

Effect of AFO (Hinged) with Quadripod on Physiological Cost Index and Balance in Hemiparetic Patients

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ABSTRACT

Objectives – To determine the effect of AFO with quadripod on physiological cost index and balance on hemiparesis patients.

Study Design - Prospective randomized parallel group design, Pre-post experimental study design.

Setting- Pt. Deendayal Upadhyaya National Institute for the Persons with Physical Disabilities, (PDUNIPPD), 4 Vishnu Digambar Marg, New Delhi-04

Participants- The subjects (60) who fulfilled the inclusion criteria were participated in the study and the informed consent were taken from subjects. 60 subjects (27 male and 33 female) were evaluated for the study.

Interventions- Hinged AFO with Quadripod

Main Outcome Measures -The outcome measures were Physiological cost index and balance (TUG test).

Result- A paired t-test was used to compared the difference between the Post test data of TUG test and PCI to identify changes on balance and physiological cost index while using quadripod and AFO with quadripod. There were significant difference shown on energy expenditure measured by PCI (t-value= 10.383, p=0.000)and balance measured by TUG test for both the interventions shows significant difference (t-value= 23.618, p=0.000) .

Conclusions- A Quadripod and AFO together improve walking balance and reduce physiological cost index post stroke in hemiparesis subjects, but only the immediate effects had been examined. The effects and acceptability of long-term usage need to be evaluated.

Keywords - Hemiparesis, physiological cost index, Quadripod, TUG test, AFO, Balance

INTRODUCTION

Stroke (cerebrovascular accident) is one of the main causes of mortality throughout the world [1]. Stroke is a major cause of death and disability worldwide [8]. Cerebrovascular accident (CVA) is the leading cause of serious, long-term

disability among adults. Each year in the United States approximately 795,000 people sustain a new or recurrent CVA and nearly half survive with some level of neurological impairment and disability [5]. CVA often results in dysfunction of one side of the body (hemiparesis) leading to gait

impairment and increased probability for fall [2]. Developing countries like India are facing a double burden of communicable and non-communicable diseases where stroke is one of the leading causes of death and disability [3], [7].

The estimated adjusted prevalence rate of stroke range 84-262/100,000 in rural and 334-424/100,000 in urban areas [4]. Compared to men, women had substantially higher age-adjusted prevalence rate (due to stress, depression and tension) (564/100,000 for women versus 196/100,000 for men) and incidence rate (204/100,000 for women versus 36/100,000 for men) for all age groups except for people aged 50-69 years [3]. Most strokes (88%) are ischemic events, including thrombosis (50%), embolism (30%), and decreased systemic perfusion (8%), while other etiologies include intra cerebral hemorrhage (9%) and subarachnoid hemorrhage (3%). [3] According to WHO estimates, 15 million people suffer strokes each year, and five million are left permanently disabled [6], [10]

AIM:-

To determine the effects of AFO with quadripod on physiological cost index and balance in hemiparesis subjects.

OBJECTIVES:-

- 1) To check the physiological cost index of the subjects with AFO and quadripod during walking.
- 2) To check the balance of the subjects with AFO and quadripod during walking.

HYPOTHESIS: - There will be significant difference on physiological cost index and balance in hemiparesis patients while using quadripod and AFO with quadripod.

NULL HYPOTHESIS:- There will be no significant difference on energy expenditure and balance in hemiplegic patients while using quadripod and AFO with quadripod

Although there are several studies available regarding the effects of cane and

AFO on hemiplegic patients but very less number of studies has shown the effect on energy expenditure and balance while using quadripod and AFO together. So the aim of this study is to investigate the immediate effect of two alternatives quadripod and AFO with quadripod on the balance and energy expenditure on hemiplegic patients. If the hypothesis is found to be true, then we can educate the patients specifically about the differences in balance and PCI with and without the AFO. This research could benefit many different realms of patient care. Clinically, physical therapists could also utilize this information when implementing balance related activities.

MATERIAL AND METHODS-

- **Study Design:-** prospective randomized parallel group design, Pre-post experimental study design
- **Inclusion Criteria:-**
 - Patients with hemiparesis
 - Both male and female Patient can able to walk 6m with quadripod
 - Age group 35-70 years
 - 3-6 months of post cerebrovascular accident (CVA)
 - Minimum 8-10 ° of dorsiflexion in affected ankle joint.
 - Modified Ashworth scale score range (ankle dorsiflexors) -0-2
 - Modified Ashworth scale score range (for ankle planterflexors)-0-3
- **Exclusion Criteria:-**
 - Subjects with no other musculoskeletal pathology and fixed contractures
 - MR and multiple disorders.
 - Subjects with any other surgical intervention in lower limb extremity.
 - Patients had gross visual-spatial or visual field deficits and had medical contraindications to walking

PROTOCOL

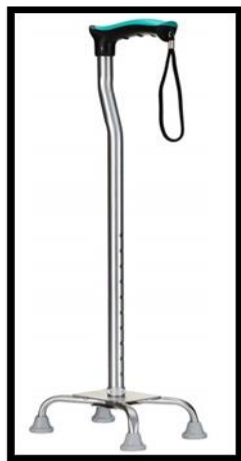
A sample of 60 persons with hemiparesis (stroke) took part in the study.

They were selected according to the inclusion and exclusion criteria. Demographic data of the persons were collected in the demographic data collection form. This includes name, age, sex, height, weight and address (Table 1).

PROCEDURE-

A total of 60 persons with hemiparesis (stroke) took part in this study. Demographic data of the subjects were collected in the demographic data form. Then the subject data were collected with quadripod. Person was initially allowed to sit at rest in a chair, located near the starting position, for at least 10 minutes before the

test starts. Then Resting Heart Rate (RHR) was taken by digital heart rate monitor. Then the subject was asked to walk in a walking course of 60 meter in length for six minutes with the quadripod. Then post-test measurements of Walking Heart Rate (WHR), Walking Distance (WD) and TUG score were taken. Then Walking Speed (WS) and Physiological Cost Index (PCI) were calculated. Then the same procedure was followed with the same subject using intervention of Hinged AFO and measurements were taken accordingly. During the total procedure a researcher was present along with the subjects to ensure safety.



STATISTICAL ANALYSIS

The Data was managed on an excel spread sheet and was analyzed using the SPSS software (version 23). Descriptive Statistics (Means and Standard Deviation) were computed for variable. The outcome variables used for analysis of Physiological cost index and balance. A paired t-test was used to analyze the difference between the pre and post intervention test data of balance and Physiological cost index to identify changes in balance and physiological cost index with use of quadripod and hinged AFO.

A significant level of $P < 0.05$ was fixed.

RESULT

Table – 1: Demographic Data of Age, Height and Weight (N=10)

Person Characteristics		N	Mean+SD
Age	Male	27	56.926+5.076
	Female	33	57.606+5.244
	Total	60	57.300+5.136
Height	Male	27	167.815+8.901
	Female	33	160.273+7.225
	Total	60	163.667+8.806
Weight	Male	27	61.926+8.783
	Female	33	54.242+5.220
	Total	60	57.700+7.977

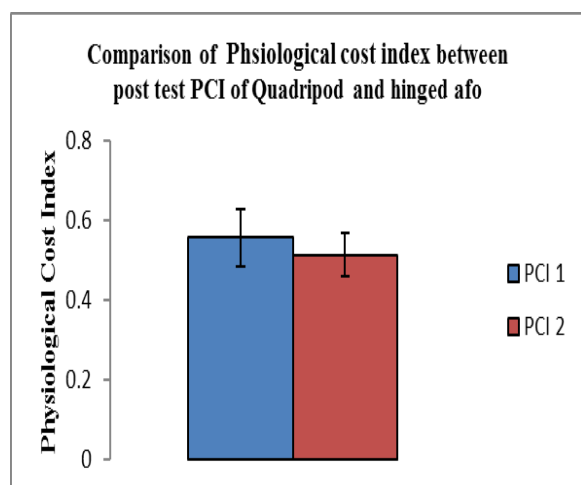
N- Total Number of Persons, Age- Years, Height- Centimeter, Weight- Kilogram, SD- Standard Deviation

A total 60 persons with Hemiplegia were participated in the study. Their age, height and weight were recorded. (Table1) represents the details of the mean and standard deviation of these scores. Out of the 60 persons who participated in the study, 27 persons were males with mean age

(years) of 56.926+5.076 while 33 females with 57.606+5.244. The mean height (cm) of male person was 167.815+8.901 and of female was 160.273+7.225. The mean weight (kg) of male person was 61.926+8.783 and of female was 54.242+5.220. The descriptive statistics of the demographic data has been given in table 5.1.

Table-2: Comparison of energy expenditure between post-test PCI of Quadripod and AFO, paired t-test, N=60

PCI	Mean+SD	t-value	p-value
PCI1	0.5565+0.07061	10.383**	0.000
PCI2	0.5138+0.05478		



Graph.2 Comparison of Physiological Cost Index

*- Significant at 0.05 level

N- Number of Persons, PCI- Physiological Cost Index, PCI 1- Physiological Cost Index with quadripod, PCI 2- Physiological Cost Index with Quadripod and AFO, SD- Standard Deviation

Table-3: Comparison of Balance between post-test TUG test Score of Quadripod and AFO, paired t-test, N=60

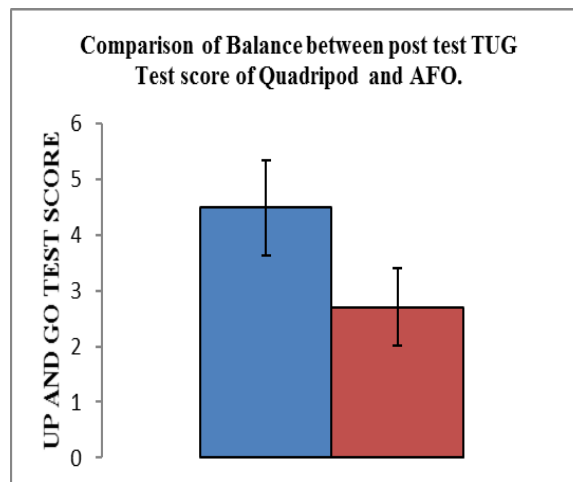
Time up and go test Sore (TUG)	Mean+ SD	t-value	p-value
TUG 1	4.483+0.8535	23.618**	0.000
TUG 2	2.700+0.6962		

**-. Significant at 0.05 level

N- Number of Persons, TUG 1-Time up and go test score with Quadripod, TUG2 2-Time up and go test score with Quadripod and AFO, SD- Standard Deviation

A paired t-test was used to compare the difference between the Post test data of TUG test and PCI to identify changes on balance and physiological cost index while using quadripod and AFO with quadripod. There is significant difference shown on energy expenditure measured by PCI (t-value= 10.383, p=0.000) (table 2) and balance measured by TUG test for both the interventions shows significant difference (t-value= 23.618, p=0.000) (table 3). Thus, it indicates that the person showed

significant reduction in energy expenditure and significant increase in balance while using AFO with quadripod.



Graph.3 -Time Up and Go test for Balance

DISCUSSION

The result of this study shows that energy expenditure of the patients were reduced by giving intervention of Hinged AFO, Upon analyzing the data, several trends were noticed, this may be due the improving walking pattern, and improving the muscle synergy activities , plantarflexors tones etc. One trend was that there was a large variation in performance across the subjects for both balance and physiological cost index test. Another trend perceived was that a learning effect was present for walking with AFO ⁽¹⁶⁾. In each set of three trials, the mean values of the last performance were the best. This demonstrates that as the participants progressed through the test, their performances improved. This Is Indicative of a possible learning effect.

Balance was improved by giving AFO, the possible cause was that AFO provide proper support to the foot, maintains the joint alignment and better muscles assistance as compared to quadripod, but the difference is very significant with some patients because, they will not get enough time to accommodate with the AFO and reduced sensory feedback may also be the point to work on. Logan c et al (1994) shows articulated AFO may have limited the sensory feedback which could

potentially hinder the participant's performances^[5] In contrast, the participants balance was slightly better when wearing their AFOs, possible reason why the subject balance was better with the AFOs was the AFOs gave them more confidence. These subjects were accustomed to wearing the AFOs during activities performance. The articulated AFOs provide additional support to the ankle region. The subjects reported feeling uneasy with the decreased amount of support and were afraid of falling when the AFOs were removed. This observation does not support Gray, Krueger, and Krynicki's study (1993) ^[18]. Their study found that a prefabricated solid AFO significantly hindered dynamic balance in well elderly subjects. This difference in findings could be because the subjects in our study had hemiplegia and were accustomed to wearing the articulated AFOs. When we removed the AFOs, this lack of support was unfamiliar to these subjects. Another difference in these two studies is that the subjects with hemiplegia used hip strategies instead of ankle strategies ^[17]

So, the finding of this research is helpful for the hemiparesis patients and help to provide better prescription criteria for them.

CONCLUSION

The hypothesis that there will be significant difference on physiological cost index and balance in hemiparesis patients while using quadripod and AFO with quadripod is supported by the study. Thus AFO intervention along with quadripod shows significant reduction on PCI and significant increase of balance and it can be concluded that hinged AFO along with quadripod is a better prescription for the persons with hemiparesis.

Limitation Of Study

There are several factors that were not controlled but that could have had a significant effect on the outcome of the study. One factor is that gender may have had an unforeseen effect on the study. Age

could also be a factor because this study included an age range of 45-70 years. This is a large range and could have had an effect on the participant's performances. More research is needed to determine the true effects of an articulated AFO with Quadripod on balance and energy expenditure duration on larger hemiparesis subjects.

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Conflict of Interest: None

Source of Funding: None

Ethical Approval: Approved

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