ijlpr 2020; doi 10.22376/ijpbs/lpr.2021.11.3.L 61-L 70

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article

Physiotherapy

To Study the Effects of the PNF Stretching and Stabilization Exercises on the Improvement of Pain and Spastic Shoulder in Hemiplegic Patients: A Comparative Study

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Abstract: Stroke is the leading cause of adult disability and inpatient rehabilitation admissions. The WHO definition of stroke is rapidly developing clinical signs of focal (global) disturbance of cerebral function, with symptoms lasting 24hours or longer or leading to death, with no apparent cause other than of vascular origin: it includes patients presenting clinical signs and symptoms suggestive of subarachnoid haemorrhage, intracerebral haemorrhage or cerebral ischemic necrosis. An estimated 70% of the patients who survive a stroke are unable to use their limbs (Upper Limb/Lower Limb) independently during the first three to four weeks post stroke. Patients who have suffered a stroke experience loss, uncertainty, and social isolation, as stroke represents a sudden, overwhelming, and fundamental change for the survivor. Personal control over progressoptimism, and fears of dependency, as well as markers of independence and interaction with therapists, were identified as important factors influencing recovery. Effective rehabilitation strategies are of utmost concern to different parts of the health care system. Their value resides both in giving people affected by stroke the best possible opportunity for their recovery as individuals and in offering health organizations the best use of limited finances and resources. The objective of the study was to compare the effectiveness of PNF(Proprioceptive Neuromuscular Fascilitation) stretching and stabilizations exercises techniques in the improvement of pain and spastic shoulder.30 post stroke patients (affected for a period of more than 6months), 40-60 years of age were randomly assigned to PNF stretching and stabilization exercises were collected on Day 0, DAY 90. Paired t-test were used for statistical interventions. Assessment of Visual Analogue Scale (VAS) and Modified Ashworth Scale were performed. Analysis of scores showed significant improvement ($p<0.02$) overtime within the groups and inter group analysis showed statistical significance. The study concluded that PNF Stretching technique is better than Stabilization techniques in improving pain and spastic shoulder in chronic stroke patients.

Keywords: Stroke, Visual Analogue Scale(VAS),Modified Ashworth Scale(MAS), PNF Stretching, Stabilization technique.

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Recieved On 18 January 2021
Revised On 06 May 2021
Accepted On 15 May 2021
Published On 24 May 2021

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Larissa Dhar, Trishna Saikia Baruah, Abhijit Dutta, Dr. S. Anita Devi (PT) , To Study the effects of the PNF Stretching and Stabilization Exercises on the improvement of Pain and Spastic Shoulder in Hemiplegic Patients: A Comparative Study..(2021).Int. J. Life Sci. Pharma Res.11(3), 61-70 http://dx.doi.org/10.22376/ijpbs/lpr.2021.11.3.L 61-L 70

1. INTRODUCTION

A Stroke also known as cerebro-vascular accident is an acute neurologic injury in which the blood supply to a part of the brain is interrupted. The WHO definition of stroke is rapidly developing clinical signs of focal (global) disturbance of cerebral function, with symptoms lasting 24hours or longer or leading to death, with no apparent cause other than of vascular origin: it includes patients presenting clinical signs and symptoms suggestive of subarachnoid haemorrhage, intracerebral haemorrhage or cerebral ischemic necrosis.[1,2,3] It is reported that 1.2% of total death occurs in India due to stroke. Stroke is the 3rd leading cause of death and the 2nd leading cause of disability.[4] Major risk factors are Hypertension, heart disease and Diabetes. Apart from these, other risk factors for stroke are cigarette smoking, blood cholesterols, oral contraceptive, alcohol, social deprivation, physical inactivity impaired ventilator function and material history of stroke. Several population-based surveys on stroke were conducted from different parts in India. Recent studies showed that the age adjusted annual incidence rate was 105 per 100,000 in the urban community and 262 per 100,000 in rural community. The ratio of cerebral infarct to haemorrhage was 2.21 hypertension was the most important risk factor. Stroke represented 1.2% of total death in India[5]Strokes can be ischemic (80%), typically resulting from thrombosis or embolism, haemorrhagic (20%), resulting from vascular rupture (eg. subarachnoid or intracerebral haemorrhage).[5] Transient stroke (typically lasting <1hr) without evidence of acute cerebral infarction (based on diffusion-weighted MRI) termed a transient ischemic attack.[6] PNF(Proprioceptive Neuromuscular Fascilitation) Stretching technique utilized to improve muscle elasticity and has been shown to have positive effect on increase active and passive ROM(Range of Motion) and flexibility. The muscle must work synergistically in order for movement to occur. This requires the muscle to have the reflexive ability to contract and relax in order to perform basic movements. PNF is divided into 2 areas 1. Strengthening and 2. Stretching techniques and patterning. The stretching techniques are most often used to inhibit spasticity. The inhibitory concepts that are applied during PNF stretching Autogenic inhibition which relies on the nerve fibers from a stretched muscle to cause the muscle to relax, thus allowing for a greater stretch and reciprocal inhibition involves agonist and antagonist effect. In order for an agonist to contract and cause movement, the antagonist incurs a reflexive relaxation to allow movement. Therefore, PNF Stretching exercises in specific diagonal pattern is to enhance the functional movement through facilitation , inhibition, strengthening and relaxation of muscle groups and to help the muscle relearn the spatial and temporal aspects of recruitment that gets impaired following cerebrovascular damage and can lead to the restoration of balance between different groups of muscles.[7,8,9]. The application of the fluctuating resistance loads while the patient stabilizes the part being trained in a symptom-free position. Exercises begin easily so that control is maintained, and progress in duration, intensity, speed and variety[9] Joint stabilization exercises are an important therapeutic approach for improving shoulder function. The expectation that this approach would decrease the muscle tone as a result of the change in length of the spastic muscle, improve the activity of the antagonistic muscle, and improve the activity of the tendon[10] . Need of the study is to evaluate the effectiveness of PNF stretching Hold-relax technique versus stabilization exercises technique for the improvement of pain and spastic shoulder in chronic hemiplegic stroke patients.

2. METHODOLOGY

A population of 30 subjects (both male and female)with hemiplegia post stroke between 2-3 months with age group between 40-60 years were taken. The definition of chronic stroke for the purpose of the study was defined as any time along the recovery continuum that is beyond 8 weeks of post stroke. Each subject was evaluated for the study. Duration of the study was of (3) three months and data were collected at day 0 and day 90. All the subjects were diagnosed and confirmed by the consultant neurologists/neurosurgeons/ physicians from the referred hospitals and diagnosed as chronic hemiplegic patients with motor deficit and referred for physiotherapy management. Written consent was obtained from all participants in the study. All the subjects were taken from:

- GNRC Hospitals
- Assam down town hospitals
- Assam down town College OPD
- In and around Guwahati

Duration of the study is 3 months and data collection started at day 0 and at the end of 12 weeks (Day 90).

2.1 Inclusion Criteria

- 1.Post stroke patients within 6 monts to two years .
- Patients in which spasticity of biceps brachii was in grade 1-3 on the Modified Ashworth Scale (MAS)
- Patients who had no shoulder in last 6months
- Both genders were included.
- Patients between 40-60 years of age.
- Patients having muscle power (Manual Muscle Testing) MMT grade 3 or greater than 3.

2.2 Exclusion Criteria

- Patients who had a severe injury of the rotator cuff, shoulder subluxation.
- Patients who had undergone shoulder surgery after a shoulder injury.
- 3. Patients with psychiatric problems.

2.3 Ethical clearance

Ethical Clearence no.-adtu/Ethics/stdnt-lett/2017/002.

2.4 Outcome Measures

2.4.1 Visual Analogue Scale(VAS)

It is a tool widely used to measure pain intensity. A patient is asked to indicate his/her perceived pain intensity (most commonly) along a 100 mm horizontal line and this rating is then measured from the left edge (=vas score). It has agood reliability and validity. t[11]

2.4.2 Modified Ashworth Scale

The scale measures the resistance and spasticity (or catch) in the joint during passive movement. The resistance is scored from 0 to 4(Ashworth scale) and from 0 to 5(modified Ashworth scale). The score is based on the classification and description. t there is high inter-rater reliability when using

the MAS compared to MTS to assess the upper limb spasticity[12]

2.5 *Procedure*

Pictures of Stabilization Exercises Technique (Group-A)

Fig. 1: Technique 1: Hand on the scapula and Protracted Scapula Axillary area

Internal rotation External rotation

Fig. 2: Technique 2

2.6 *Protocol*

Subjects meeting the inclusion criteria were selected and their guardians asked to sign the written consent form stating the voluntary acceptance to participate in the study. The subjects were assigned to 2 groups-

2.6.1 GROUP A

Group A consisted of 15 chronic hemiplegic stroke patients subjects received treatment based on stabilization exercises method. A 3 months program was set up. The exercise session was performed for 30 minutes, 5 days a week.

2.6.2 GROUP B

Group B consisted of 15 chronic hemiplegic stroke patient Subjects received treatment based on PNF stretching hold-relax method. A 3 months program was set up. The exercise session was performed for 30 minutes, 5 days a week.

2.6.3 GROUP A

Group A received scapular stabilization exercise. The rehabilitation were conducted individually and adjusted to current needs and abilities of each of the patients. The therapeutic regime will remain the same for all participants.
The scapular stabilization exercise was comprised of 4 stages:
1. Patient position,
2. Therapist position,
3. Exercise, and
4. Relaxation stages.

2.7 *Patient position*

The patient was seated on a Chair and maintained a stable posturewithout any neck or upper extremity movements while the knees were bend with the feet flat on the floor.

2.7.1 Therapist position

The therapist stood behind the patient.

2.7.2 Therapist Hand Placement

The therapist placed the hand on the scapula and axillary areas.

2.8 Performance

2.8.1 Technique 1

The patient was asked to relax the entire body . While breathing deeply and holding the shoulder and neck in a relaxed and comfortable posture, the patient held the shoulder joint at 90° and the elbow joint at 120° and protracted the scapula for 10 seconds, and then returned to the starting position. Fig.1

2.8.2 Technique 2

The patient performed shoulder external rotation with upper limb abduction of 45 degree, elbow flexion of 90 degree ,and performed internal rotation and external rotation . Fig.2These exercises were be done with 10 second hold, 10 second rest with 10 repetitions. All the subjects were treated in study setting for 5 days per week for 3 months, and outcome was assessed by using VAS and MAS to know the effectiveness before and after one month of study intervention.

2.9 Pictures of Pnf Stretching Hold-Relax Technique (Group-B)

Protracted-Elevation and Retracted-Depression

Fig. 3: Protracted-elevation

Fig. 4: Retracted-depression

2.9.1 Group B

The patients were treated to PNF hold relax technique. The rehabilitation were conducted individually and adjusted to current needs and abilities of each of the patients. The therapeutic regime will remain the same for all participants. These exercises were carried out 30mins a day 5 days a week, treating the pain and spastic shoulder. The scapular patterns targeting the various groups of scapular muscles can be administered in two diagonals: 1.Anterior elevation – posterior depression and 2. Posterior elevation – anterior depression. The session began with conventional treatment including passive ROM, passive stretching followed by hold-relax technique. (3 sets of 10 repetitions) in the diagonal pattern of anterior elevation and posterior depression.

2.10 Protracted-Elevation And Retracted-Depression

2.10.1 Patient position

The exercises consisted of (3 sets of 10 repetitions) were performed with the patient lying on the treatment table. (Fig. 3, Fig.4).The patient was asked to lie with the unaffected side on the treatment table and affected side above.

2.10.2 Therapist position

The therapist stood on the affected side behind the shoulder of the patient facing towards the diagonal pattern.

2.10.3 Therapist Hand placement

The therapists one hand was placed over the medial border of the scapula.The other cupped-palm of the hand stabilized the acromion process.

2.10.4 Performance

The therapist then passively performed the protracted-elevation and retracted-depression and position at the stretch position and asked the patient to contract isometrically for 6 seconds. This was followed for 3sets of 10 repetitions.

2.11 Retracted Elevation and Protracted-Depression

Fig.5:Protracted- Depression Fig.6:Retracted-elevation

2.11.1 Patient position

The patient was asked to lie side with the unaffected side on the treatment table and affected side above. Fig.5:

2.11.2 Therapist position

The therapist stood on the affected side behind the shoulder of the patient-facing towards the belly button Fig.5,6**.**

2.11.3 Hand placement

The therapist's hand was placed on the axilla grasping the tendon. The other hand is placed over the spine of the scapula of the patient.

2.11.4 Performance

The therapist then passively performed the retracted-elevation and protracted-depression at a stretch position and asked the patient to contract isometrically for 6 seconds. This was followed for 3sets of 10 repetitions. Scapular PNF techniques were incorporated in functional or diagonal patterns for performing the exercises, and these techniques was also be used to stretch or strengthen the muscles selectively. All the subjects were treated in the study setting for 5 days per week for 3 months and the outcome was be assessed by using VAS and MAS to know the effectiveness before and after one month of the study intervention.

3 STATISTICAL ANALYSIS

All analyses were obtained using SPSS version 21. Demographic data of patients including sex, age, Visual Analogue Scale (VAS) and Modified Ashworth Scale (MAS) were descriptively summarized. An alpha-level of 0.00 was used to determine statistical significance. Statistical techniques used for analysis were pair t-test and independent t-test, which is applicable, to compare each point of time in the two groups. Both within the group and between-group analysis was done to analyze the dependent variables. The data obtained using the scale of this study VAS and MAS are following the normal criteria. Paired t-test was performed to find the effectiveness of the PNF stretching and stabilization exercises technique in improving pain and spastic shoulder. An Independent sample t-test was carried out to compare PNF stretching and stabilization exercises in improving pain and spastic shoulder.

4 RESULT

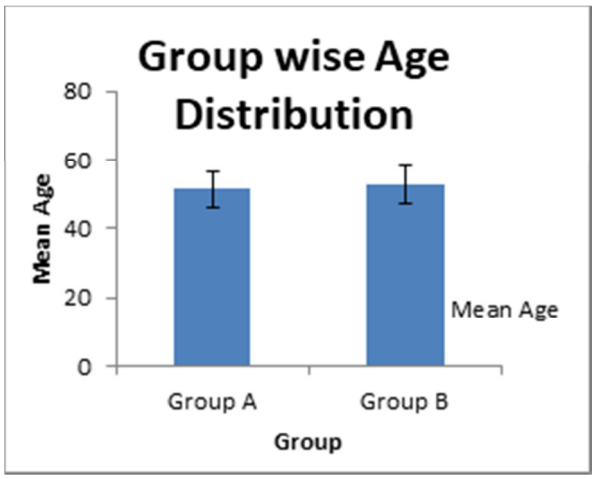

Fig 7:Group wise age distribution

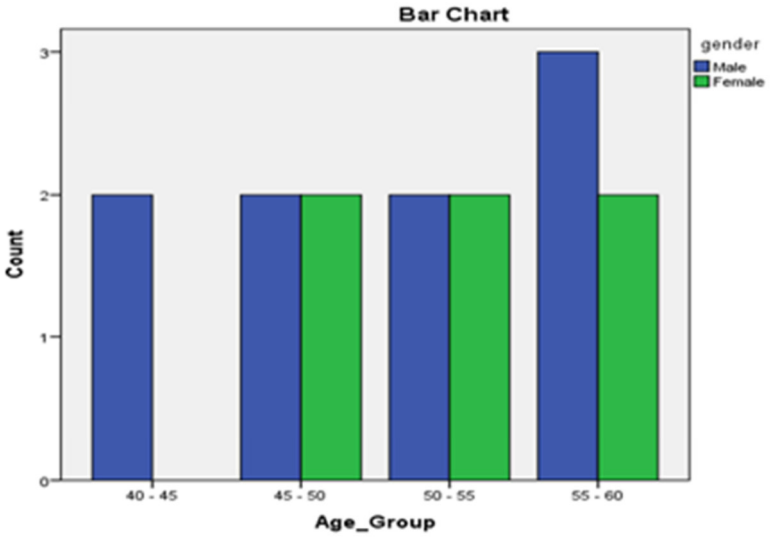

Fig 8: Male-female age group distribution A

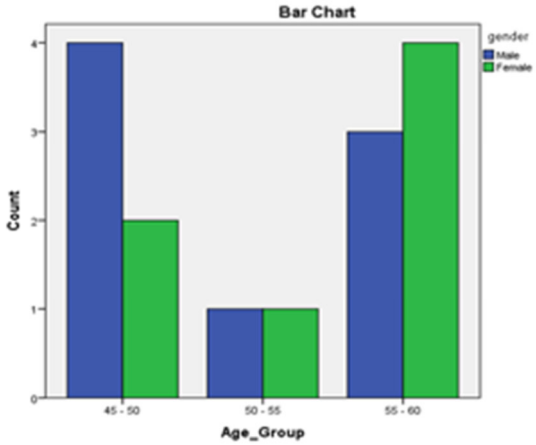

Fig 9: Male-female age group distribution

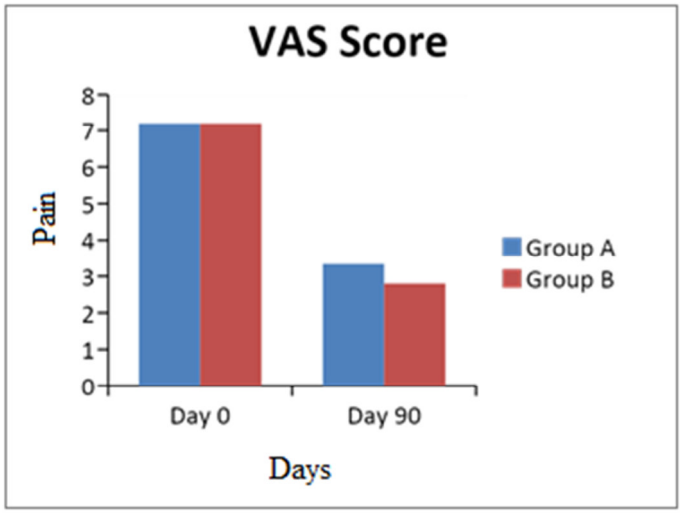

Fig 10: Group analysis of VAS Score

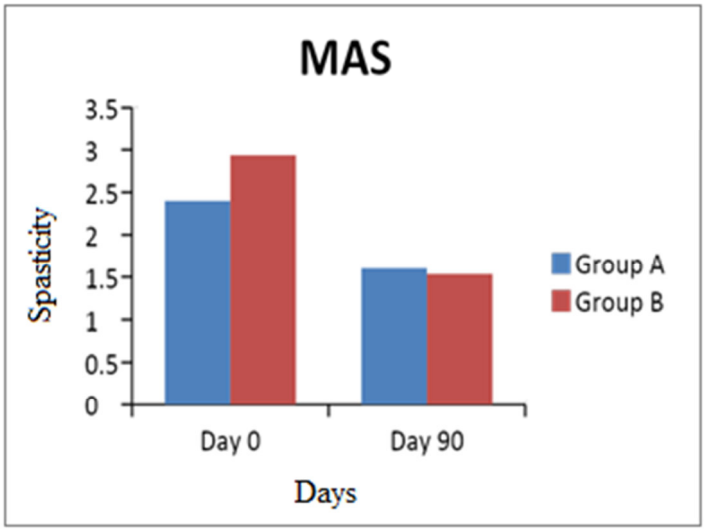

Fig 11: Group analysis of MAS

4.11 Analysis and Interpretation

Table 1: Within Group analysis VAS and MAS

Outcome Measure	Group	Day	Mean±SD	P	t	Comment
VAS	A	0	7.20±1.373	.005	23.401	Null hypothesis rejected
		90	3.33±1.175			
	B	0	7.20±1.373	.002	7.790	Null hypothesis rejected
		90	3.33±1.175			
MAS	A	0	2.40±.986	.005	7.483	Null hypothesis rejected
		90	1.60±.737			
	B	0	2.93±.799	.002	7.359	Null hypothesis rejected
		90	1.53±.640			

Significant (p= 0.05). (significant difference within Group A and B on day 0 and day 90.)

Table 2: Between Group Analysis VAS and MAS

Outcome measure	Groups	N	Mean±SD	P	Comment
VAS	Group A	15	7.359±0.640	.002	Null hypothesis rejected
	Group B	15	3.867±1.922		
MAS	Group A	15	0.800±.414	.002	Null hypothesis rejected
	Group B	15	1.400±0.737		

Significant (p= 0.05). (There is significant difference in pre and post physiotherapy treatment in Group A compared to Group B)

The data obtained using scale of this study VAS and MAS are following the normal criteria. Paired t-test was performed to find effectiveness of PNF stretching and stabilization exercises technique in improving pain and spastic shoulder. Independent sample t-test was carried out to compare PNF stretching and stabilization exercises in improving pain and spastic shoulder. The above table (Table 1) is constructed to see the significant difference within Group A and B on day 0 and day 90. Fig.7-11.In Group A, VAS decreased after the application of the PNF stretching technique. Paired t-test was performed to see the significant difference between VAS on day 0 to day 90. It was found that in Group A, t= 23.401 which is significant (p= 0.05). We can say that there has been a remarkable decrease in the VAS scale after applying PNF Stretching technique. In Group B, VAS decreased after the application of stabilization technique. Paired t-test was performed to see the significant difference between VAS in day 0 to day 90. It was found that in Group B, t= 7.490 which is significant (p=0.05). We can say that there has been a remarkable decrease in VAS scale after applying Stabilization technique. In Group A, MAS decreased after application of PNF Stretching technique. Paired t-test was performed to see the significance difference between MAS on day 0 to day 90. It was found that in Group A, t= 7.483 which is significant (p=0.05). We can say that there has been a remarkable decrease in scale on day 0 today 90after applying PNF stretching technique. In Group B, MAS decreased after application of stabilization technique. Paired t-test was performed to see the significant difference between MAS in day 0 to day 90. It was found that in Group B, t=7.359 which is a significant (p=0.05). We can say that there has been a remarkable decrease in VAS scale after applying stabilization technique.

4.12 Between-group analysis

The mean values of VAS and MAS (Table 2) show that there is significant difference in pre and post physiotherapy treatment in Group A compared to Group B. As the P-value in the between-group analysis is 0.02, null hypothesis is

rejected and the alternative hypothesis is accepted. Thus the intervention used in Group B has better effects than the intervention used in Group A.

5 DISCUSSION

The present study was undertaken to determine the effectiveness of PNF Stretching and stabilization exercises to improve pain and spastic shoulder in hemiplegic patients. A common sequela of stroke is hemiplegic shoulder pain, which can hamper functional recovery and subsequently lead to disability[13]. The underlying mechanisms include soft tissue lesions, impaired motor function. Preventative measures, like positioning and handling, can reduce the risk of developing hemiplegic shoulder pain[14] . The goal of the PNF techniques is to promote functional movement through facilitation, inhibition, strengthening, and relaxation of muscle groups by using concentric, eccentric, and static muscle contractions[15] .Shoulder pain, upper limb motor function, and function independence were significantly improved after comprehensive rehabilitation[16] .Data collected through the study showed more improvement in pain and spastic on shoulder patients in Group B. Thus it can be concluded that PNF Stretching is more effective in improving pain and spastic shoulder in hemiplegic patients. Shoulder pain improves in many cases with prompt diagnosis and appropriate management. [17] Deepak Joshi *et al.*, conducted a study on the effect of scapular proprioceptive neuromuscular facilitation (PNF) on shoulder pain, range of motion (ROM), and upper extremity (UE) function in hemiplegic patients. The experimental group received conventional treatment plus scapular PNFhold relaxation technique while the control group received only conventional treatment comprising passive shoulder ROM and stretching exercises and transcutaneous electrical nerve stimulation for 12 sessions. They found that the Scapular PNF has positive impact on post stroke shoulder pain and ROM, helps in strengthening proximal muscles of UE, thereby correcting scapular alignment and improving the UEfunction in stroke patients.[18] PNF stretching is positioned in the literature as the most effective stretching technique when the aim is to increase ROM, particularly in respect to short-term changes in ROM [19] .The visual analogue scale (VAS) has been used in studies after stroke to obtain information from patients about aspects of their health that cannot easily be assessed by observers[20] Young Youl et al, conducted a study on the effects of stretching and joint stabilization exercises applied to spastic shoulder joints on improving shoulder dysfunction in hemiplegic patients. The exercises were performed once a day, five times per week for eight weeks. They found that exercise therapy program that combined stretching and joint stabilization exercise was more effective than other exercises for improvement of spastic shoulder joint dysfunction in hemiplegic patients. The most important objective of the study was to compare the improvement of pain and spastic shoulder between group A and group B subjects. When we analyze the mean value for pre-test and post-test it is found that the mean value of; 1.Mean VAS scores are 7.20 and 7.20 for group A and group B subjects respectively for pre-test and the values are found to be decreased in post-test i.e. 3.33 and 3.33 for group A and group B respectively.2. MAS scores are 2.40 and 2.93 for group A and group B subjects respectively for pre-test and the values are found to be decreased post-test i.e. 1.60 and 1.53 for group A and group B respectively. After 90 day the mean difference is found to be;1. In VAS are 3.33 and 3.33 in group A and group B respectively and is found that statistically group B is more significant (0.05).2. In MAS score are 1.60 and 1.53 in group A and group B respectively and is found that statistically group B is more significant (0.05).From the results it is evident that patients who received treatment of PNF stretching (group-B) showed statistically significant differences in VAS from 7.20±1.373 before treatment to3.33±1.175 after treatment and MAS, from 1.60±.737 before treatment to 1.53±.640 after treatment($p<0.05$).[21] In scapular stabilization, the increase in stability and the decrease in spasticity of shoulder dysfunction are considered important because of their effects on stabilization of the shoulder joint. Scapular stabilization exercises for the scapulohumeral external rotation muscle in patients improved scapulohumeral rhythm. When a person tries to move the upper extremities and the range of motion is decreased, scapular stabilization exercise is used to correct abnormal scapular location and functional movement disorder and primarily provides stability to the entire scapula. When rotating the scapula upwards, the couple force of the trapezius, lower trapezius and serratus anterior muscles, which act as stabilizer muscles, plays a vital role in scapula movement.[22] But in case of PNF stretching techniques it stimulates the proprioceptive myo-receptors of the muscles and tendons. The muscle spindle which is found in muscles transmits information to the spinal cord regarding muscle length and the speed of lengthening. So, when a muscle is stretched quickly this muscle spindle fires and causes a reflexive contraction within that muscle that is undergoing the stretch. Greater the speed of stretch, the stronger the reflex contraction in the muscle being stretched. Thereby, improving the efficiency of the nerves control of muscles, normalizing muscle tone, and increasing the circulation of blood and tissue fluid which plays a vital role in improving or relieving the pain and spastic nature of the joint.[23] Therefore, PNF stretching show more improvement in pain and spastic shoulder when compared to patients who received treatment of stabilization exercises.

6 CONCLUSION

This study led to the inference that stabilization and PNF stretching is beneficial in improving shoulder deficit in chronic stroke and thereby a better functional recovery. When both group are statistically compared at p=0.00 level of significance and significant difference is found in both the treatment procedures. When we analyze the mean value for pre-test and post-test it is found that the mean value of: Mean VAS score are 7.20 and 7.20 for group A and group B subjects respectively for pre-test and the values are found to be decreased post-test. Independent t-test was performed to compare the effectiveness between stabilization and PNF Stretching technique. The tests were carried out separately for improving pain and spastic shoulder in chronic stroke patient. Both the techniques showed improvement in day 90 but scale VAS and MAS showed increased improvements in PNF Stretching (group-B).

7 LIMITATIONS

1. The study was done on a small sample size.
2. The study did not include long term follow up. Thus results cannot tell us about the effectiveness of both the treatment procedures in the long term.
3. There is a wide variation in the age taken in the study.
4. The subjects selected included both side hemiplegic.

8 AUTHORS CONTRIBUTION STATEMENT

Larissa Dhar Carried out the research as a part of the curriculum of Masters in Physiotherapy which included review of literature, data collection, methodology, etc under the supervision of S.Anita Devi. Trishna Saikia Baruah Contributed in procedure of the intervention, data collection an in results analysis. Abhijit Dutta Contibuted in the study as co-guide and guided the candidate in literature reviews, procedure, data collection, discussion and in methodology part.

9 ACKNOWLEDGEMENT

I would pay my heartiest approbation and gratitude to Dr. AbhijitDutta(PT), for his valuable guidance and help in carrying out the research work.I would like to gratefully acknowledge the supervision of Dr.S.Anita Devi (PT) for her constant encouragement , advice , support and timely help to carry out my study which not only made this work a profound learning experience but also a valuable lesson in the disciple of conducting a clinical study. I would like to gratefully acknowledge the supervision of Dr. Trishna Saikia Baruah (PT) for her constant encouragement, advice.I would like to express my special thanks of gratitude to all the participants,who helped me in completing my research work.

10 CONFLICT OF INTEREST

Conflict of interest declared none.

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