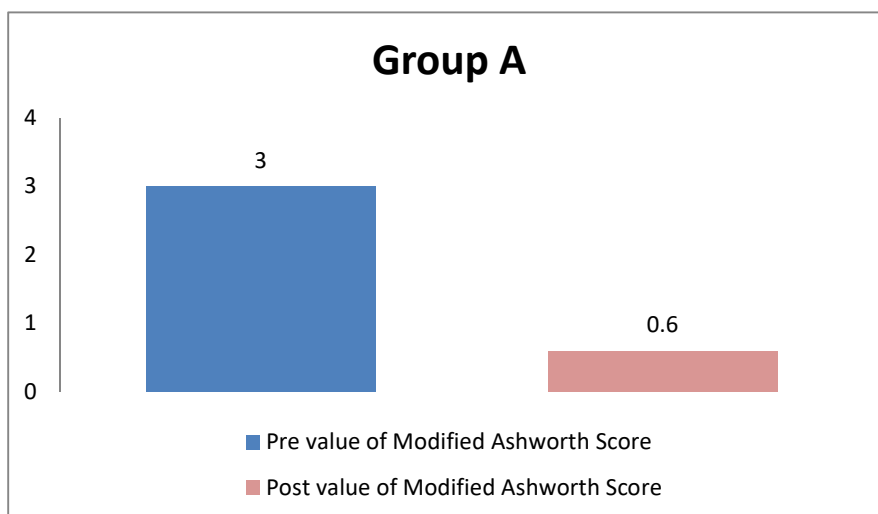
SEX \ GROUP	MALE	FEMALE	TOTAL
A	11	4	15
B	10	5	15
TOTAL	21	9	30

Table 3- Descriptive Summary Of Pre –Post Fugl Meyer And Mas Scores.

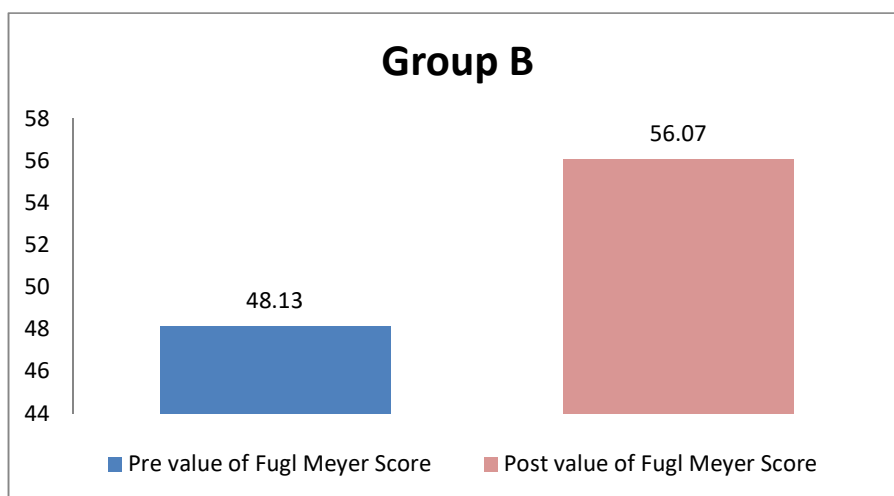
Descriptive Statistics						
		N	Minimum	Maximum	Mean	Std. Deviation
GROUP A	Age	15	45	70	57.40	7.790
	Pre value of Fugl Meyer Score	15	42	53	48.13	2.669
	Post value of Fugl Meyer Score	15	53	65	59.40	2.995
	Pre value of Modified Ashworth Score	15	3	3	3.00	.000
	Post value of Modified Ashworth Score	15	0	2	.60	.737
GROUP B	Age	15	45	70	57.40	8.322
	Pre value of Fugl Meyer Score	15	42	53	48.13	2.669
	Post value of Fugl Meyer Score	15	50	60	56.07	3.555
	Pre value of Modified Ashworth Score	15	3	3	3.00	.000
	Post value of Modified Ashworth Score	15	0	2	.93	.799



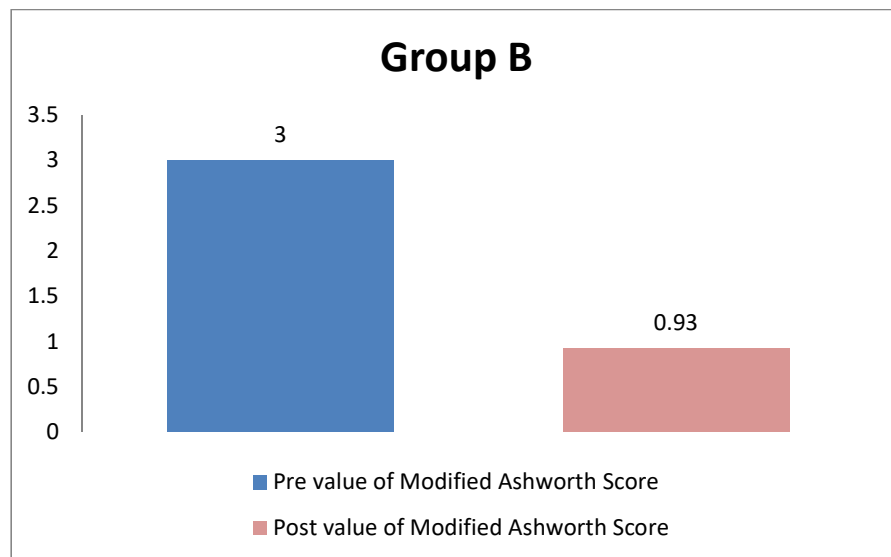
GRAPH FOR MEAN VALUE OF PRE-POST FMS(GROUP A)



GRAPH FOR MEAN VALUE OF MAS(GROUP A)



GRAPH FOR MEAN VALUE OF PRE-POST FMS(GROUP B)



GRAPH FOR MEAN VALUE OF MAS(GROUP B)

Table 4-Paired t –Test For Related Pre-Post Fms

Paired Samples Test										
Group		Paired Differences					t	df	Sig. (2-tailed)	Remark
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
A	Pre value of Fugl Meyer Score - Post value of Fugl Meyer Score	-11.267	3.731	.963	-13.333	-9.200	-11.694	14	.000	***
B	Pre value of Fugl Meyer Score - Post value of Fugl Meyer Score	-7.933	2.017	.521	-9.050	-6.817	-15.236	14	.000	***

Table 5- Paired z Test For Pre-Post Mas

Test Statistics				
Groups		Z	Asymp. Sig. (2-tailed)	Remark
A	Post value of Modified Ashworth Score - Pre value of Modified Ashworth Score	-3.482	.000	***

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B	Post value of Modified Ashworth Score - Pre value of Modified Ashworth Score	-3.453	.001	**
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**Significant at $p < 0.01$

***Significant at $p < 0.001$

Thus there is significant difference between pre post values of Modified Ashworth scale Score for both the groups.

Table 6- Across Group Comparison

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
AGE	A	15	57.40	7.790	2.011
	B	15	57.40	8.322	2.149
Post value of Fugl Meyer Score	A	15	59.40	2.995	.773
	B	15	56.07	3.555	.918
Post value of Modified Ashworth Score	A	15	.60	.737	.190
	B	15	.93	.799	.206

Table 7- t- Test For Equality Of Means-Fms

	t-test for Equality of Means							Remark
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
						Lower	Upper	
Post value of Fugl Meyer Score	2.777	28	.010	3.333	1.200	.875	5.792	*

*Significant at $p < 0.05$

Thus, there is significant difference between the Fugl Meyer Scores of group A & B.

Table 8- z-Test For Equality Of Means For Mas

Test Statistics					
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Remark
Post value of Modified Ashworth Score	86.000	206.000	-1.184	.237	NS

Not Significant.

Thus, there is no significant difference between the Modified scores of group A & B.

RESULT-

In this study, 30 post stroke hemiplegic patient with upper limb involvement and brunnstrom stage 3 were enrolled. Before exercise, fugl-meyer and MAS score was taken. After completion of 8 weeks PNF and Brunnstrom programme again fugl-meyer and MAS score was taken. Age and gender were subjected to descriptive statistical analysis and shows mean and std deviation of age 57.40 and 7.790 for group A, And 57.40 and 8.322 for group B. Gender distribution were 33% for female 67% for male for both the group.

Study have found pre value of fugl Mere score 48.13 for both A & B group and post value of fugl mere score 59.4 for group A and 56.07 for group B that means A group had showed more better result.

Score of MAS for group A pre value is 3 and post value is 0.6. Pre value of MAS score for group B is 3 and post value is 0.93. For confirming normal distribution normality test Shapiro-wilk, kolmogorov-smirnov test was done and have seen that both groups, the pre post values follow normality assumption so we have used parametric test but MAS Values are not checked because that is nominal data.

The paired sample test for normally distributed data showed statistical significant difference between pre post values of Fugyl Mere Score for both the groups at $p < 0.001$ along with pre post values of MAS score for both the group showed significance difference at $p < 0.001$.

After across group comparison t test for equality of means was done and result showed significance difference between the fugal meyer scores of group A and B at $p < 0.05$ but there was no significance difference between the modified Ashworth score of both group

DISCUSSION-

This study was for evaluation of effectiveness of PNF and Brunnstrom approach on improving hemiplegic upper limb function. In the initial data analysis of mean values of fugal meyer assessment scale value and MAS were found to be significant that means both technique showed significant reduction in spasticity measured on Ashworth scale as well as improvement in functional activity measured on fugal meyer scale.

Brunnstrom approach is one form of neurological exercise therapy in rehabilitation of stroke uses primitive synergistic pattern in training attempting to improve motor control through central facilitation(7)

La foose C, Troch M, Broeckx1998 recent studies revealed that right hemiplegic patient treated with brunnstrom approach showed effective improvement in hand functions among stroke patient(7).

Sullivan PE et al mentioned PNF to be one of the major therapeutic approaches aimed at improving the important feature necessary for functional activities of hemiplegic patients such as muscular tone, strength, and flexibility(13)

As per Gardiner PNF contained more of skilled diagonal movements emphasizing more on functional activities. The patterns of movements used are spiral and diagonal and they are closely allied to those of normal functional movement of daily living.(13)

Currently, research has proven that PNF Techniques do increase ROM (Funk et al 2003, Lucas and koslow, 1984, wallin et al 1985). Mechanism involved for this is autogenic inhibition, reciprocal inhibition, stress relaxation and gate control theory all of which provide potential ways for PNF to increase ROM (shaman et al 2006 Rowland et al 2003)(15)

Through this research found that PNF group showed more increase in statistical value than Brunnstrom at $p < 0.001$

Possible mechanism is that studies have proven PNF improve BDNF (Brain Derived Neurotropic factor) level, it is the more abundant Neurotrophin within the brain and promote Neurogenesis and angiogenesis which is very effective for development of Neuroplasticity. BDNF also regulate both excitatory and inhibitory synaptic transmission.(14)

According to this research, we assume that as PNF improve BDNF and regulate inhibitory synaptic transmission so fugal meyer score is increasing through Neuroplasticity and MAS Score is decreased through inhibitory synaptic transmission so neuron get harder to generate action potential there by spasticity is decreased.

CONCLUSION-

Priliminary findings of data indicate that both PNF and BRUNNSTROM Approach is an effective intervention on improving upper limb function of chronic hemiplegic

function as p value had showed $p < 0.001$ but across group comparison had showed PNF being more effective than brunnstrom approach on improving upper limb function at $p < 0.005$

LIMITATION-

- Small sample size.
- Less treatment duration
- Only brunnstrom stage 3 is included.
- Statistical analysis was not done for individual muscle in MAS.
- Spasticity being reversible in absence of intervention, this study could not assess whether the effect of interventions were retained after the intervention has stopped.

RECOMMENDATION-

Longer term studies with larger clinical samples to confirm and expand the finding of study

Only the brunnstrom stage 3 was considered in this study, further research can include other stages.

For checking spasticity, study can be done in specific muscle wise.

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