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A STUDY ON FORWARD WALKING VERSUS BACKWARD WALKING ON BALANCE AND MOBILITY IN MCA STROKE SUBJECTS

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ABSTRACT

Background and Objectives: Stroke patients have characteristic walking patterns showing long gait cycles, low walking speeds, differences in stride length between the affected side step length and the unaffected side step length, and short stance phases and relatively long swing phases on the affected side Post stroke, rehabilitation efforts place little emphasis on walking adaptability (backward walking) and instead focus on forward steady-state walking (i.e. Walking uninterrupted in a straight line on a flat surface). Given the mobility challenges experienced by adult's post-stroke, greater attention to walking adaptability is needed. Hence, study focuses on efficacy of Forward Walking versus Backward walking on Balance and mobility Post MCA–Stroke patients. **Methods:** 30 subjects having difficulty in maintain balance and walking and who have full filled with the inclusion criteria were randomly assigned into Group A and B with 15 subjects in each group. Group A subjects are treated with Forward Walking regime and Group B subjects are treated with Backward Walking regime for 6 weeks. The outcome of this intervention was measured with Functional Independent Measure and Berg Balance Scale, these recorded before and after the session of 6 weeks of intervention. **Results:** Statistical analysis of the data revealed that the scores from FIM and BBS analysis of the pre score and post score intervention shows a significant improvement in Backward Group (Group B) compared to Forward Walking Group (Group A) by using Paired t test analysis. **Conclusion:** Finally, the study concluded that 6 weeks of training program with backward regime exercises has shown better improvement in maintain the balance and walking ability in the MCA stroke individuals by using FIM and BBS measurement.

KEYWORDS: MCA Stroke, Forward and Backward Walking, Balance, Gait.

INTRODUCTION

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". Stroke is a sudden loss of neurological function caused by an interruption of blood flow to the brain.[1]

Incidence of stroke increases dramatically with age, doubling every decade after 55. The cumulative incidence of stroke ranged from105 to152/100,000 persons per year, and the crude prevalence of stroke ranged from 44.29 to 559/100,000 persons in different parts of the country during the past decade in our country.[2]

Impairments of motor control and subsequent functional limitations in ambulation ability are among the most common manifestations of stroke. Residual deficits in balance also persist with a 73% incidence of falls in the first 6 months following hospital discharge among individuals with mild to moderate impairment.[3]

Stroke patients have characteristic walking patterns showing long gait cycles, low walking speeds, differences in stride length between the affected side step length and the unaffected side step length, and short stance phases and relatively long swing phases on the affectedside.[4]

The recovery of walking ability is an important element for the improvement of quality of life and the achievement of functional independence in daily life, and is one of the most important goals not only for patients, but also fortherapists.[5]

Balance is one of the main components which are compromised following stroke leading to an increased to risk of falls. Balance is diminished in people with weakness. Symmetry of weight bearing is also impaired following stroke. With patients bearing as much as 61-

80% of their body weight through their non-paretic extremity. In addition, stroke can cause a reduction in patient's limits of stability which is defined as the maximum distance that an individual can shift his or her weight in any direction without loss of balance. Another important component which is compromised to a large extent following stroke is mobility.

Balance and mobility is significant factor that influences the patient's chances of returning to pre morbid environment. Due to diminished velocity in hemiplegic gait it affects functional implications. The slow walking velocity attributes to reduced joint movements, step length as well as poor balance.[6]

Forward walking and backward walking has been increasingly used as a treatment technique for individuals with neurological impairments. Forward walking consists of heel contact to toe off, which means that forward walking and backward walking(heel-off) had opposite contact positions (toe or heel). Patients walking forwards is critical to planning because of these abnormalities arise as a result of impairments inflexibility strength, movement control, coordination and balance.

During forward walking focus is on moving out of synergy by combining hip and knee extension with hip abduction.[7]
Backward walking is similar to forward walking (FW) in many features, but the task demands and neural control of Backward Walking are generally different than those for Forward walking. Backward walking is a movement that involves conscious extension of the hip joint when stepping backward, which is different from forward walking.

Backward walking consists of (1) toe-contact to heel-off (2) toe-contact to toe-off. The moment of the toe-off pattern were smaller than those of the heel-off pattern. Walking backwards focus is on moving out of synergy by combining hip extensors with knee flexors. Backward walking training consisted of backward walking over ground without use of assistive devices to promote optimal posture, weight bearing through the lower limbs and lower limb motor recovery. Perform continuous backward walking with increased cadence and / or step length as well as overall distance, while maintaining balance.[8]

The Berg Balance Scale (BBS) provides a quantitative assessment of balance and It was intended for use in monitoring the clinical status of patients or effectiveness of treatment interventions overtime. FIM is used to assess a patient's level of mobility as well as change in patient status in response to rehabilitation or medical intervention.

Walking impairment after a stroke is primarily due to the loss of adequate lower extremity function and is a significant cause of disability, with nearly two-thirds of stroke survivors having significant limitations in walking. This impairment results are nan increased risk for falls, fractures and a progressive decline in mobility. With the increasing survival rate after stroke, walking impairment is becoming an even greater public health issue. Hence, novel neuro rehabilitative approaches are needed to improve the potential of walking recovery after stroke.[9]

In general, forward walking is widely performed method of training, some studies have recently investigated the effects on stroke patients of backward walking Nadeau et al.7 reported that backward walking and forward walking have different exercise physiological characteristics and that the temporo-spatial characteristics of backward walking could increase the frequency and endurance for walking.[10]

AIM OF THE STUDY

Aim of the study is to compare the effects of forward walking versus backward walking on balance and mobility in subjects with MCA stroke.

OBJECTIVES OF THE STUDY

- To determine the effects of forward walking on balance and mobility in MCA stroke subjects.
- To determine the effects of backward walking on balance and mobility in MCA stroke subjects.
- To compare the effectiveness of forward waking and backward walking on balance and mobility in MCA stroke subjects.

MATERIALS AND METHODOLOGY

STUDY SETTING: outpatient department of Sims College of physiotherapy, Guntur
STUDY DESIGN: comparative study
STUDY DURATION: 1year
TREATMENT DURATION: 3 Sessions per week for 6 weeks
SAMPLING METHOD: simple random sampling method
SAMPLE SIZE: 30subjects
Group- A treatment: 15 subjects - Forward waking
Group- B treatment: 15 subjects - Backward walking

MATERIALS USED

- parallel bars
- stool
- couch
- consent form

CRITERIA FOR SELECTION

INCLUSION CRITERIA

- Patients with MCA stroke with a history of 6months.
- Stroke patients with age: 45-65years
- Gender: both male and female
- Side involved: both right or left

- Patient who were capable of independent walking without aids a minimum distance of10m. Patients who were willing to cooperate.

EXCLUSION CRITERIA

- Medical conditions contraindications to perform intensive training (such as Cardio Vascular diseases)
- Homonymous hemi-anopia
- Contractures of the lower limb
- Any cognitive or sensory deficits
- Recurrent stroke
- Subjects with rheumatic or orthopaedic disorders.

OUTCOME MEASURES

Balance - Berg Balance Scale(BBS)

- The Berg Balance Scale (BBS) provides a quantitative assessment of balance in older adults created by Berg 1989. It was intended for use in monitoring the clinical status of patients or effectiveness of treatment interventions overtime.

Mobility ---- Functional independence measure scale (FIM)

- FIM is used to assess a patient's level of mobility as well as change in patient status in response to rehabilitation or medical intervention.

PROCEDURE

Subjects of age group 45-65 years will be taken for this study those who fulfilled the inclusion criteria. Informed consent will be obtained from all the subjects. All the subjects will be assessed for their balance and mobility by berg balance scale (BBS) and functional independence measure scale (FIM) before the treatment and the data is recorded. All the participants in the study (forward walking and backward walking group) underwent stretching exercises as a warmup exercises along with their respective treatment approach.

GROUP –A (FORWARD WALKING)

The subjects in the Group A received forward walking (FW) treatment for 40 minutes, 3 times a week for 6 weeks. The subjects are given forward walking. Patients walking forwards manual assistance can be provided by trainers to normalize gait in the presence of muscle weakness and impaired balance. One therapist provides manual assistance to foot placement during stepping movements of the weaker lower extremity while a second therapist stands behind the patient and provides manual assistance to pelvic rotation movements.

GROUP –B (BACKWARD WALKING)

The subjects in Group B received backward walking (BW) for 40 minutes, 3 times a week for 6 weeks. First, the subject is asked to take step backward within parallel bars. The subject was told to take support with the unaffected hand if required. The therapist provides assistance to move the subject's leg in the correct position.

Assistance was provided to move the subject's leg in correct pattern, preventing the subject from moving the leg back in full extension. When the subject started mastering the movement in correct pattern the amount of assistance was gradually reduced.

Following this, the subject was asked to perform backward walking within in parallel bars. After the subject was able to perform that with minimum possible support, the subject is asked to walk backward actively away from the parallel bars. Constant supervision was given to prevent the subject from any falls. Finally, when the subject is comfortable with backward walking, the distance and speed of walking is progressively increased. All backward walking training session were performed by physiotherapist and the duration of Treatment is 40minutes therapy session with the Frequency of 3 days in a week for 6 weeks.[11]

STATISTICAL ANALYSIS

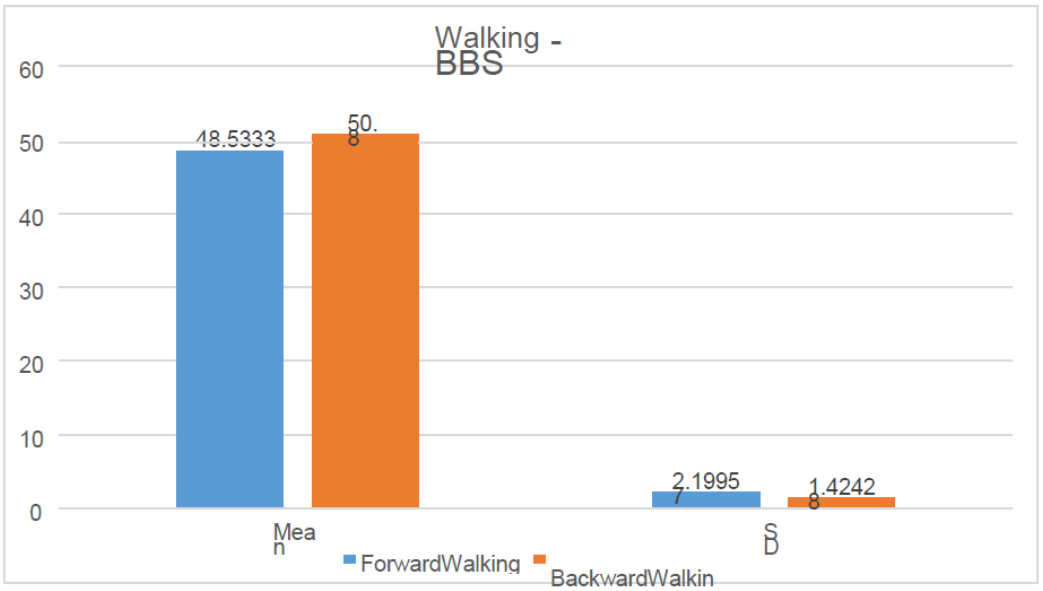
Statistical analysis was performed using MS excel. The demographic data like standard deviation and mean difference percentage were calculated and presented. To observe the treatment impact before and after the treatment in the group. The analysis was carried out using statistical tests, for the outcomes measures with BBS and FIM.

The statistical significance was set at $P< 0.05$ with 94% confidence intervals.

A total of 30 subjects who met the inclusion criteria have undergone baseline assessment and included subjects were randomized into two group consisting15 subjects in group-A and 15 subjects in Group-B.

Table 1: comparison between group A and group B post-test mean scores of BBS.

GROUP	N	Mean	Standard Deviation	P value	Inference
Forward Walking	15	48.5333	2.19957	0.002	Highly Significant
Backward Walking	15	50.8000	1.42428		



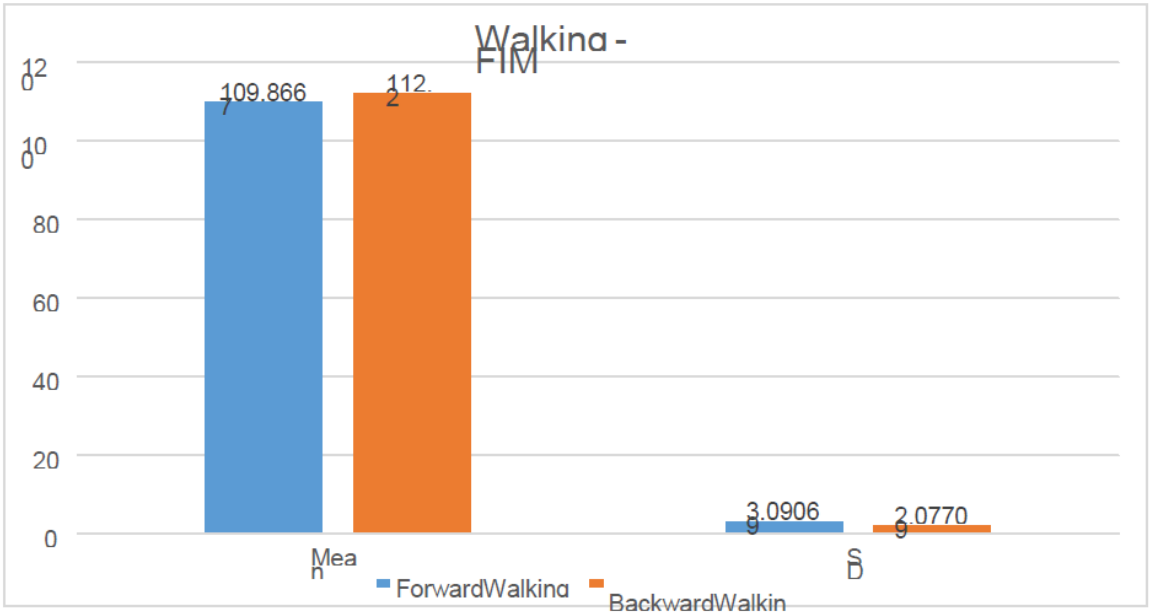
Graph 1: BBS Walking.

RESULTS

The above table and graph shows mean values changes within the group A and group B from post-test in BBS were found to be statistically significant (P<0.002).

Table 2: comparison between group A and group B post-test mean scores of FIM

GROUP	N	Mean	StandardDeviation	P value	Inference
Forward Walking	15	109.8667	3.09069	0.022	Highly Significant
Backward Walking	15	112.2000	2.07709		



Graph 6: Fim.

Results: the above table and graph shows mean values changes within the group A and group B from post-test in FIM were found to be statistically significant (p<0.022).

DISCUSSION

Forward Walking and Backward Walking training in improving Balance and Mobility in subjects with MCA stroke, 30 participants of age 45-65 with Balance and Functional Independence impairment based on BBS and FIM were recruited in this study. Participants were

initially assessed by BBS and FIM were been evaluated for baseline comparison and as PRE test data on 1st day of treatment session, each participant were underwent for 40 mins 1 sessions per day 3 times per week for 3 weeks, 6 weeks treatment duration of Walking training using Forward Walking in Forward walking group and Backward walking training in Backward walking Group.

This study shows that, there was a significant improvement of Balance and Mobility by Forward and Backward walking training in Forward and Backward Walking groups respectively based on BBS and FIM measurement. Backward walking group shows that, there was a significant improvement of Balance on BBS measurement after the Backward walking training, that is BBS Mean Data is increased from **36.1333 to 50.8000** and p value of **0.00** on Paired t test statistical Analysis which is highly significant. Along with BBS data, FIM Measurement also shows significant improvement, that is FIM Mean data of Backward walking group is increased from 90.9333 to 112.2000 and p value of **0.00** on Paired t test statistical Analysis which is highly significant.

This results of improvement were similar to the work done by K. Balasubramanian et al 2019 using Backward walking training in quantifying and comparing dynamic balance in post- stroke individuals.[12,13]

Comparison of forward walking and backward walking on balance and mobility in stroke patients. During backward walking the same motor program is used as during forward walking, but requires approximately double muscle activity compared to forward walking. Backward walking offers more benefits than forward walking alone backward walking creates more muscle activity in proportion to effort than forward walking. This suggests greater level of energy expenditure in backward walking than forward walking. Compared to forward walking, there is increased cadence and decreased stride length in backward walking. Walking speed and stride length were lower in backward walking than in forward walking. Peak hip extension was significantly lower in backward walking and peak hip flexion movement, knee extension movement, ankle dorsi flexion, and plantar flexion movements were lower in backward walking than forward walking. EMG studies comparing the muscle contraction of lower limbs (biceps femoris, vastus lateralis, and rectus femoris) on backward walking and forward walking found that the EMG activity tend to be higher in backward gait than forward gait. Backward walking leads to an increase in dorsiflexion ROM, increase pelvic mobility, increase knee extensor strength.[14]

This study was also similar to the study done by Misato Makino et al 2017 using backward walking training in improving mobility in post stroke individuals focusing on moments of the paretic side, walking speed, stride length, and cadence.[15]

Kinematic analysis of backward walking provides evidence that lower extremity muscle activity and doriflexion ROM is greater during backward walking. Training an individual backward provides adaptability which improves neuro muscular efficiency. A study done by yang, et al. found that program of backward walking significantly increases gait speed, step length, stride length in a group of individuals with hemiparesis as result of stroke.[16]

On the other hand, improvement of Balance was more significantly improved in Backward walking group compared to Forward walking group, that is Levene Test for Equality of Variance Stating that Backward walking is superior to Forward walking group. This results were similar to the work done by Ze-Hua Chen and Xiang-Ling Ye et al 2020 who had conducted systematic review and meta-analysis of randomized controlled trials to determine the effect of BW training on patients with stroke.[17]

Supporting with previous literature and from the results of this study, we found that Balance is also found greatly improved by Backward walking training, with a possible mechanism of no visual cue and relaying with higher concentration of the surroundings with kinesthetic sense, protective reflex and neuromuscular control to meet the need thereby balance and mobility was greatly enhanced.[18,19]

We will now support that backward walking considered as plausible effective alternative to forward walking in order to improve balance and mobility in post stroke subjects.

CONCLUSION

Individuals in this study participated in 6 weeks' intervention period which focuses on efficacy of Forward Walking versus Backward walking on Balance and mobility Post MCA –Stroke patients. Both the groups show significant improvement on balance and mobility in stroke subjects but backward walking training shows more improvement than forward walking on balance and mobility function on BBS and FIM measurement in stroke subjects.

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