Effectiveness of Circuit Class Training for Gait Parameters in Subactute Stroke Patients

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ABSTRACT

Introduction: Mostly the CVA patient's exhibit hemi paretic gait distinguished by unhurried and unevengait pattern accompanied byfaulty selective musclespower, retardedas well aschangedbalance reaction along withdecreased weight bearing on the hemiplegic limb. Many studies have shown that use of walking aids, muscle strengthening, over ground walking, treadmill training and FES, are some of the available physiotherapy treatments to ameliorate gait in patients with stroke. Objectiveof our research programme is to find out the difference between the efficacies of circuit class training versus conventional exercise programme on gait parameters in sub- acute stroke subjects.

Methodology: In this study using pre-post-test experimental design, 30 subjects with sub- acute strokewere assigned to 2 (groups A and group B) based on inclusion and exclusion criteria. Each group shall contain 15 subjects. Group A receives circuit class training 1 hour per session on alternative days for 4 weeks and Group B received conventional training programme for 30 minutes a day, for all days in a week, for 4 weeks, total sessions were 22-24. The outcomes are 6 MWT, DGI and SSQOL. The pre- and post- test values are taken on the first day and then after 4 weeks of treatment.

Results: After the treatmentthere was an improvement within both groups. In the circuit class training group, there was an improvement after the intervention (P<0.04) and conventional exercise therapy group (P<0.03). There was no remarkabledifferentiation between theseboth protocols. The significance level between both the group was kept as P>0.5.

Conclusion: Afterthe 4 weeks of the study the results reveals that the two groups (group A and group B)show marked changes in the gait parameters as well as the quality of life. However, when comparing circuit class interventions and conventional interventions there was no difference in the level of significance. So, our study concluding that both exercise protocols are effective and there is no significant difference between these both protocols on gait parameters and quality of life in subjects with sub- acute stroke.

Keywords: Stroke, Circuit class exercises, Conventional physiotherapy, Gait parameters.

INTRODUCTION

According to WHO stroke is "rapidly developing clinical signs of focal or global disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death with no apparent cause other than of vascular origin".[1] Risk factors of stroke includes age, obesity, diabetes mellitus, hypertension, lack of exercise, smoking, dyslipidemia and positive family history. Stroke is the secondarykey factor of mortalityworld-wide, following heart diseases. According to 2013 studies. Global prevalence of ischemic stroke is 8.32-9.00, incidence rate is 1.96-2.3, and in case of men incidence is 3.43 – 3.85 and prevalence is 9.27 – 10.05. Hemorrhagic stroke shows a reduction in prevalence and ischemic stroke rates. In women the incidence rate is 1.42-1.63, prevalence rate is 3.23-3.51, and in women, incidence rate is 1.72-1.94 and prevalence rate is 3.81 to 4.17.[2] In India Prevalence of stroke shows a higher value in rural areas as compared to urban areas. In rural areas the prevalence rate is 165/100,000 and in urban areas it is 136/100,000. The prevalence of stroke in men is double the rate as compared with women. In Kerala the stroke prevalence in men was 6.74/100 persons, this is nearlydouble the amountnotice in women (3.48/100 persons).[3] Radiologically stroke is classified in to acute, sub-acute (18-76days) and chronic.[4] Stroke recovery is different in terms of different stages. Patients with sub-acute stroke show more prognoses in comparison with acute stroke. If correct rehabilitation is not given in sub-acute stage the deformities may aggravate.

Ability to walk and independence in ambulation decide the level of dysfunction in stroke patients. The seriousness of the lower extremity paresis is depending on the replacing of the gait after the stroke. The common gait impairment after stroke isreduced gait speed, reduced foot space and standing time imbalance.[5]Relearning of the motor control of the gait cycle is a major aspect of the rehabilitation of the stroke patients. This is effective in the first week after the stroke, in order to prevent synergic pattern formation. For completing the motor task, the patient may adapt gross extensor and flexor synergies. And this will lead to lesser degrees of freedom and the patient may go for a preferred state.[6] Gait impairments in stroke patients is occur due to lack of muscle coordination. Muscle coordination is changed due to the change in muscle strength. Changes in muscle mass, changes in muscle fiber type and the changes in the aerobic capacity after stroke will lead to changes in muscle strength. This may influence the gait in stroke patients. Spatiotemporal asymmetry in walking is the common kinematic problem occurs during post stroke. The ultimate goal of rehabilitation in post stroke patients is restoration of the walking ability. The improvement in walking ability may reduce the excess use of energy by the stroke patients, and also it prevents the synergy formation.[7] The common impairment in gait kinematics of stroke includes reduced foot clearance throughout the swing period of gait. It is a key factor since they this may leads to falls and the chances of getting injury also high.[8]Gait abnormalities post stroke includes reduced stride length, movement speed, muscle power and joint range of motion. The knee component will be more involved than other joints. During swing phase of gait knee flexion will be affected. Hence stiff knee gait develops, that is associated with stroke.[9] Lower limbs are considered as the locomotor's unit and trunk act as a passenger unit which has to be carried by the locomotors unit during the gait.It due to the loss of muscle power of the erector spinae, multifidus, and the transverse abdominal muscles which help to make the upright position of the trunk while walking. Trunk control is the one of the main factors in recovery of daily living activity due to stroke.[10] so, the early rehabilitation of the trunk control is also important.

After stroke Circuit class interventionprovide a superintend group conclave for patients to practice tasks, it enables expandedtraining time without increased manpower. Circuit class intervention explains how to provide patient centered training. In post stroke patients circuit class training has shown superiority among other conventional therapy in improving mobility and upper limb function.[11]

The aim of the research programme is to decide the gait impairments and to know the effectiveness of circuit class training versus conventional exercise programme in sub-acute stroke patients. Most of the patients with sub-acute stroke are receiving different types of therapeutic interventions. Out of these limited studies have been documented for the full recovery of gait impairments.

To enhance the recovery of gait parameters among sub-acute stroke patients within short period of time because there are less studies based on these and to know comparatively circuit class training or conventional exercise interventions is appreciablyhelpful. Also, we hypothesized that the physiotherapy interventions are helpful in improving the quality of life in stroke patients. And also helps for the overall increment in the life expectancy after the stroke.

SUBJECT AND METHODS

Research design was randomized controlled trail. Study setting was JDT Islam Physiotherapy and rehabilitation center Calicut (Kerala), IQRAA international hospital and research center Calicut (Kerala) and IQRAA community clinic Kallayi, Calicut (Kerala). Sample size was 30. Convenient sampling method was used.

Inclusion criteria were Sub-acute stroke, 45 – 60 age group, Brunstorm stage > 2, capability to dofollow step by stepinstruction, sit unsupported and stand with 1 person assisting), hemiparesis of less than 3 months resulting from first stroke, Ability to understand the commands and response. Exclusion criteria were persons who had suffered a hemi spatial neglect,other neurological disorder such as Parkinsonand patient who uses assistive devices, presence of significant medical complication. Participants enrolled in the study research programmeafter the initial assessment and fulfilled the inclusion and exclusion criteria.

PROCEDURE

30 participants with sub-acute stroke were randomly selected and assigned equally into 2 groups. Group A received circuit class Training (CCT) and Group B conventional training. Treatment procedures were described to the patient and written consent was acquired from them. Gait parameters were assessed as outcome measure before and after 3 weeks of interventions with 6MWT; DGI and quality of life were assessed using SS-QOL.
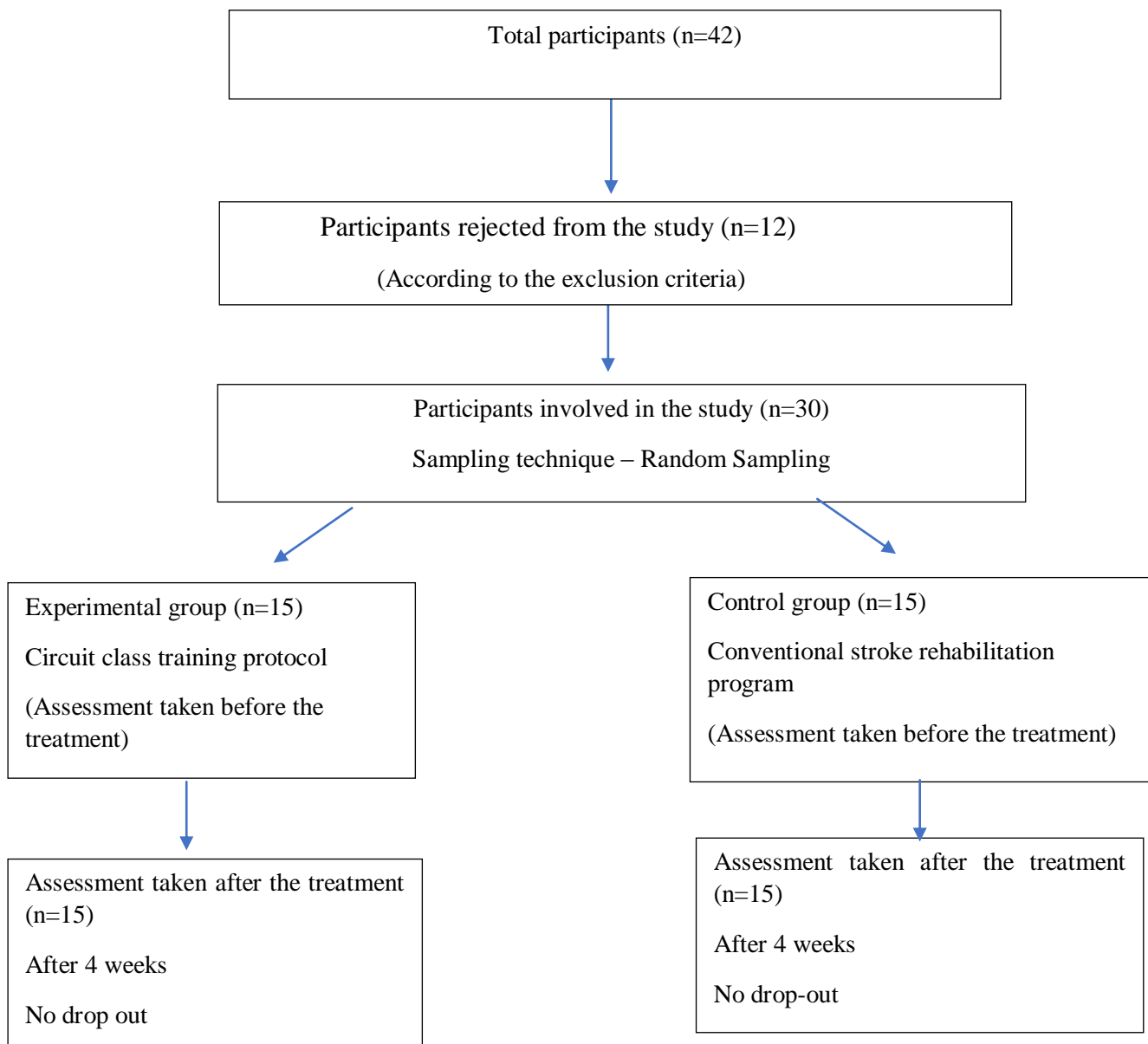
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┌─────────────────────────────────────────────────────┐
│              Total participants (n=42)               │
└─────────────────────────────────────────────────────┘
                          ↓
┌─────────────────────────────────────────────────────┐
│      Participants rejected from the study (n=12)     │
│                                                      │
│           (According to the exclusion criteria)      │
└─────────────────────────────────────────────────────┘
                          ↓
┌─────────────────────────────────────────────────────┐
│      Participants involved in the study (n=30)       │
│                                                      │
│           Sampling technique – Random Sampling       │
└─────────────────────────────────────────────────────┘
           ↓                              ↓
┌──────────────────────────┐  ┌──────────────────────────┐
│ Experimental group (n=15)│  │ Control group (n=15)     │
│                          │  │                          │
│ Circuit class training   │  │ Conventional stroke      │
│ protocol                 │  │ rehabilitation program   │
│                          │  │                          │
│ (Assessment taken before │  │ (Assessment taken before │
│ the treatment)           │  │ the treatment)           │
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           ↓                              ↓
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│ Assessment taken after   │  │ Assessment taken after   │
│ the treatment (n=15)     │  │ the treatment (n=15)     │
│                          │  │                          │
│ After 4 weeks            │  │ After 4 weeks            │
│                          │  │                          │
│ No drop out              │  │ No drop-out              │
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Fig 1.0 Flow diagram showing the participants selection

Protocol for circuit class training

Circuit class training participants underwent exercise for four weeks. In a week 3 times they did the exercises. Each exercise session comprises1 hour and completedexercises for improving the activities of daily living.[11]

The exercise protocol for circuit class training shown below.

Lower extremity exercises

- Step raises in forward and lateral aspects.
- Quadriceps eccentric exercises using steps.
- Toe standing, either in normal surface or aboveblocks.
- Hamstring exercises in seated position.
- Gastro- Soleus muscle stretching in standing
- Bicycle ergometer

- Sit to stand exercises from different surfaces. As a progression therapist can ask the patient to keep the unaffected leg over steps.
- Step ups- and step down over stairs.

Exercises during sitting and walking
- Walking inside the department (forward, backward and sideways).
- Walking outside the department (normal terrain, uneven surfaces).
- Treadmill walking.
- Stair climbing up and coming down.
- Obstacle walking.
- Putting down and picking up objects from the surfaces.

Postural control exercises in standing
- Reaching activities in different stance (feet together and feet apart).
- Touching objects with feet, alternatively.
- Ball throwing and catching.
- Single- leg standing.
- Heel walking or toe walking (braiding).
- Stepping grid.

Figure: 1.0 treadmill training as a part of circuit class training

Fig 1.1: lower limb reaching activities

Fig 1.2: stepping up and down activities

Conventional exercise therapy protocol

The conventional therapy exercises was executed using task oriented exercises (these exercises includes strengthening exercises and balance exercises, and exercises improve activities of daily living). The treatment protocol was based on NDT principles. Participants in this group performed exercises for 30 minutes a day, 5 to 6 days per week, over a period of 4 weeks, for a total of 22-24 sessions[12].

RESULT

SPSS 20.0 version were used for analyzing the statistical data. The master chart was prepared in Microsoft Excel spreadsheet and the statistical analysis was done Both Group A and Group B participants accomplished the wholeexercises in the treatmentperiod.The normality of the samples was checked using Kolmogorov- Smirnov test was used.

Independent sample t test was used as a parametric test to analyze the inter-group significance.

Paired t- test was used for measuring the treatment effect before and after the treatment. The outcome measures- 6 MWT, DGI, and SSQOL.

Graph 1.0: graphical representation of subject's gender wise demographic data
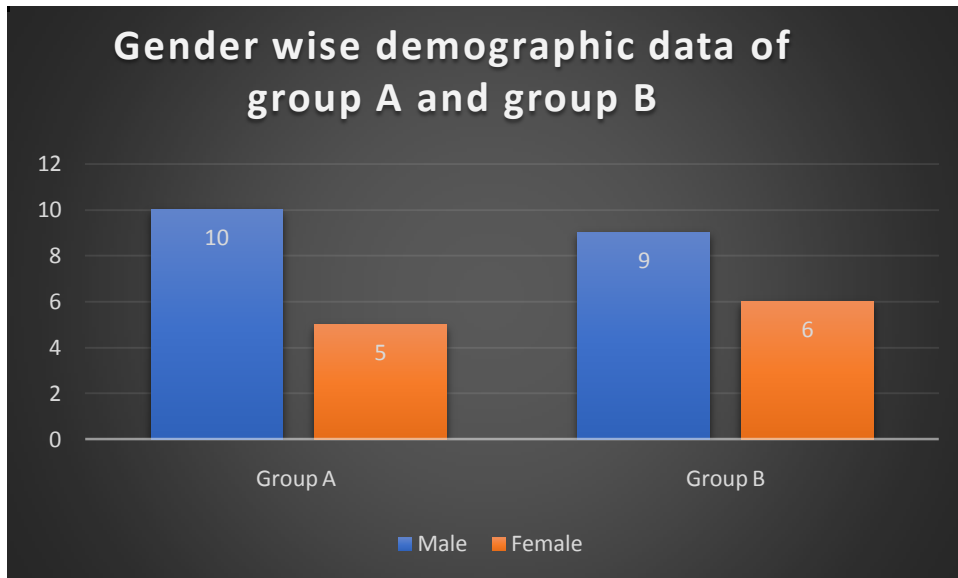
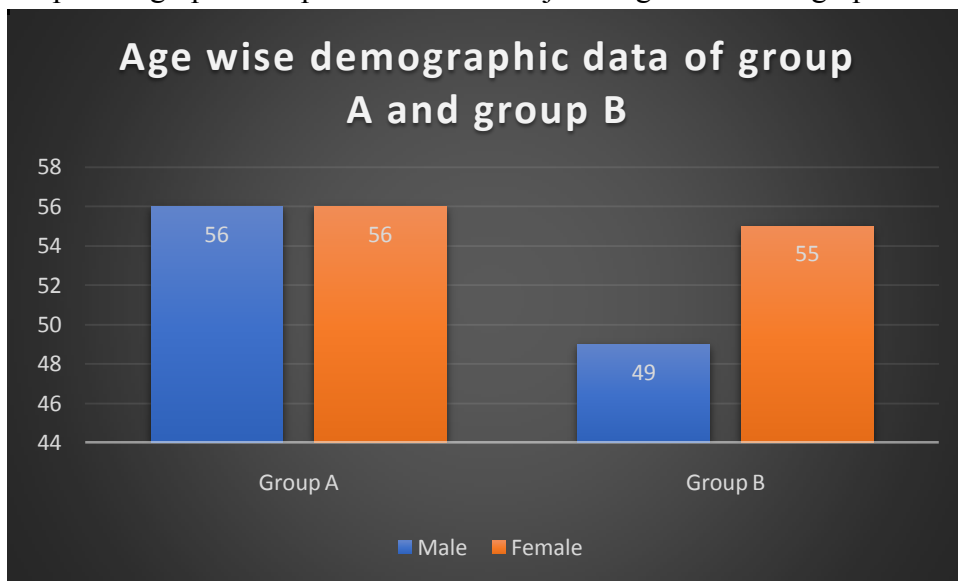Graph 1.1: graphical representation of subject's age wise demographic data

Table 1.1: measurement of mean value of outcome measures in circuit class training group (before and after the treatment).

Parameters	No. of samples	Mean value	S.D	T Value	P Value
Pre DGI	15	18.87	.915		.
Post DGI	15	21.9333	.884	-26.050	0.00
Pre 6- minute walk test	15	176.07	16.757		
Post 6- minute walk test	15	419.73	50.063	-17.874	0.00

Pre- SSQL	15	93.27	5.496	-4.657	0.00
Post- SSQL	15	130.200	29.207		

DGI: dynamic gait index, SSQL- Stroke specific quality of life

Table 1.2: Measurement of mean value of outcome measures in conventional therapy group (before and after the treatment).

Parameters	No. of Samples	Mean value	S.D	T Value	P Value
Pre DGI	15	17.93	.961	-26.060	.00
Post DGI	15	19.20	1.014		
Pre 6- minute walk test	15	178.00	9.118	-17.874	.000
Post 6- minute walk test	15	357.80	37.963		
Pre- SSQL	15	93.73	7.025	-17.563	.00
Post- SSQL	15	125.73	14.993		

Byassessing the means of posttest variables of CCT and conventional exercise programme, the values reveals there is no remarkable variancebetweenCCT and group conventional therapy.

Altogether resultbased on the research were investigatedand that reveals a remarkable enhancementamong circuit class intervention and conventional exercises. It is very relevant to notify that all parameters in participants among two groups,by comparingbefore and aftermeasurements two groups shown remarkable enhancement.

DISCUSSION

Purpose of our experimentation is to analyses thebenefits of circuit class exercises and convention exercise programme on gait parameters and quality of life among sub-acute stroke population.

Results of this research revealnotablevariation in both circuit class exercises and conventional exercise therapy programme in before and after treatment session, but effects of the study not showing any superiority to both the interventions.

In this research we have incorporated circuit class exercises (group A) and conventional exercise therapy group (group B) and these two are favorable techniques in treating gait parameters. So in this research we desired to differentiate between circuit class exercise and conventional exercise protocol in ameliorating gait parameters and we ought to checktherange of these interventions to produce ambulatory changes in stroke populations.

According to S.M Kim et al [2016] Circuit class training Programme is effective in gait of sub-acute stroke patients. FMA-LL, 6 MWT and Barthel index shows a significant improvement that indicates p<0.001. In our study the circuit class training and conventional exercise therapy protocol is used to enhance the gait parameters of sub-acute stroke patients and our DGI and 6 MWT shows values shows p<0.05 and this evident that circuit class training is much effective in sub-acute stroke patients with gait impairments.

The results of the current study are in line with the study of English et al [2009]. Similar circuit class training protocols was used. But the circuit class training from the current study is different because the treatment was given to sub-acute stroke patients who were capable of executing sit to stand training but

in English et al study the patient should able to walk minimum of 10 meter. $p < 0.05$, which supports that virtual reality training facilitates the functional recovery of the upper limb and it is also a valid tool for the stroke rehabilitation.

The possible neuro physiological mechanism that improves the gait in stroke subjects while treating with circuit class training are inherently designed to provide rich feedback through different environment. The intrinsic motor learning capacities may be compromised by the stroke therefore, even though it could be hypothesized that extrinsic feedback may have make easy the functioning. Along with the above points, intensified stimulation and participationowing to different environment of these exercises provides the mutual simulations and may have also contributed to the added benefits of circuit class training. This suggests that circuit class training can be a majoraid in exercises in stroke subjects, because the different task and different environment given by this exercises can regulate a neural network in the motor, premotor, and parietal cortex. This proposes that sensory feedback can facilitate cortical reorganization. Circuit class training generates patient specific motor training as well as repetitive training and it has been postulated to create the physiological basis of motor learning.

According to the results of the statistical analysis, it is suggested that the upcoming studies can be modified to accommodate the following changes.

1. Long term follow up study to evaluate the long-lasting effect.
2. To increase the efficacy of the treatment, study sample can be made bigger than this study.
3. Both dominant side and non-dominant side may be included to find the effectiveness of the techniques.
4. Blinded studies will prevent human bias.

CONCLUSION

In this study, both circuit class training and conventional exercise therapy shows an improvement in gait parameters in subjects with sub-acute stroke patients. With reference to the statistical analysis and interpretation, it was noted that both circuit class training and conventional exercise therapy has greater effect in improving gait parameters in subjects with sub-acute stroke.

Therefore, the study concludes that,

"**Circuit class training and conventional exercise programme has similar effects on gait parameters and quality of life in subjects with sub-acute stroke.**

Conflict of interest

The authors established that there is no conflict of interest within the scope of interest in the manuscript.

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