"EFFECTS OF TRUNK AND LOWERLIMB LINKED EXERCISE ON GAIT VELOCITY, TRUNK STABILITY AND QUALITY OF LIFE IN RECOVERING STROKE PATIENTS: A PILOT STUDY"

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ABSTRACT

INTRODUCTION: Stroke is neurovascular disease caused by interruption of blood flow to brain, result in neurological deficit. Neurological deficits that lead to loss of leg strength and impaired balance are two factors that correlate to walking ability Post stroke people have more forward leaning posture with an anteriorly bent pelvis in standing and their modified postural alignment is linked to worse trunk control and equilibrium capacity. Facilitation of trunk control, therefore, is used to influence the extremities. Trunk and Lower limb linked exercises initiates trunk extension & rotation pattern. It is coordinated with either a leg-reach pattern or a flexed-leg "push" pattern. Two initiation patterns result in different spinal patterns, different type of muscular activity and changes in distribution of weight. **OBJECTIVE:** To evaluate the effectiveness of Trunk and lower limb linked exercises on Gait velocity, trunk stability and Quality of life (QoL) in recovering stroke patients. **MATERIAL AND METHODOLOGY:** All patients were screened as per inclusion and exclusion criteria. They were allocated into two groups (12 patients in each), experimental group (Trunk and lower limb linked exercises) and control group (conventional therapy) by using computer generated random sampling. Outcomes were measured using 10 Meter Walk Test, Trunk Impairment Scale (TIS), and Stroke impact scale (SIS – v.3.0) was done before and after intervention, training was given for 5 days in a week for 4 weeks. **RESULT:** There is significant difference between the group mean values during 4 weeks of intervention period and outcome measurement indicates that the Trunk and lower limb linked exercises was significant effective than conventional therapy alone on gait velocity, Trunk stability and quality of life among recovering stroke patients. **CONCLUSION:** Trunk and lower limb linked exercises enhance Gait velocity, Trunk stability and quality of life (QoL) among recovering stroke patients.

KEY-WORDS: Recovering stroke patients, Trunk and Lower limb linked exercises , Trunk Impairment Scale (TIS) Stroke impact scale (SIS), Quality of life (QoL).

I. INTRODUCTION:

Stroke occurs when blood flow to the brain is interrupted. Without oxygen-rich blood, brain cells die. About 2 million brains cells die per minute, during a stroke. Stroke is the leading cause of high levels of morbidity and long-term functional disability in adults. There are two type of stroke: Ischemic and Haemorrhagic stroke.[1] Commonest type of stroke is ischemic stroke affecting 80% of individual. This occurs by a clot blood vessel which reduces the oxygen and nutrients supplied to the brain. In hemorrhagic stroke the blood vessel is rupture, or the leakage of blood in brain occurs. [1]

It is the fifth most common cause of death in United States which is estimated to be 1,40,000 each year.[2] According to the data of national stroke association, it is estimated that 795,000 new or recurrent stroke occur each year which rises rapidly with increasing age.[3] Women have a lower age-adjusted stroke incidence than men. Incidence of stroke increases with age, doubling in the decade after 65 years of age.[3] 28% of strokes occurs in individuals younger than 65 years of age.[1] Hemorrheagic stroke accounts for the largest number of deaths with mortality rates of 37% to 38% at 1 months, whereas ischemic strokes have a mortality rate of only 8% to 12% at 1 month.[1]

Due to neurological deficit in stroke, there will be impairments of sensory, motor, cognitive, perceptual and language functions, which causes dyspraxia, dysesthesia, speech disorders , visual impairments and reduces voluntary control, body movement and balance impairment. balance impairment is affected early after stroke, performance of simple and complex both tasks become difficult which results in their functional mobility. Impaired balance has also been identified as the strongest predictor of falling, which in turn is related with fear of falling, limited activity and quality of life. approximately 35% of patients with a chronic stroke still may be unable to stand and experience poor standing balance, asymmetric weight distribution, impaired weight shifting ability, or gait abnormality.

The trunk control is a central key to maintain distal limb movement control, balance control and functional activities. The core is the biggest part of our body and plays an important role in the stabilization and movement of body segments. The trunk control responsible for maintaining posture and enables the movement of legs or arms, opposing gravity. It also contributes to smooth central movement so that our body easily can be changed to new posture (Ryerson et al., 2008). In stroke patients, trunk flexors, extensors and bilateral rotators are affected which causes difficulty in maintaining upright position of body and center of mass with the base of support during static and dynamic movements. For maintaining a balance the musculoskeletal system has the ability to maintain stability which is seen when the rotation of trunk occur the muscle activity is not unilateral rather the static hold contralateral muscle require to stabilize central aponeurosis which help in forward population of pelvis.[4,5] trunk control is related to measures of balance, gait and functional ability in patients with stoke.

Stroke is characterised to walk with an asymmetric gait pattern. They often take shorter steps with the less affected lower extremity to minimize weight bearing on the affected lower extremity. There is reduced transfer of weight and weight acceptance onto the affected lower extremity in stance phase. These compensatory changes lead to decreased hip extension of the affected hip, particularly in mid to late stance phase. Major impairment of stroke is decreased hip extension during stance phase of walking.[9] These gait deviations are associated with reduced gait speeds accompanied by a change in the timing and distance covered by each step.[9]

Trunk and Lower limb linked exercises initiates trunk extension & rotation pattern. It is coordinated with either a leg-reach pattern or a flexed-leg "push" pattern. Two initiation patterns result in different spinal patterns, different type of muscular activity and changes in distribution of weight. These basic movement patterns allow the body to be positioned for functional use. [3]

Walking speed is widely used in the clinic as an indicator of gait performance after stroke.[10] It is simple to measure, highly reliable and responsive.[11] comfortable and maximum walking speeds are required to document walking ability properly. Comfortable walking speed is often used as an indicator of walking performance in clinical assessment [10], whereas maximum walking speed is important for daily activities, such as crossing a street [11]. The 10-Meter Walk Test is a commonly used measure for assessing walking speed.[12] It is commonly used as a measuring tool in stroke rehabilitation. (ICC values of 0.96 to 0.98)[10]

The trunk impairment scale (TIS) is a new tool to measure motor impairment of the trunk following stroke. The TIS was used to measure the ability to control the core muscles. The TIS evaluates static and dynamic sitting balance as well as co-ordination of trunk movement. TIS have sufficient reliability, internal consistency and validity for use in clinical practice and stroke research. [ICC value of TIS (VERSION 2.0) is 0.96 and 0.99][13] Inter-tester reliability ranged from 0.87 to 0.96 and intra-tester reliability from 0.85 to 0.99, indicating high reliability and internal validity.[14]

The Stroke Impact Scale (SIS) (VERSION 3.0) is a disease-specific, self-report questionnaire that evaluates disability and health-related quality of life after stroke. Excellent concurrent validity was reported for SIS-ADL (r = 0.64 to 0.85). Test-retest reliability was investigated with reported ICCs ranging from 0.70 to 0.94.[15]

AIM:

To study the Effects of Trunk and lower limb linked exercises on Gait velocity, trunk stability and quality of life in recovering stroke patients.

OBJECTIVES:

To evaluate the effectiveness of Trunk and lower limb linked exercises on Gait velocity and trunk stability in recovering stroke patients.

To determines the effectiveness of Trunk and lower limb linked exercises on Quality of life in recovering stroke patients.

II. METHODOLOGY:

Patients were recruited a Random sample from Parul Sevasharam Hospital, Limda. Patients were included (1) Stroke clinically confirmed by neuro physician (2) Stroke duration within 6 months (3) Age between 40 and 60 years (4) Patients able to walk at least 10 meters with or without walking aids. (5) Unilateral stroke.(6) Both male and female will be included. (7) Patients able to understand and follow simple verbal instruction. (MMSE scoring at least 23 out of 30). Patients were excluded (1) Medically unstable with comorbidities. (2) Patients who have second episode of stroke. (3) Presence of severe orthopaedic and cardiovascular conditions and homonymous hemianopsia. 12 patients who satisfied the selection criteria and received neuro physician approval were enrolled in the study. The study was approved by ethical committee of Parul University Institutional Ethics Committee for Human Research (PU – IECHR). Also written consent was taken from each patients who participates in study.

INTERVENTION:

GROUP A (EXPERIMENTAL GROUP):

A. Lower body initiated Weight shifting patterns: Sitting (10 repetitions for each activity)
1. Anterior weight Shift
2. Posterior weight Shift
3. Lateral weight Shift
B. Trunk and leg linked patterns as the leg moves in space: Standing (10 repetitions for each activity)
1. Pelvic and lower trunk flexion and Pelvic and lower trunk extension
2. Pelvic elevation or depression with trunk lateral flexion
- Experimental Group will be treated with 5 days in a week for 4 weeks. Each treatment session lasts for 40 to 45 mins.

GROUP B (CONTROL GROUP):
- Facilitatory techniques like Quick icing, Quick stretching, muscle belly tapping, Joint approximation for paretic muscles and Inhibitory techniques like prolonged icing, sustained stretching for spastic muscles.
- Strengthening for weak muscles.
- Balance and Gait training
- Functional training involving activities of daily living.

- The exercises will be performed for total of 40 to 45 minutes including 6 minutes of rest period in between as per the patient's requirement, once in a day, 5 days per week for 4 weeks.

OUTCOME MEASURES:

- **GAIT VELOCITY**

  10-Meter Walk Test is a performance measure used to assess walking speed in meters per second over a short distance.

- **TRUNK STABILITY**

  Trunk stability is parameter of this study , it was analyzed using this Trunk Impairment Scale (TIS).

  This scale measures trunk balance in stroke patients it has three components:

  ➢ Static Sitting

  ➢ Dynamic Sitting

  ➢ Balance and Coordination

- Maximum score of this scale is 23.

- **QUALITY OF LIFE**

  Stroke Impact Scale (version 3.0) (SIS) assesses eight dimensions of health related Quality of Life:

  Strength, Hand function, Mobility, Activities of daily living, Emotions, Communication, Memory, Thinking and Social role function. (59 Questions)

  On a scale of 0 to 100, with 100 represting full recovery and 0 represting no recovery.

III. DATA ANALYSIS

The software used was SPSS version 20.0 for windows. Kolmogorov- Smirnov test was used to test normality of the data. The results were statistically analyzed using unpaired t-test and paired t-test. Unpaired t-test used to analyze and compare between the scores of control group with that of the experimental group. Paired t-test used to analyze and compare the difference in scores before and after the intervention of the same patient. p value of 0.05 was considered to be statistically significant.

IV. RESULT

Results Data was meaningfully assorted through calculation of Mean and Standard Deviation. Later on Paired 't' test was applied for comparison within Group A and Group B for Gait velocity, Trunk stability, Quality of life . Thereafter unpaired 't'test was applied for comparison between Group A and Group B for gait velocity, Trunk stability, quality of life . The level for Significance was fixed at $p<0.05$.

In this study 24 subjects with the age group of 40 to 60 years were taken and divided into two groups. Group A (Experimental Intervention) and Group B (Conventional Intervention). 24 individuals completed the study program without any complications. The data obtained in both the groups are as follows.

Statistical Package for Social Sciences [SPSS] v20 (IBM, Corporation) was used for the data analysis.

TABLE 1: Age and Height Distribution of Group A and Group B

Groups	AGE (years)	HEIGHT (cm)
Group A	50	157.83
Group B	47.83	158.33

Table 1: Shows baseline characteristic of subject Mean Age of Group A 50 and Group B 47.83 years, Mean Height of Group A 157.83 and Group B 158.33 cm.
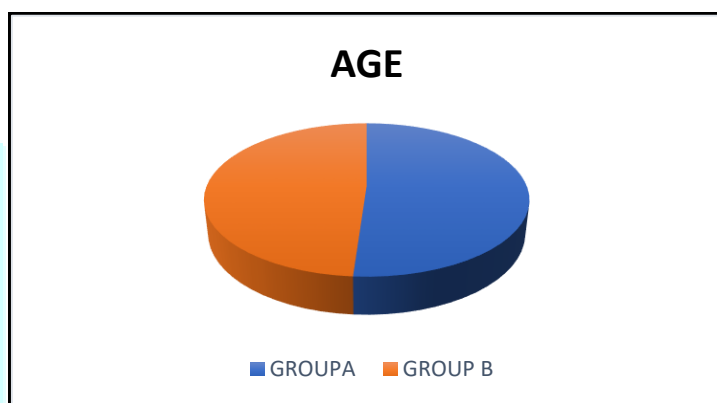
Graph: 1 age distribution of all participants

TABLE 2: Gender Distribution of All Participants

GENDER	GROUP A	GROUP B	TOTAL
MALE	8	6	14
FEMALE	4	6	10

Table 2: shows Gender distribution of both groups. Group A shows 8 male with 4 female and Group B showed 6 male and 6 female.
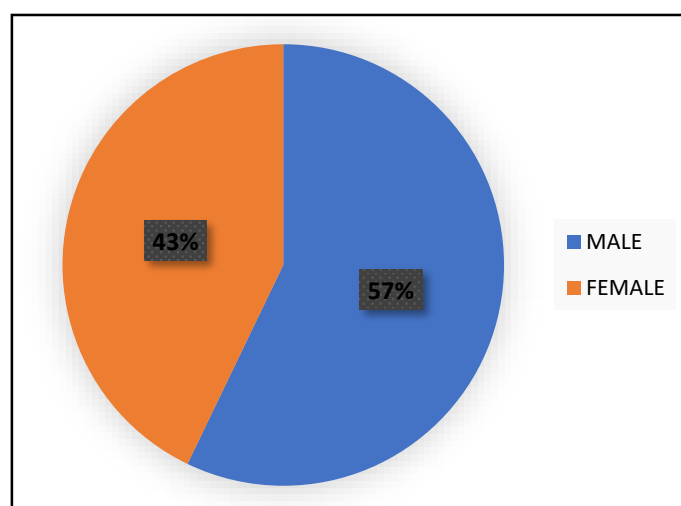

Graph: 2 gender distribution

TABLE 3: Pre - Post Difference in Comfortable Gait Velocity for GROUP A and GROUP B

Variant	MEAN±SD		t value	P value	Result
	PRE	POST			
COMFORTABLE GAIT VELOCITY (IN M/S) GROUP A	0.153±0.0122	0.216±0.0267	-7.846	0	HS
COMFORTABLE GAIT VELOCITY (IN M/S) GROUP B	0.143± 0.0830	0.155 ± 0.076	-12.871	0	HS

Table 3: Comparison of pre and post mean of Comfortable Gait Velocity, Paired t-test was performed for analysis, Pre test Mean ± SD value of Gait Velocity Group A and Group B was 0.153±0.0122 and 0.216±0.0267 respectively, when it was compared with the post test Mean ± SD value of Gait velocity Group A and Group B 0.143± 0.0830 and 0.155 ± 0.076 after 4 weeks of intervention respectively; the obtained T – value was finding had showed that there was a highly significant difference in comfortable gait speed in pre test and post test values. ($P < 0.05$)

TABLE 4: Pre - Post Difference in Fast Gait Velocity for GROUP A and GROUP B

Variant	MEAN±SD		t value	P value	Result
	PRE	POST			
FAST GAIT VELOCITY (IN M/S) GROUP A	0.249±0.0213	0.391±0.0693	-7.943	0	HS
FAST GAIT VELOCITY (IN M/S) GROUP B	0.248± 0.0246	0.266 ± 0.027	-4.504	0	HS

Table 4: Comparison of pre and post mean of Fast Gait Velocity, Paired t-test was performed for analysis, Pre test Mean ± SD value of Gait Velocity Group A and Group B was 0.249±0.0213 and 0.391±0.0693 respectively, when it was compared with the post test Mean ± SD value of Gait velocity Group A and Group B 0.248± 0.0246 and 0.266 ± 0.027 after 4 weeks of intervention respectively; the obtained T – value was finding had showed that there was a highly significant difference in fast gait speed in pre test and post test values. ($P < 0.05$)

TABLE 5: Pre - Post Difference in TIS for GROUP A and GROUP B

Variant	MEAN±SD		t value	P value	Result
	PRE	POST			
TIS GROUP A	10.333±2.534	15.833±2.886	-11.734	0	HS
TIS GROUP B	43.510±3.224	51.295±3.418	-12.872	0	HS

Table 5: Comparison of pre and post mean of Trunk impairment scale (TIS), Paired t-test   was performed for analysis, Pre test Mean ± SD value of SIS Group A and Group B was 10.333±2.534 and 15.833±2.886 respectively, when it was compared with the post test Mean ± SD value of SIS Group A and Group B was 43.510±3.224 and 51.295±3.418 after 4 weeks of intervention respectively; the obtained T – value was finding had showed that there was a highly significant difference in Trunk stability in pre test and post test values. ($P < 0.05$)

**TABLE 6: Pre - Post Difference in SIS for GROUP A and GROUP B**

Variant	MEAN±SD		t value	P value	Result
	PRE	POST			
SIS GROUP A	43.72±4.503	60.500±4.304	-16.800	0	HS
SIS GROUP B	9.66±2.806	12.833±3.01	-6.917	0	HS

Table 6: Comparison of pre and post mean of Stroke impact scale (SIS), Paired t-test   was performed for analysis, Pre test Mean ± SD value of SIS Group A and Group B was 43.72±4.503 and 60.500±4.304 respectively, when it was compared with the post test Mean ± SD value of SIS Group A and Group B was 9.66±2.806 and 12.833±3.01 after 4 weeks of intervention respectively; the obtained T – value was finding had showed that there was a highly significant difference in Quality of life in pre test and post test values. ($P < 0.05$)

TABLE 7: Inter Group Comparison of Comfortable GAIT VELOCITY between GROUP A and GROUP B

	GROUP A difference of GAIT VELOCITY	GROUP B difference of GAIT VELOCITY	t value	P value	Result
MEAN ± SD	0.0226 ± 0.0383	0.0630± 0.0278	-2.955	0.001	HS

Table 7: Comparison between Group A and Group B. The Mean ± SD value for Comfortable Gait Velocity of Group A and Group B was 0.0226 ± 0.0383 and 0.0630± 0.0278 respectively. On analysing the mean values, there was significant difference between the groups (t-value = -2.955 and p-value < 0.05). Thus, taking the mean values into consideration, it can be concluded that Group A (Experimental group) shows more significant improvement than Group B (Conventional Intervention).
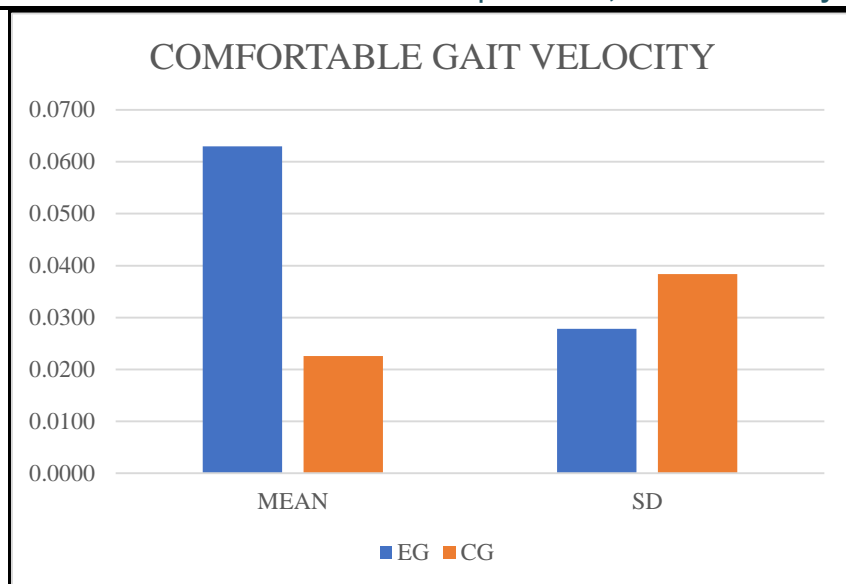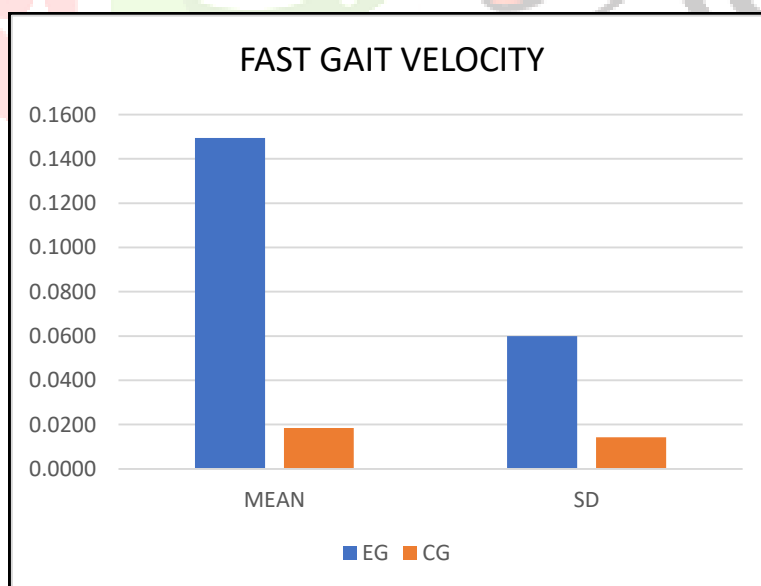
Graph: 3 inter group comparison of comfortable gait velocity between group a and group b

TABLE 8: Inter Group Comparison of FAST GAIT VELOCITY between GROUP A and GROUP B

	GROUP A difference of GAIT VELOCITY	GROUP B difference of GAIT VELOCITY	t value	P value	Result
MEAN ± SD	0.0185 ± 0.0143	0.149± 0.0600	-7.348	0.001	HS

Table 8: Comparison between Group A and Group B. The Mean ± SD value for Fast Gait Velocity of Group A and Group B was 0.0185 ± 0.0143 and 0.149± 0.0600 respectively. On analysing the mean values, there was significant difference between the groups (t-value = -7.348 and p-value < 0.05). Thus, taking the mean values into consideration, it can be concluded that Group A (Experimental group) shows more significant improvement than Group B (Conventional Intervention).
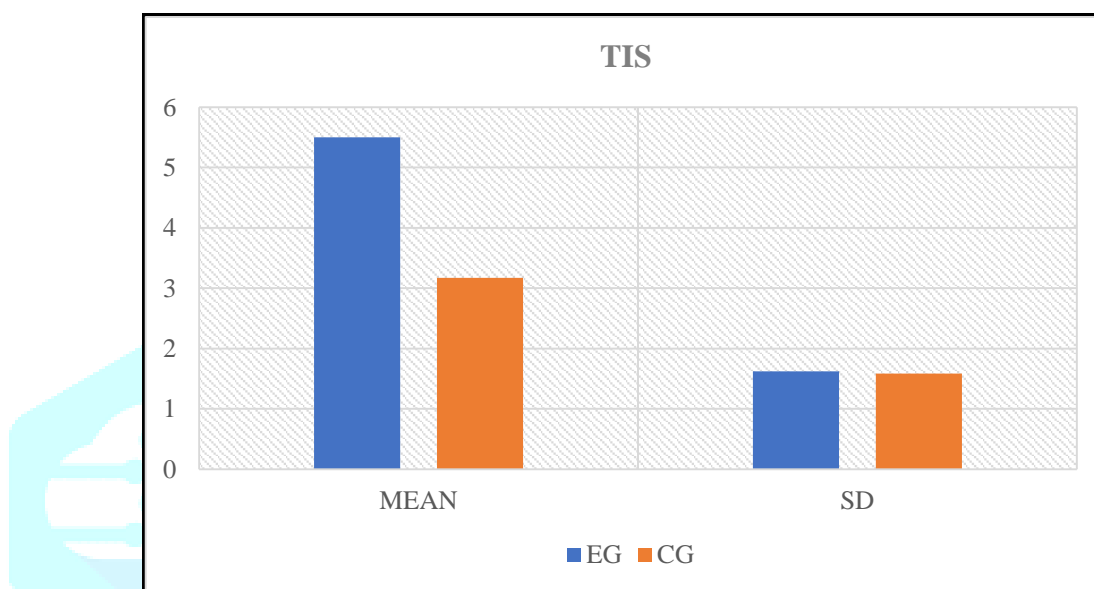

Graph: 4 inter group comparison of fast gait velocity between group a and group b

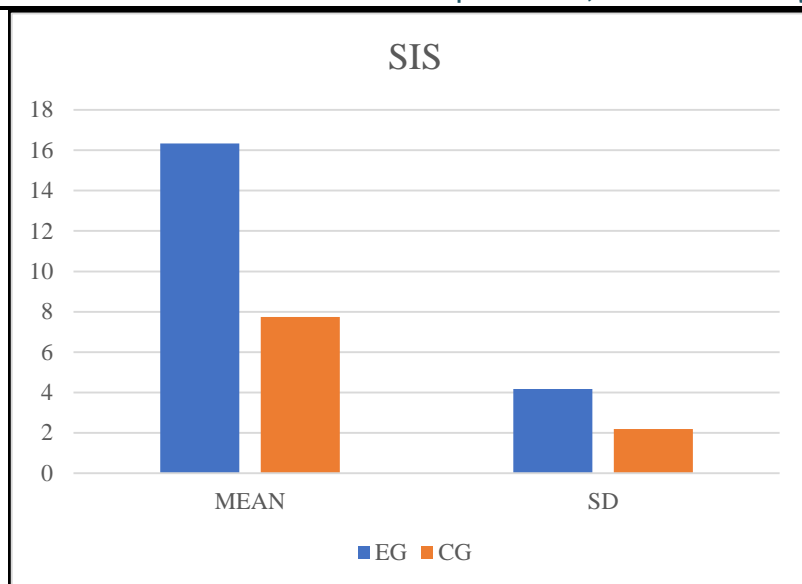**TABLE 9: Inter Group Comparison of TIS between GROUP A and GROUP B**

	GROUP A difference of TIS	GROUP B difference of TIS	t value	P value	Result
MEAN ± SD	5.50 ± 1.624	3.17 ± 1.586	-3.561	0.002	HS

Table 9: Comparison between Group A and Group B. The Mean ± SD value for Trunk Impairment Scale (TIS) of Group A and Group B was 5.50 ± 1.624 and 3.17 ± 1.586 respectively. On analysing the mean values, there was significant difference between the groups (t-value = -3.561 and p-value < 0.05). Thus, taking the mean values into consideration, it can be concluded that Group A (Experimental group) shows more significant improvement than Group B (Conventional Intervention).

Graph: 5 inter group comparison of tis between group a and group b

TABLE 10: Inter Group Comparison of SIS between GROUP A and GROUP B

	GROUP A difference of SIS	GROUP B difference of SIS	t value	P value	Result
MEAN ± SD	7.747 ± 2.193	16.33 ± 4.181	-6.079	0.002	HS

Table 10: Comparison between Group A and Group B. The Mean ± SD value for Stroke Impact Scale (SIS) of Group A and Group B was 7.747 ± 2.193 and 16.33 ± 4.181 respectively. On analysing the mean values, there was significant difference between the groups (t-value = -6.079 and p-value < 0.05). Thus, taking the mean values into consideration, it can be concluded that Group A (Experimental group) shows more significant improvement than Group B (Conventional Intervention).

Graph: 6 inter group comparison of sis between group a and group b

V. DISCUSSION:

Stroke patients have several deficits including impaired motor control, difficulty with co-ordination and postural adjustments and difficulty in maintaining balance, Trunk stability and gait. In this study we added Trunk and lower limb linked exercises. In persons with hemiplegia, posture, tone and coordinate reciprocal movements, which are required for normal gait, are usually impaired.

In present study, 24 recovery stroke patients were selected as per inclusion and exclusion criteria, 12 patients in each groups results showed that individual who received Trunk and lower limb linked exercises for 4 weeks with out come measures 10-Meter Walk Test, Trunk impairment Scale, Stroke Impact Scale experienced greater improvement in enhancing functional performance, Trunk stability and gait speed.

In this study, it was carried out with the concept of strong correlation between Trunk and lower limb including 24 recovering stroke patients who were randomly divided into two groups. For Group A Trunk and lower limb linked exercises and Group B Conventional therapy were administrated for 5 days in a week for 4 weeks for determining effects on gait velocity, Trunk stability and Quality of life by using reliable and valid outcome measures like 10-Meter Walk Test, Trunk Imapirement Scale (TIS) and Stroke Impact Scale (SIS).

In these study the experimental group who received Trunk and lower limb linked exercise showed a significantly improvement of Comfortable gait velocity, Fast gait velocity , TIS and SIS where as control group shows less significant improvement as compare to Trunk and lower limb linked exercises invention a but was for Comfortable gait velocity, Fast gait velocity , TIS and SIS.

Thus, In the present study the intervention given in both the groups was shown to be effective, but intervention given in Group A (Trunk and lower limb linked exercises) was found to be more effective when compare to Group B (Conventional therapy). Therefore, Trunk and Lower limb linked exercises are more effective in improving gait velocity, trunk stability and Quality of life among recovering stroke patients than conventional exercises treatment.

VI. CONCLUSION

Following 4 weeks of Trunk and lower limb linked exercises enhances Gait velocity, Trunk stability and quality of life (QoL) among recovering stroke patients.

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