

EFFECT OF SHOULDERGIRDLE DYNAMIC STABILIZATION EXERCISE ON TRUNK STABILITY AND HAND FUNCTION IN CHRONIC STROKE PATIENTS

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Abstract: Stroke is major cause of mortality and long term adult disability and has a significant physical and psychosocial impact on individuals. The loss of upper limb function in chronic stroke directly impacts on trunk stability and shoulder girdle stability on affected side. Trunk stability is essential for optimal functioning of the upper limb; good shoulder function is pre-requisite for effective hand function where trunk provides stable base for execution of upper extremity function in accomplishing activities of daily living. Fifty five subjects suffering from chronic stroke were enrolled in this study were randomized and divided into two groups group A received shoulder girdle dynamic stabilization exercise and group B received shoulder girdle dynamic stabilization exercise along with it conventional physical therapy three times per week for six weeks. Subjects were assessed for recovery of trunk stability and hand function with TIS, FMA and NHPT after 6 weeks of intervention there was no statistically differences between the two groups with regards to trunk stability, upper limb functions and dexterity function the findings in this study has been influenced by small sample size.

KEY WORDS: Dynamic stabilization, trunk stability, upper limb function, shoulder girdle stability, hand functions, dexterity.

Introduction

Stroke or brain attack is sudden loss of neurological function caused by sudden interruption of blood supply to brain; ischemic stroke which results when a clot block or impair blood flow depriving brain of essential oxygen and nutrients. Hemorrhagic stroke occurs when blood vessel rupture causing leakage of blood flow to brain¹ CVS has been found to be a major cause of death and disability in all communities². As stroke mortality rates decline individuals are more likely to have residual impairments that could affect daily living more than 80% of individuals experience hemiparesis^{3,4} and those people who initial have upper extremity paresis, it is estimated that 70% have residual impairment⁵ many of them do not regain functional use of paretic arm, which can lead to difficulties in activities of daily living and engagement in community life.⁶

Stroke often causes paralysis on affected side as soon as it occurs it decreases adjustment ability of trunk and loss of anticipatory activation of trunk muscles during voluntary movement and decrease the area of stability and there is also delay and disruption in maintaining equilibrium reaction there is presence of spasticity of the trunk musculature especially in the shoulder and the pelvic girdle, resulting in a pattern of downward rotation of the scapulae and upward inclination of the pelvis, which can cause the trunk in the affected side to appear laterally flexed.⁷ and as a reduced weight bearing on paretic limbs as a result of which risk of fall increases.⁸ When trunk stabilization precedes and order of muscle recruitment changes because of use of specific muscles or failure of proper interaction between muscles, wrong compensation causes micro damage to body in extremity movement thus trunk stabilization contributes to maintaining selective motor control during proper spinal alignment and functional activities⁹.

Anatomically in normal individuals shoulder girdle have no direct articulation with spinal column which is very much dependent upon complex muscular activity in order to provide a stable yet fully dynamic foundation of moving arm. The lack of proximal stabilization affects the limb profoundly in

which arm can only be moved in spastic synergies. Distal spasticity further increases as patient tries to compensate for loss of fixation as he attempts to move against gravity.¹⁰ due to hemiparesis of distal region in upper extremity stroke patients have lack of precise proximal control at shoulder joint complex because paretic muscles do not overcome the weight of the arm.¹¹⁻¹² therefore if shoulder joints are stabilized the performance ability of upper extremities would increase and this would also greatly affect hand function¹³

In this study shoulder girdle dynamic stabilization exercise is being incorporated in experimental group which compares the individual's stabilizing pattern with the stabilization developmental pattern of a healthy infant. This can be achieved by the activation of the stabilizers when placing the patient in developmental positions as done in this study. The intervention includes a comprehensive stabilization of all elements of the trunk. Trunk and shoulder girdle stabilization is an important factor in the overall function of upper body musculature, presumably including the hand functions.¹⁴

MATERIALS AND METHODS OF STUDY

- **STUDY DESIGN**

Interventional

- **SAMPLE DESIGN**

The sampling design was non probability convenient sampling method. A simple random method was used for assigning patients into two groups

- **SOURCE OF DATA**

Data was collected from physiotherapy department OPD & IPD

- **SAMPLE SIZE**

The sample for this research study consists of 55 patients (as five patients got excluded from study due to drop out)

- **Inclusion criteria**

- 1) Patient having history of hemorrhagic or ischemic stroke since six months or more than that.
- 2) Both male and female patients.
- 3) Age is in between 40 to 70 years.
- 4) Patients who presented with a first ever stroke without previous neurological pathologies.
- 5) Patient's mini mental state examination score should be >24.
- 6) Patients with brunnstorm stage of motor recovery grade 3

- **Exclusion criteria:**

- 1) Patients having shoulder pain, subluxation, or shoulder hand syndrome.
- 2) Patient with psychiatric and anxiety disorder.
- 3) History of CVA more than one time or bilateral CVA at a time.
- 4) History or present illness of cardio-respiratory disorder breathlessness, asthma.
- 5) If patients were participating in any other study then they were excluded.
- 6) Patients with history of epilepsy were excluded

TEST DESCRIPTION AND MEASURES

- **Trunk impairment scale :**

- Trunk stability is parameter of this study; it was analyzed using the following scale

This tool measures trunk balance in stroke patients it has three components

- Static sitting
- Dynamic sitting
- balance
- coordination
- the maximum score of this scale is 23.

- **fugl –meyer performance measure**

the fugl-meyer assessment is stroke specific, performance based impairment index. it is designed to assess motor functioning, balance, sensation, and joint functioning in patients with post stroke hemiplegia. it is applied clinically and in research to determine diseases severity, describe motor recovery and to plan and assess treatment features of measure

the scale comprised of five domains and there are 155 items in total:

- motor functioning (in upper and lower extremities)
- sensory functioning (evaluates light touch on two surfaces of the arm and leg and position sense for 8 joints)
- balance (contain 7 tests, 3 seated and 4 standing)
- joint range of motion (8 joints)
- joint pain
- scoring
- less than 84- hemiplegia
- 85 to 95 – hemi paresis
- 96 to 99- slight motor dyscoordination

- **Nine hole peg test**

This test is used to assess upper extremity function and to measure finger dexterity in this participant ask to remove pegs from the holes one by one and replace them back into the container scores are based on the time taken to complete the test activity recorded in seconds scoring of nine hole peg test in healthy male adult is 19.0 seconds with right hand and in 20.6 seconds with left hand and for healthy female adults, the nine hole peg test score is 17.9 seconds and 19.6 seconds with right and left hand respectively.

TREATMENT DESCRIPTION

• Group A(experimental group)

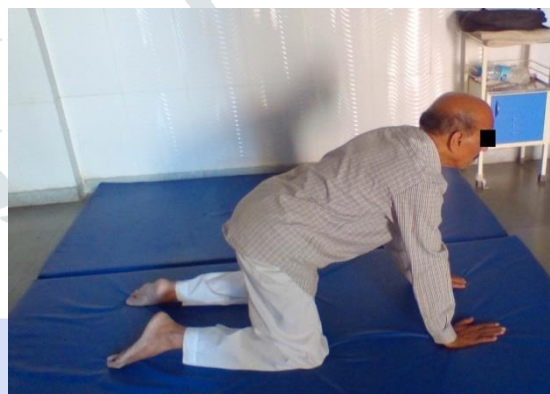
Experimental group was given shoulder girdle dynamic stabilization exercise as treatment approach. The participant actively participated in the treatment and were given intervention in prone lying position on mat

The subjects had performed a prescribed exercise in clinical setup at IPD and physiotherapy department (OPD) at limda, for three times a week for six weeks. Each training session consisted of five exercises which was performed in the following order

- 1) Prone static
- 2) Quadruped static
- 3) Quadruped dynamic rock forward
- 4) Side sitting position with dominant arm support
- 5) Bear position



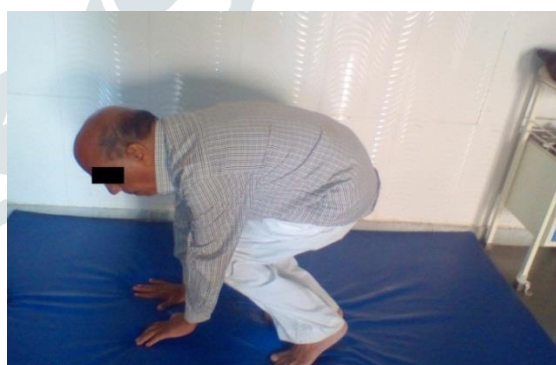
prone static



quadruped static



quadruped dynamic rock forward



Bear position



side sitting

Group B (control group)

- Subjects of this group were given conventional physiotherapy that included the following procedures for 60 minutes daily
- Stretching were given to biceps ,wrist flexors , hamstrings ,gastrocnemius and pectoral's major with 10 to 15 repetitions each.General mobility exercises were given :Standing on a wobble board, Walking through an obstacle, Walking in different direction ,Tandem walking

DATA ANALYSIS

Using microsoftexcel data was converted into SPSS (Statistical package for social and science) format for analysis SPSS version 21 was used descriptive statistics were first calculated and distribution of data was checked.

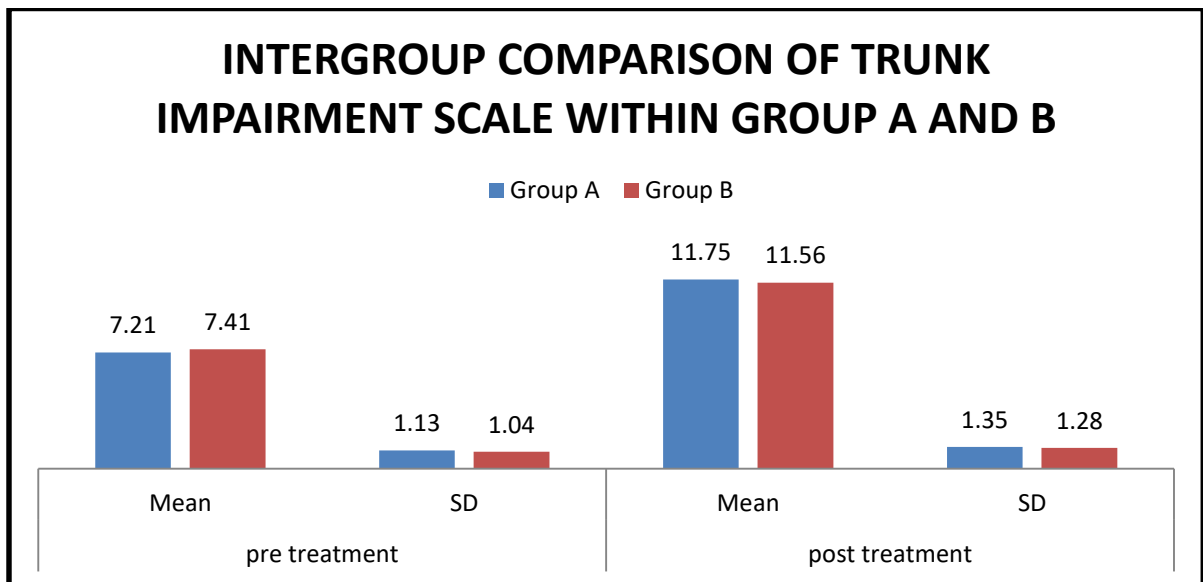
Characteristics of group A	Value	Characteristics of group B	Value
Mean age standard deviation (years)	55.92±10.381	Mean age standard deviation (years)	53.55±9.81
Gender no. M/F	14/14	Gender no. M/F	15/12
Dominant side no. R/L	26/2	Dominant side no. R/L	24/3
Affected side no.R/L	10/18	Affected side no.R/L	14/13
Type of lesion Ischemic/ Haemorrhagic	17/11	Type of lesion Ischemic/ Haemorrhagic	19/8
MMSE mean ± standard deviation	26.32±2.58	MMSE mean ± standard deviation	27.3±1.95
Duration of stroke onset mean± standard deviation	8.90±3.57	Duration of stroke onset mean± standard deviation	9.22±2.11

Table 1:Demographic and clinical characteristics of study participants n=55

To analyze the effects on outcome measures Trunk Impairment Scale ,Fugl Meyer Score Nine Hole Peg Test before and after Exercise In Group A and Group B Wilcoxon Signed Rank Test was used .

Group	Pre treatment		Post treatment		Z value	P value
	Mean	±SD	Mean	±SD		
GroupA	7.21	1.13	11.75	1.35	-4.660	<0.001
Group B	7.41	1.04	11.56	1.28	-4.615	<0.001

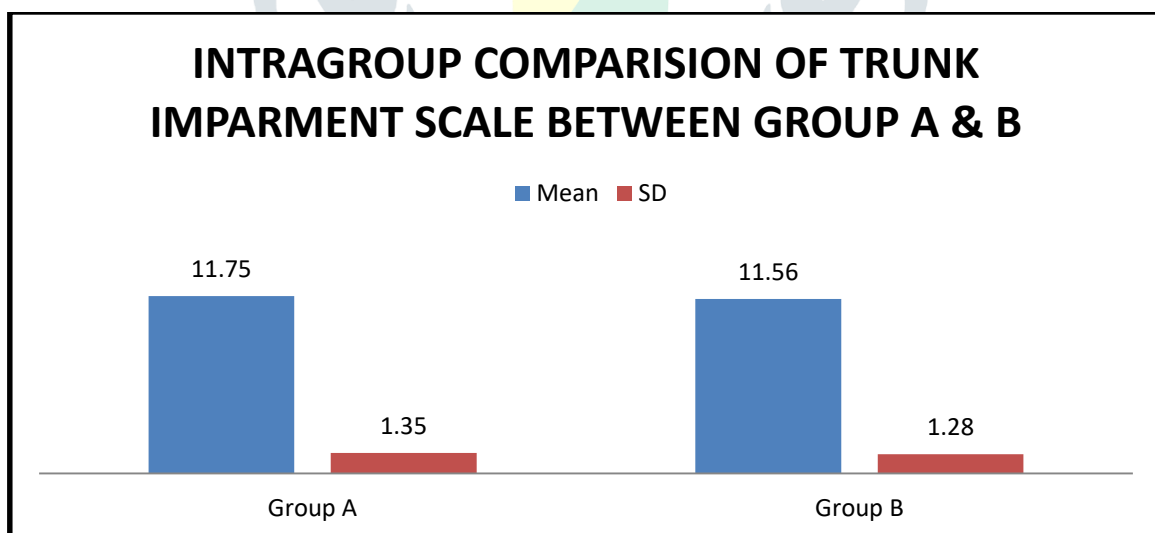
Table 2: Mean Difference in Trunk Impairment Scale in Group A and Group B



Graph 2 Intergroup comparison of trunk impairment scale within Group A and Group B

Table 3: Mean Difference in Trunk Impairment Scale Between Group A and Group B

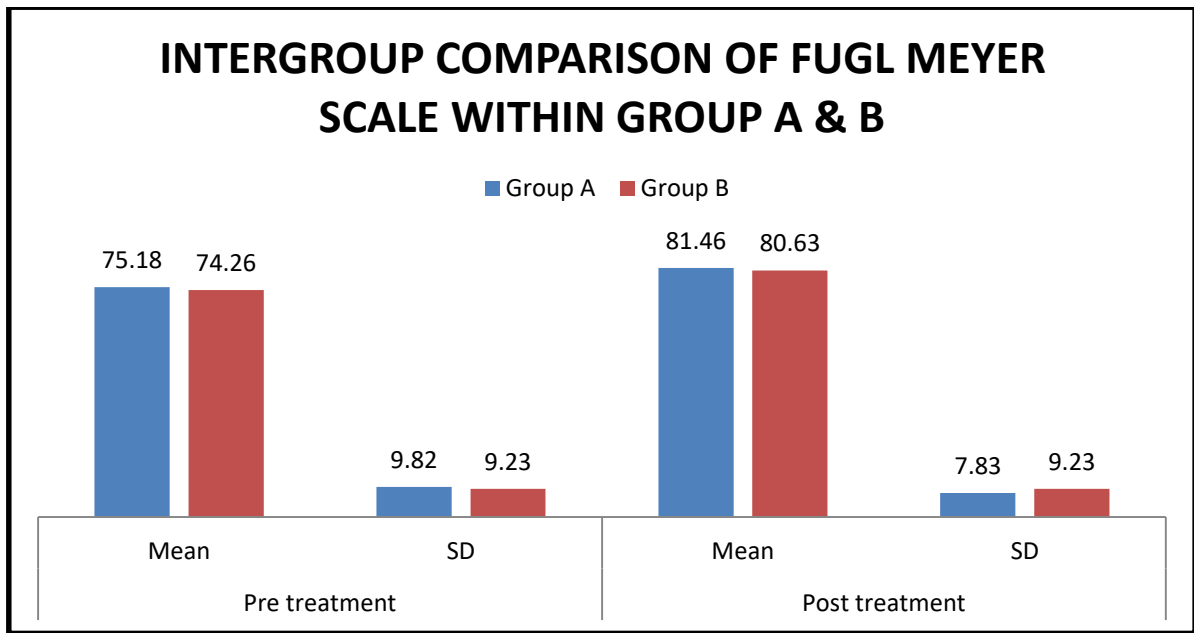
	Group A	Group B	U Value	P-value
Mean	11.75	11.56	333.00	0.436
SD	1.35	1.28		



Graph 3 Intragroup comparison of trunk impairment scale in between Group A and Group B

Group	Pre treatment		Post treatment		Z value	P value
	Mean	±SD	Mean	±SD		
Group A	75.18	9.82	81.46	7.83	-4.46	<0.001
Group B	74.26	9.23	80.63	9.23	-4.47	<0.001

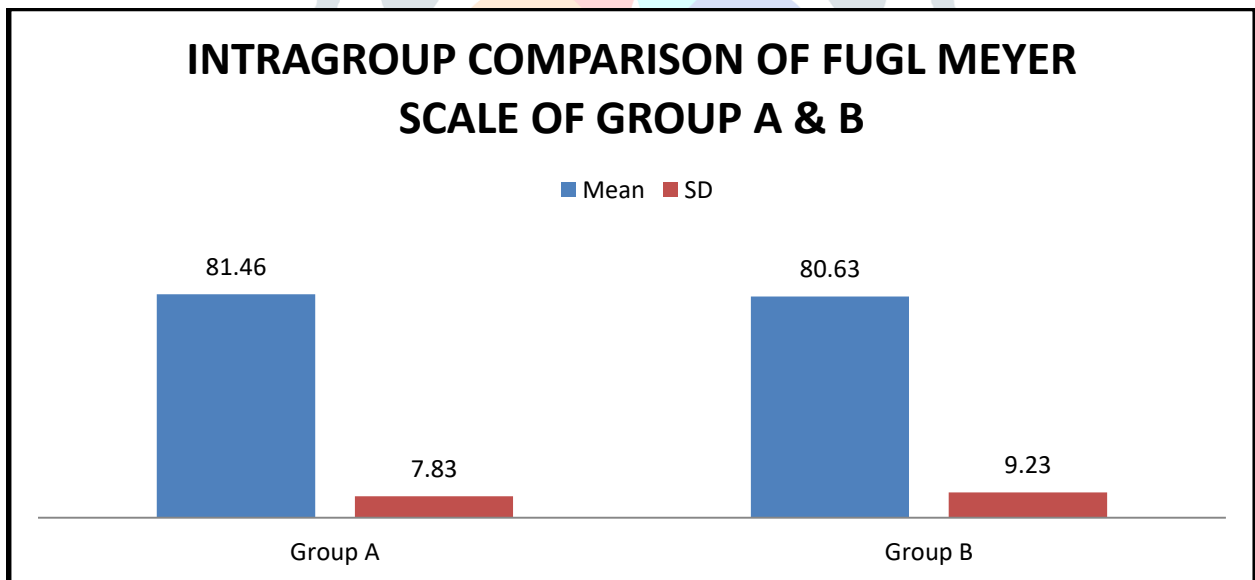
Table 4: Mean Difference in Fugl Meyer Scale in Group A and Group B



Graph 4 Intergroup comparison of Fugl Meyer scale within Group A and Group B

	Group A	Group B	U Value	P-value
Mean	81.46	80.63	377.50	0.99
SD	7.83	9.23		

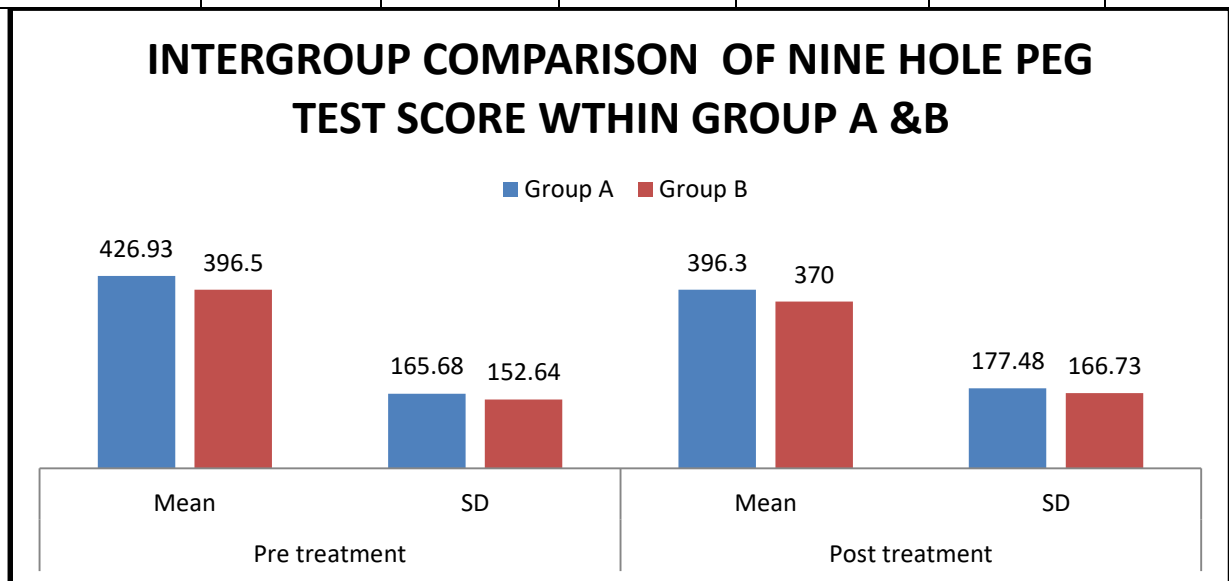
Table 5: Mean Difference in Fugl Meyer Scale between Group A and Group B



Graph 5 Intragroup Comparison of Fugl Meyer scale between Group A and Group B

Table 6: Mean Difference in Nine Hole Peg Test score in Group A and Group B

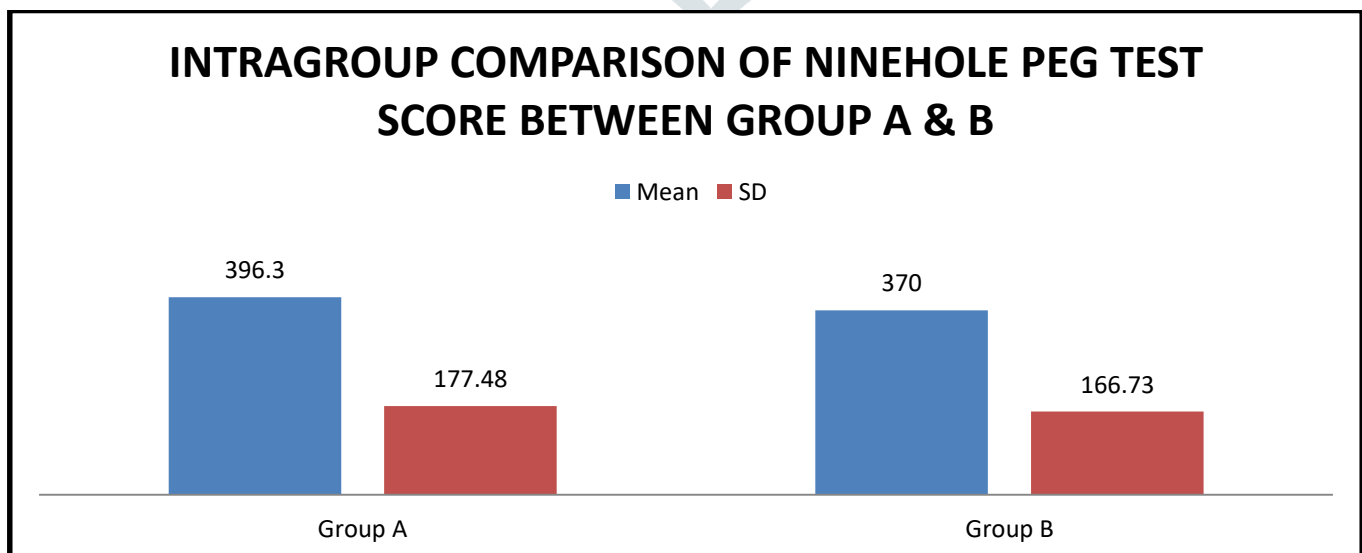
Group	Pre treatment		Post treatment		Z value	P value
	Mean	±SD	Mean	±SD		
Group A	426.3	165.8	396.3	177.48	-4.384	<0.001
Group B	396.0	152.4	370.0	166.73	-3.574	<0.001



Graph 6 Intergroup Comparison of Nine hole peg test score within Group A and Group B

	Group A	Group B	U Value	P-value
Mean	396.3	370.0	314.00	0.28
SD	177.48	166.73		

Table 7: Mean Difference in Nine Hole Peg Test score between Group A and Group B



Graph 7 Intragroup Comparison of Nine hole peg test score between Group A and Group B

Discussion

The result of this study had shown that individuals who participated in the treatment program in which Group A received (shoulder girdle dynamic stabilization exercise) along with conventional physiotherapy and Group B received only conventional physiotherapy for six weeks three times in a week with outcomes TIS, FMA and Nine hole peg test .

- **The effect of shoulder dynamic stabilization training on upper limb(hand) function**
- However it is possible that with regular follow up period and in combination with medical follow up a positive effect of shoulder girdle dynamic stabilization could have been established. This is supported by slight improvement in upper limb (hand) function (though not statistically significant) at six weeks follow up post baseline. Duncan et al (2000) reported that the most evident neurological recovery still maybe observed in patients for up to six months of stroke.¹⁵
- With regards to outcome measures FMA- UE and NHPT the experimental group as well as control group indicated better movement of upper extremity, wrist and hand as well as coordination and grasp and release ability on inter group comparison. But on intra - group comparison indicated lower scores with regards to their sensation and passive joint motion possible reasons for this may be severity of stroke or the presentation of stroke patients although researcher did not aim to assess this factors. The absence of selective movement may lead to abnormal movement pattern and therefore preventing joint through full range of motion (Lang et al 2012).¹⁶ During this study period the participants of both group received conventional physiotherapy of sixty minutes along with that experimental group received shoulder girdle dynamic stabilization During this study the participants trunks were supported and stabilized on a mat during shoulder girdle stability training similarly in current study it was found that shoulder girdle dynamic stabilization exercise triggers co-contractions of many muscles through mechanical compression of the plane of the joint and stimulate the mechanoreceptors around joints to provide more proprioception thus it improved dynamic stability as well as postural stability of joints
- The opposite effect was noted with participants who did not received shoulder girdle dynamic stabilization exercise. the use of compensatory mechanisms may improve motor function in short term but could eventually be associated with other complications such as shoulder pain and decreased range of motion at of upper limbs joint and trunk (Lum et al 2009)¹⁷.the participants in this study were positioned and stabilized to prevent any atypical movement and to initiate co-contraction required around shoulder girdle.
- Although the experimental group received shoulder girdle dynamic stabilization exercise training in addition to traditional exercise therapy no difference was noted regarding the change in upper limb function both group changed from moderate to mild impairment with regard to upper limb function at six weeks. Tim et al reported that when eighteen healthy adults performed upper extremity weight bearing exercises in isometric postures, muscle activity increased in postures that increased upper extremity weight bearing. The WBG's score was 13.54 ± 2.35 points before the exercises and 14.06 ± 2.59 points after the exercises. The CG score was 11.45 ± 2.86 points before the exercises and 11.71 ± 3.00 points after the exercises. The difference in the changes between the two groups was also not statistically significant.⁵⁶⁻⁵⁷ the results of the present study support their suggestion¹⁸⁻¹⁹
- Jemyung shim et al reported that group that perform stabilization exercise of shoulder showed a significant increase ($p < 0.05$) of muscles activation increased at post intervention compared to pre intervention in stabilizers of the shoulder in addition hand power and hand function also increased so in this study it was attempted to find correlations between shoulder and hand. However in case of isometric resistance exercise muscle activation decreases so hand power and hand function also decreased²⁰
- The absence of any statistically significant differences in upper limb (hand) function between the two groups with regard to shoulder girdle dynamic stabilization training could be attributed to both groups receiving standard rehabilitation during the research study. Both groups could have improved in similar way because they were comparable regarding severity and hence little or no difference between the two groups was noted both groups received intensive therapy daily and hence could have benefitted from that. No relationship could be established between the shoulder girdle stability and change with regard to upper limb (hand) function

- **The effect of shoulder dynamic stabilization training on trunk stability**
- The result was found statistically significant on intergroup comparison with regards to trunk impairment scale at six weeks post baseline follow-up. in the current study it causes selective stimulation of chest zones can evoke core muscles which is mediated by monosynaptic reflexive activation system so there was improvement in trunk stability in experimental group (HS Yoone al 2014).²¹
- The literature suggest that positive highly significant effect of trunk control on functional abilities of stroke patients can be attributed to the fact that the trunk serves as a central key point of the body that provides proximal stabilization. In addition control of movement takes place from proximal to distal body regions so if an improved level of proximal trunk control were attained a better distal limb control might be anticipated during functional performance. so there was improvement in trunk stability in control group.²²
- This view point is supported by findings from Miyake et al also concluded that trunk stability has an effect on stability of shoulders which in turn improves the movement of the elbow, wrist and fingers²³Behm Dg et al also concluded that stable trunk provides a solid foundation for torque generated by extremities which supports the current study²⁴.
- Se yong Hun Yu et al verified the effect of core stability enhancing exercise core control ability was evaluated using TIS. The control group showed no significant differences in TIS score ($p < 0.05$) but in the experimental group significant difference was found in TIS score.²⁵
- No statistically significant difference was found between two groups trunk stability at six weeks post baseline follow- up. the confounding factor associated with the ability to establish the effect of shoulder girdle stabilization training on trunk stability was that both group received standard rehabilitation and shoulder girdle dynamic stabilization exercise was only add on intervention strategy for experimental group Hence no relationship could be established between the shoulder girdle stability and change with regard to trunk stability while intra group comparison

Conclusion

On the basis of present study it can be concluded that shoulder girdle dynamic stabilization exercise along with conventional therapy can be beneficial in improving trunk stability and hand functions in chronic stroke patients for improvement in activities of daily living in terms of trunk impairment scale Fugl Meyer performance and dexterity in both experimental and conventional group

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