EFFECT ON GAIT PERFORMANCE IN MCA TERRITORY STROKE PATIENTS USING DESIGNED STRUCTURED EXERCISE PROTOCOL VERSUS CONVENTIONAL EXERCISE-A PILOT STUDY

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ABSTRACT

Background- Worldwide, stroke is the third leading cause of mortality and morbidity combined and second leading cause of death. It affects gait in the majority of the patients. The rehabilitative process aims to help the patient achieve a high level of functional independence. However, there is no specific validated protocol for the improvement of gait. The study was undertaken to compare the effectiveness of structured exercise protocol (SEP-G) designed for the purpose and conventional exercises in the improvement of gait in stroke patients. **Methodology**-The study with 20 hemiplegic patients of 35-60 years of age with one-time stroke were randomly assigned in two groups, group A (n=10) Structured exercise Protocol (SEP-G) and group B (n=10) Conventional Exercises (CT) and treatment was given as per planned schedule for 4 weeks. The outcome measures (Spatiotemporal variables such as step length, Stride length, speed, cadence,2 min walk test was measured before and after training **Result**-Paired and unpaired t-test was applied. Unpaired t test showed that Group A had significantly greater higher mean in Cadence and Speed and greater stride length.

Conclusion-The study showed that SEP-G and CT were significantly effective in improving gait performance in stroke patients. The pilot showed that the designed structured exercise protocol training offered better results. This finding motivates a further study with larger number of participants for greater reliability.

KEYWORDS- Stroke, gait, hemiplegic, Conventional exercise. Structured protocol, improved cadence, stroke rehabilitation.

INTRODUCTION

Worldwide, stroke is the third leading cause of mortality and morbidity combined and second leading cause of death.[1-2] In India, among all deaths and disabilities, strokes cause 7.3% and 3.5% of deaths and disability respectively.[3] Stroke is observed when there is sudden rupture or blockage of a blood vessel in the brain, leading to subsequent damage to the cells and tissues of central nervous system.[4] The clinical consequences of the stroke depend upon the affected area and extent of damaged brain tissue. Acute manifestations from the stroke, in

addition to chronic musculoskeletal adaptation, contribute to subsequent weakness, commonly on the side contralateral to the brain injury. [5]

Walking is a common factor of autonomous function commonly affected by stroke. [6] Although the majority of stroke patients walk independently, they are not able to walk efficiently. They walk with gait abnormalities and affected spatiotemporal variables like uneven stride length, and short step length are commonly seen. Also, the walking speed of the patient decreases with increased energy expenditure and decreased biomechanical efficiency. Patient also lack flexibility in performance due to reduced muscle strength and the gait abnormalities [5,7] It is reported that therapeutic intervention recovers fitness, balance, speed and capacity of walking. [8] Various common gait training strategies include neurodevelopment techniques, muscle strengthening, treadmill training and intensive mobility exercise and structured exercise protocol training. Among these, some exercises are reported to be more effective in the improvement of gait parameters than others. [9]

Currently conventional exercises are prescribed for improvement to patients of stroke due to MCA lesion. However, the exact exercises and number of sets prescribed vary from physiotherapist-to-physiotherapist and institution-to-institution. A standard structured validated exercise protocol would be beneficial and would enable continuity of care, measurable and comparative outcomes to beneficially impact patient care and further therapeutic development. Such a protocol currently does not exist.

Therefore, a structured protocol was designed for MCA territory stroke patients' gait rehabilitation and this pilot study was undertaken to compare the effectiveness of this protocol with conventional training.

MATERIALS AND METHODOLOGY

The study was conducted at Physiotherapy OPD, Medicine ward, of a tertiary care hospital for a period of 1 months after approval from the Institutional Ethics Committee. Participants were included based on predefined inclusion and exclusion criteria given below:

Inclusion criteria- Patients with stroke in unilateral MCA territory, belonging to both gender, Capable of understanding instructions, Muscle weakness assesses by manual muscle testing scale, grade 0-3 degree, Written informed valid consent available.

Exclusion Criteria- Patients with Musculoskeletal pathological conditions that affect Gait, who develop major illness, trauma, or stroke during the study, with uncontrolled post stroke seizures.

Total 20 Patients of MCA territory stroke patients were included for the study after written informed consent. They were equally divided into 2 groups viz. experimental group (Group A) which was treated with the Structured Exercise Protocol for Gait (SEP-G) and the control group which followed the conventional exercise system (Group B). Groups were assigned randomly using chit method.

A team of three senior physiotherapists, including the researcher, were trained in the SEP-G protocol. A uniform set of conventional exercises previously in use in the hospital was retained. Patients were assigned to them in consecutive order to eliminate bias. Data pertaining to clinical history, examination findings were noted.

Participants underwent 3 supervised sessions of one hour each, every week for 4 weeks. Variables of study were recorded at the onset of the training and at the end of 4 weeks. The variables studied were spatiotemporal which includes stride length, step length, cadence, speed, 2min walk test.

Data was recorded in Excel sheet. All information was coded to maintain patient's privacy and confidentiality of data. All data was analysed using Microsoft Excel.

RESULT

Table no.1-Group wise age distribution

Age		
Group	**Mean**	**S.D.**
Structured Exercise	54.70	8.86
Conventional Exercises	55.20	8.89

There was not significant age difference amongst participants in both groups ($p>0.05$).

Table no.2-Group A (Structured Exercise)

Gender	Females	Males
Group A	4	6
Group B	4	6
Total	10	10

Groups A & Group B patients were gender matched.

Compare all 5 parameters pre-post exercise (to show that both groups were comparable)

Table no.3- Pre-Post comparison of SEP-G

	Variable	Time point	Mean	S.D.	P- value
Structured exercises	**Stride Length(inches)**	**Pre**	33.30	4.00	*
		Post	52.80	4.18	
	Step Length (inches)	**Pre**	16.90	4.41	4.84E-06*
		Post	27.00	2.62	
	Cadence (steps/min)	**Pre**	64.20	10.46	7.74E-06*
		Post	91.40	5.23	
	speed pre (meters/sec)	**Pre**	2.60	0.52	0.0005*
		Post	3.60	0.52	
	2 min walk test (meters)	**Pre**	100.60	11.16	0.00458
		Post	118.20	15.50	

(* indicates P-value (<0.001) is significant)

Significant improvement was noted in all five variables measured after SEP-G (all p<0.01)

Table no.4- Pre-Post comparison of Conventional Exercise (By using Paired t-test)

	Variable	Time Point	Mean	S.D.	P-value
Conventional Exercises	Stride Length (inches)	Pre	32.90	5.17	0.0006*
		Post	44.20	4.96	
	Step Length	Pre	18.50	4.14	0.0001*
		Post	27.30	2.98	
	Cadence (steps/min)	Pre	64.70	11.37	4.85E-05*
		Post	89.30	3.97	
	Speed Pre (meters/sec)	Pre	2.50	0.53	0.0054*
		Post	3.30	0.48	
	2 min walk test (meters)	Pre	101.90	6.89	0.0023*
		Post	122.50	17.04	

(* indicates P-value (<0.001) is significant)

Table no.5 Improvement in Spatiotemporal variables

Variables	Difference in Pre- & Post in Group A	Difference in Pre- and Post in Group B	P value
Stride length (inches)	19.5	11.3	0.004*
Step length	10.1	0.15	0.147
Cadence (steps/min)	27.2	24.6	0.132
Speed Pre(meters/sec)	1	0.8	0.254
2minwalktest(meters)	18.4	22.6	0.281

(* indicates P-value (< 0.001) is significant)

Table no.6 Group Comparison (By using Unpaired t test)

Variable	Group	Mean	S.D.	P-value

Stride Length (inches)	Structured Exercise	52.80	4.185	0.0003*
	Conventional Exercises	44.20	4.962	
Step Length	Structured Exercise	27.00	2.625	0.4070
	Conventional Exercises	27.30	2.983	
Cadence (steps/min)	Structured Exercise	91.40	5.232	0.1628
	Conventional Exercises	89.30	3.974	
Speed Pre (meters/sec)	Structured Exercise	3.60	0.516	0.0982
	Conventional Exercises	3.30	0.483	
2 min walk test (meters)	Structured Exercise	118.20	15.498	0.2811
	Conventional Exercises	122.50	17.038	

(* indicates P-value (<0.001) is significant)

DISCUSSION

This study undertook to validate designed structured exercise protocol and to ascertain the user experience in terms of feasibility and time involved in implementation. The protocol is designed to offer a novel combination of exercises that will compare equally or favorably to the conventional exercises used for rehabilitation of stroke patients.

The pilot study aimed to compare the effectiveness of SEP-G and CT in the walking performance of stroke patients. The pilot study was conducted with 20 subjects. Subjects were divided in 2 groups. Written, informed valid consent was taken. The patients were split into two groups which received designed structured exercise protocol (experimental group) and conventional exercises (control group). The intervention was carried out for 4 weeks with 3 supervised sessions per week. Post intervention results showed that patients receiving SEP-G had significant improvement in spatiotemporal variables. The researcher was unable to find any study that focused on the components of the SEP-G protocol, to enable direct comparison.

The improvement in the spatiotemporal variables can be explained on the basis of neuronal plasticity following the brain lesion. It is suggested that complex organization provides the foundation for functional plasticity in the motor cortex. Cortical representation reflects changes

associated with skill development which is stimulated by repetitive training and practice. [7] Muscle weakness in stroke patients can result in immobilization or reduced physical activity. The strength of hip flexor muscles, knee extensor muscle, and ankle plantar flexor muscle are the main factors for comfortable or fast walking speed in stroke patients. [11] In designed structured exercise protocol training real life activities were followed whereas in conventional training a simple repeated exercise of movement was followed. In SEP-G intersegmental coordination was taken into consideration which could contribute to improvement in walking performance. On contrary in CT group intersegmental coordination was not taken into consideration. SEP-G added specificity and variability to practice.

Hence, structured exercise protocol training was found to improve the walking performance because of task specificity of motor relearning programme which assisted in improving motor control of lower limb and motor learning in walking.[12] A meta-analysis of Wist S. et al. suggested that appropriately targeted progressive resistant training is effective in improving muscle strength.[13] Similarly, in this study Structured exercise protocol(SEP-G) training significantly improved spatial and temporal variables of the patient The reason for these results may be structured exercise protocol training which improved passive viscoelastic properties of muscle and tendons which could influence hypertonia.[5] In this study significant difference was observed in the pre and post-treatment values of both the groups. Structured exercise protocol (SEP-G) training showed significant improvement in the outcome measures suggesting that it facilitates the walking performances. This was confirmed using statistical analysis by using ‘Paired t- test’ for within group comparison and ‘Unpaired t test’ for between the group comparisons. Present study, shows that after intervention there was significant improvement in the outcome with structured exercise protocol(SEP-G) training as SEP-G provides specificity and variability in practice of the exercise. Patients were given chance to practice in variability of contexts. Although skill performance may be initially delayed, it might have helped in improved retention of skill. Then acquired skill can be applied more easily to other novel environmental situations in real life activity. However, continuous practice carried out in conventional training might have slight context and learner had only inadequate number of solutions. [13,14] In these 20 participants were recruited and were divided in 2 groups

Group A (Structured exercise protocol) (SEP-G)

Group B (Conventional exercises) (CT)

Group-wise comparison (Unpaired t test) Group A showed

Higher mean in cadence and speed (p& gt; 0.05)

Greater stride length (p= 0.0003)

A significant difference was observed in both groups regarding spatiotemporal variables, (Stride length and higher mean in Speed, and Cadence) which suggests that SEP-G facilitates more efficiently gait parameters in the stroke patients as compared to CT. The limitations of the study were the small sample size. A combined study of SEP-G and CT with a large sample size including all variables and measures is the further recommendation of the study.

STRUCTURED EXERCISE PROTOCOL

Subjects of both groups will be intervened with SEPG and CT for 60 Minutes three times a week. It aimed to prevent soft tissue adaptive shortening, elicit muscle activity, increase muscle strength and control to provide support, propulsion, Balance and toe clearance and train rhythm and coordination.

Structured exercise protocol training- The exercise protocol is derived from the exercises proposed by Gresham GE, et al Yang YR et al using the materials. [10], Brunstorm approaches [11] and Bobath approach in this training major emphasis is given on exercises in lying, sitting and standing positions. Here intersegmental coordination was incorporated to assess the walking performance.

STRUCTURED EXERCISE PROTOCOL

Physiotherapy Treatment in Stage I and Stage II	1.Bed Mobility Exercise (Turning) Duration of training - 1st week 10 reps, 2 times a day

	2. Exercise to develop hip control on paralysed side by Raimistes adduction phenomenon Duration of training- 2ndweek 10 reps, 2 times a day
	3. Kinesiotaping for hemiplegic shoulder pain Duration – 2nd and 3 rd week Tape should be kept for 2 hours Daily.
	4.Prescibing Shoulder support to prevent hemiplegic shoulder pain and subluxation in stroke Duration – 4th week should be worn during exercising, transfers and positioning.
	5.Exercise variation – To gain mid-range of motion in paretic upper limb Progression – 5th and 6th week 10 reps, 2 times a day
	6. Local facilitatory technique – Tapping Rubbing Duration 7th ,8th and 9th week 5 times twice a day
	7.Exercises to generate flexor activity on weaker side on phenomenon on imitation synkinesis Duration – 10th 11th week 5 reps 2 times a day
	8. Functional task oriented exercises from isometric to eccentric contraction Duration – 10th, 11 th week 10 reps, 2 time a day

Physiotherapy Treatment in Stage III, IV and V	1. Passive manipulation techniques with grasping exercises and cutaneous stimulation Duration – 12th week 15 reps once a day
	2. Hand manipulation technique for spasticity – Free hand swatting movements distally directed over PIP and DIP joints Duration- 13th 14 th week 5 times once in a day
	3. Facilitation exercise for finger extension by flexing shoulder to 90 degrees (Souques finger phenomenon) Duration – 14 th week 5 times once a day
	4. To decrease synergy – Task oriented activites Duration – 15th week 10 reps twice a day
	5.Introducing a new movement outside the synergy Duration – 16th week 10 reps twice a day
	6.Matrix Rhythm therapy for spastic muscles Duration – 16 th week 1hour 17 th week 1 hour

Physiotherapy Treatment in Stage VI and VII	1. Gait training exercises for stroke Pre ambulatory exercises a. Closed kinematic chain exercises with Bilateral knee bending and straightening exercises b. Closed kinematic chain exercises with alternate knee bending and straightening exercises (Duration 17 th and 18th week 15 reps twice a day)
	2. Modified kinematic chain exercises a. Normal leg moves in contact with floor so more weight is brought on paralytic leg b. Normal leg moves on Unstable surface like ball rather than floor (Duration 18 th week 10 reps twice a day)
	3. Weight bearing exercises on paretic side with floor mat on normal side. Duration 19th week 15 reps twice a day
	4. Mini squate exercise with peg board Duration 20th and 21st week15 reps twice a day

	5. Anterior pelvic rotation and protraction exercises with peg board Duration 22 nd and 24 th week 15 reps twice a day

CONVENTIONAL PHYSIOTHERAPY TRAINING

Physiotherapy exercises in stage 1 And II	1.Positioning in supine, side lying, prone Duration 1st and 2nd week 2 hours on each position
	2.Moist pack and Infra-red rays for hemiplegic shoulder pain Duration 3 rd and 4th week 10 min each session twice a day
	3.Passive movements for paretic limb Duration 3rd, 4th, and 5th week 15 reps twice a day
	4. Chest physiotherapy- Percussions and vibrations Duration- 3rd, 4th ,5th week 30 to 40 percussions and vibration at the end of expiration
	5.Uses of splints Duration 5th and 6th week Alternate 2 hrs to be wore

	6.Functional electrical stimulation for paretic muscles Duration 7th to 9th week 90 contractions in 3 sets
	7.Arrangement of patients room
	8.Facilitatory exercises for hypertonia (Light moving touch and fast brushing) Duration 10th week 5stroking on each dermatome

Physiotherapy treatment in stage III,IV,V	1.Stretching exercises – sustain slow stretching for 20 sec to be given Duration 16th, 17 th week 2times daily
	2.Deep massage for paretic side (efflurage, Kneading) Duration 18th week 15 min each hemiparetic part
	3. Prolonged pressure / Tendon pressure On hemiparetic side Duration (18th week 2 min each part)
	4.Ice massage on paretic side Duration 19th week 10 min on each part
	5.Use of splints Duration 2 hours twice a day

Conventional exercise training in stage VI and VII	1. Berg balance exercises in sitting and standing Duration 21 st week 5 min each exercise twice a day
	2. Exercises on tilt table Duration 22 nd week half hour during one session twice a day

	3. Strengthening exercises with TheraBand, weight cuff Duration 23rd week 15 reps twice a week
	4. Parallel bar exercises in standing and walking Duration 24th week 15 reps twice a day
	5.Traning exercises for normal and free ambulation without any support Duration 24th week 15 reps twice a day

CONCLUSION

The study showed that SEP-G and CT were significantly effective in improving gait performance in stroke patients. However, the comparison between the designed SEP-G and CT showed that the former is more effective in the improvement of gait performance. Further studies will contribute to strengthening the evidence for the use of the structured exercise protocol.

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