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Research Article

PATTERN OF WEIGHT DISTRIBUTION IN STANDING IN PATIENTS WITH STROKE AND ITS CORRELATION WITH MULTIDIRECTIONAL REACH

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ABSTRACT

Background: Impaired Postural Control is a key characteristic of the mobility problems in patients with Stroke. This leads to loss of autonomy and puts patients at a significant risk of falling. 70 % patients with stroke are unable to reach sideways to the floor even when seated. However, asymmetry measured in a objective way as a pre requisite to functional loss is unclear. **Aim:** To find out patterns of weight distribution measured using objective tool in standing in patients with stroke and its correlation with multidirectional reach. **Methodology:** It was cross sectional study, 30 patients with Stroke were included. BOBO PRO, balance platform was used to assess patterns of weight distribution. Patients were asked to stand on balance platform and readings were recorded. After that evaluation of postural stability in standing was done by MDRT. **Results:** Patients with stroke bears more weight on unaffected side (68%). On affected side more weight was on hindfoot i.e., 21.53 % out of 31.73 %. No correlation was found between patterns of weight distribution and multidirectional reach. **Conclusion:** Patients with Stroke tend to bear more weight posteriorly on affected side foot. However, weight distribution pattern didn't show any correlation with Multidirectional reach.

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INTRODUCTION

Stroke is the commonest neurological cause of morbidity & mortality all over the world, being the second most frequent cause of death and most frequent cause of permanent disability(1). Impaired Postural Control is a key characteristic of the mobility problems in patients with Stroke and is caused by a complex interaction of motor, sensory, and cognitive deficits(2). Previous studies in patients with Stroke have demonstrated reduced load on the affected lower extremity and increased postural sway during quite standing, delayed or impaired balance responses, and deficits in anticipatory adjustments to perturbations, particularly in the affected leg(3,4). They lead to loss of autonomy and put patients at a significant risk of falling. It is well known that one of the most common standing balance disorders after stroke is the inability to transfer weight to the affected leg while standing(5) Various authors have suggested that symmetry in the sense of even weight distribution is crucial when standing to extend the limits of stability and allow for more effective postural coordination(6,7). Restoration of balance and gait is a therapeutic goal for most patients with stroke(8). Independent

living requires the capacity to maintain balance while reaching for various items at and beyond arm's length(9,10). More than 70% of patients with Stroke who are admitted to rehabilitation are reportedly unable to reach sideways to the floor even when seated. A common goal of physiotherapy for patients with Stroke is to improve trunk control and their ability to take weight through their affected limb(11,12).

Jip Kamphius, 2013; suggested that Weight Bearing Asymmetry (WBA) is common impairment patients with Stroke i.e., they carry disproportionately more weight on non-paretic limb. WBA can be a beneficial method of compensating for reduced accommodative and regulatory activity in the affected leg during quite standing(13). However, it remains to be investigated till what extent, WBA is advantageous for dynamic postural stability, such as when stepping to recover balance after an external perturbation. Some of the authors have mentioned that Weight distribution does not appear to be affected by weight transfer exercises, however there may be some evidence that training for reaching activities might influence postural control and time adjustments in patients with Stroke(14,15). However, the relevance of symmetrical weight

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distribution as a prerequisite for functional tasks is unclear. Hence, the rationale behind focusing on symmetry during quiet standing is therefore unclear, and the following objectives were chosen for this study.

1. To find out patterns of weight distribution in standing in patients with stroke.
2. To assess patient's stability with modified functional reach test (Frt) in patients with stroke.
3. To correlate the patterns of weight distribution in standing with Frt in patients with stroke.

Therefore, the research question for this study was, What is the pattern of weight bearing distribution in patients with stroke Anddoes pattern of weight distribution have any correlation with multidirectional reach?

MATERIALS AND METHODS

Study Design & Setting

It was a cross sectional observational study carried out at Vikhe Patil Memorial Hospital, Ahmednagar, for 6 months.

Participants

The participants for this study were sampled from willing patients receiving inpatient or outpatient Physiotherapy services at the mentioned tertiary care hospital. A purposive sampling was done using eligibility criteria of diagnosed cases of Stroke, ability to stand with without minimal assistance, no visual deficit, for the inclusion and Neurological conditions other than Stroke, history of any surgery related to lower limb, present Musculoskeletal injuries such as fractures, dislocation or any soft tissue injuries on affected side or non-affected side for exclusion. Total 30 samples were included in the study.

Apparatus

BOBO PRO, a computerized interactive proprioceptive platform was used to measure patterns of weight distribution. It includes Balance Board and bobo software. Bobo board has sensors (3 accelerometer) for foot and hand over specific area and power button. Bobo software is inbuilt in tab which contains balance tests. After completion of test, report is generated where percentage of weight distribution on different parts of foot (forefoot & hindfoot), for both legs can be seen in percentage.

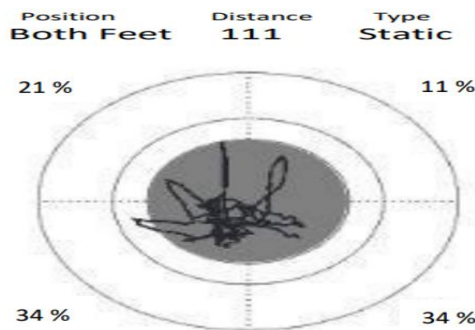


Figure 1 Percentage of weight distribution on Forefoot and Hindfoot of both the legs.

Multidirectional Reach Test(MDRT) was performed to assess Postural Stability, it determines limits of stability in 4 directions, (forward, backward, and both lateral). It measures how far individual can reach, thereby shifting Center of Gravity

(COG) to the limits of Base of Support (BOS) with feet stationary. Scale has good validity and reliability. In present study only forward & lateral reach were included.

Procedure

After obtaining approval from Ethical Committee, participants were recruited. All participants gave written informed consent to participate in the study. At the beginning of the testing session a demonstration was given of the task needed to perform. First MDRT was performed, where patients were asked to stand in upright position with feet shoulder width apart near wall on which yardstick was mounted. Testing consisted of four conditions, each containing three trials as follows.

- (i) Standing with the unaffected side near the wall and leaning forward;
- (ii) Standing with the unaffected side near the wall and leaning backward;
- (iii) Standing with the back to the wall and leaning unaffected side.

After completion of the testing 5 minutes rest interval was given. Patients were then asked to stand on balance board of BOBO PRO, which was kept on firm surface about 1.5-2 cm ht. with eyes looking straight in forward direction. Therapist then ran test which samples for duration of 20 s. Test selected was Static, Double leg stance test. Three trials were taken with 30 second rest interval in between each. Data was recorded in the form of relative amount of weight in two parts of foot, Hindfoot and forefoot, on affected and unaffected leg.

RESULTS AND DISCUSSION

Demographic data were summarized using descriptive statistics and reported as mean and SD.

Pearsons Correlation coefficient was used to determine a relationship between Percentage Weight Bearing and Postural stability.

Table 1 Demographic characteristics and frequency distribution of the Patients with Stroke

N= 30		
Age		45.86 ± (14.53)
Height (cm)		168 ± (8.5)
Weight (kg)		74.06 ± (9.45)
BMI (kg/m²)		28.9 ± 4.2
Gender (M/F)		18 / 12
Dominant side (R/L)		19 / 11
Affected side (R/L)		21 / 9
Type of stroke (H/I)		4/26
Duration of Stroke	7 days-8 months	12
	8 months- 1.5 years	08
	1.5 years -3 years	06
	3 years -4 years	04

Table 2 Distribution of Weight Bearing in different parts of foot, (Forefoot & Hindfoot) on affected and unaffected leg in percentage.

Central	Affected	Unaffected
13.66 ± 2.8 cm	5.73± 1.2 cm	11.8± 2.2 cm

Table 3 Mean & SD of the distance reached in different directions in standing position measured in cm.

		Correlation Coefficient(r)	P Value
Forefoot Affected	Lateral Reach Affected	0.1037	0.7131
	Lateral Reach Unaffected	0.5009	0.0572
	Forward Reach	0.6416	0.0099
Forefoot Unaffected	Lateral Reach Affected	-0.1135	0.6871
	Lateral Reach Unaffected	-0.2447	0.3794
	Forward Reach	0.2537	0.3616
Hindfoot Affected	Lateral Reach Affected	0.1392	0.6209
	Lateral Reach Unaffected	0.5793	0.0236
	Forward Reach	0.4885	0.0647
Hindfoot Unaffected	Lateral Reach Affected	-0.0723	0.7976
	Lateral Reach Unaffected	-0.4842	0.0674
	Forward Reach	-0.7803	0.0006

The study has also focused on weight bearing on different zones of foot, to understand how exactly the patterns of weight distribution in patients with Stroke are. It was found that patients with Stroke have disproportionately maximum weight on hindfoot. Where mean weight bearing on affected forefoot was 10.2% and unaffected forefoot was 16.93 % also mean value of weight bearing in affected hindfoot was 21.8% and unaffected hindfoot was 51.13 %. Nicolas Genthon *et al.*, found the COP was located more backward (about 2 cm) under the loaded paretic limb than under the loaded strong limb (19). An explanation for finding could be that Ankle joints are principally involved in the sagittal stabilization of quiet upright standing. Plantar COP displacements are mainly controlled along by using ankle flexor/extensor muscles. Following Stroke, the co-ordination of these muscle activations is likely to be adversely affected, thereby causing decreased ability for symmetrical weight bearing or shift weight to either limb (20). When looking at postural stability in patients with Stroke, it was found that Mean and Standard Deviation of Multidirectional Reach Test for lateral affected side was 5.73 ± 1.2 cm, lateral unaffected side was 11.8 ± 2.2 cm and forward was 13.66 ± 2.8 cm. Michal Katz-leurer *et al.*, has conducted similar study, their findings for Forward reach was 31.7 ± 7.8 while for affected side was 13.8 ± 3.7 and unaffected side was 15.5 ± 6.8 (21).

The findings for lateral reach (affected and unaffected) are in line with our study, however there is wide deviation in range of central reach. It could be because of reason that in this study patients were asked to perform central reach with affected hand. Crosbie *et al.*, mentioned that patients with Stroke experiences difficulty in maintaining stability when attempts task or any activity. This increases with use of affected side as patient has to focus on task and couldn't perform simultaneous adjustments required for stability (22). Alternatively, stroke patients may be more apprehensive to transfer weight in the forward direction because recovery strategies from this position are more difficult and may require a stepping response (20). Also, according to weight distribution pattern found in our study, with more weight on hindfoot and Center of Pressure (COP) behind body, patients may find it difficult to shift weight in forward direction.

Another objective was to correlate the patterns of weight distribution in standing with FRT in patients with stroke. In our study no correlation was found between WBA and postural stability. Two of earlier cross-sectional studies analyzed the correlation of WBA with measures of postural sway and both reported that greater WBA was associated with more postural sway. (23,24). It could be due to the fact that reaching activities places more demand on adjustment of COP under limits of stability. Siri Tessem *et al.*, found that healthy individuals displaced their COP to the contralateral side of their reaching arm, whereas stroke subjects did not show the same systematic pattern of COP displacement (11). COP displacement during reaching is commonly viewed as a postural orientation; a counterbalancing procedure in response to the reaching arm. It can be said that Lack of correspondence between weight distribution in quiet standing and reduced postural stability during reaching in stroke subjects may indicate problems of anticipation and adjustment of postural orientation in relation to the voluntary action of reaching rather than WBA.

It must be acknowledged that the results of this study were based on a relatively small sample of stroke patients with

DISCUSSION

Primary goal of the study was to find out patterns of weight distribution in standing in patients with stroke and if there is any correlation of WBA and Postural Stability. It was found that majority of patients carried more weight on unaffected side, with mean value of weight bearing on affected side found to be 32% and on unaffected side 72.93% which is similar to the earlier established findings. Chengetanai S. *et al.*, found that an overwhelming majority (95.0%) of the patients carried more weight on the unaffected legs (16). The average percentage difference between the affected and non-affected sides was 20.0%, the mean mass carried by the non-affected limb regardless of the side being involved is 60% while that of the affected side was 40% (10,16). Impaired muscle tone and weakness, are considered primary cause behind the deficit (17). Resulting from musculoskeletal and sensorimotor impairments there is increase in COG displacement also, which reflects postural instability. Apart from these various authors believed that it possibly could be result of learned disuse of affected extremity (18).

specific lesions. Clearly, studies with larger samples and more diverse types of stroke lesions are required to provide relevant data for the wide range of patients with Stroke who undertake rehabilitation. This study has provided a first step in this process, Further work is required to investigate the relationship of patterns of weight distribution and its effect on functional independence, also what could be the reason behind specific patterns of weight distribution seen in patients with Stroke also needs to be investigated.

CONCLUSION

Patients with Stroke tend to bear more weight posteriorly on affected side foot. However, weight distribution pattern didn't show any correlation with Multidirectional reach.

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