CENTER OF PRESSURE TRAJECTORY DURING WHOLE BODY REACHING IN HEMIPLEGIC PATIENTS

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INTRODUCTION

Center of pressure (COP) trajectory is one of the most common methods used to characterize the balance control of both normal subjects and patients with neurological disorders, such as stroke. Voluntary movements, such as targeted reaching, are practical essence for daily function and have been proved to be more effective in challenging and training the balance ability than simulated balance perturbations such as moving platforms [1,2]. Seated reaching for targets in different directions at the level of shoulder height has been shown to affect COP trajectory significantly. Whole body reaching (WBR) requires the subjects to pick up a target on the floor and the target distances were found to affect the movement of COP and activation patterns of postural muscles [3]. The purposes of this study were to compare the performance of WBR with different balance ability and the effects of target distances (10% body height vs 30% body height measured from the midpoint of both big toes) and directions (middle, M; left, L) on COP trajectory as measure by COP path excursion (WTP), COP maximum displacement in frontal (MML and sagittal (MAP) direction.

METHODS

Fifteen normal adults and 23 stroke subjects who fulfilled the inclusion criteria participated in this study. They were instructed to pick up a light weighted bean bag on the floor in two directions (in the middle and to the left or paretic side) at two distances (away from the big toe for 10% and 30% of body height) while standing erectly on RSSCAN pressure mat. A total of 12 trials (3 x 2x 2) were required. The functional reach distance (FR) was also measured as an indicator of balance ability.

The COP trajectory data were normalized (WTP to body height and foot length, MML to foot width, and MAP to body height and foot length) and averaged for statistical analysis. The FR was normalized by body height.

One way analysis of variance was used to compare the difference between normal and hemiplegic subjects. Repeated-measure analysis of variance was used to examine the target location effects. Pearson correlation coefficients were used to examine the performance of WBR for targets at various locations. The statistical significant level was set at α =.05 and all statistical analysis was performed using SPSS 8.0 software package for Windows.

RESULTS AND DISCUSSION

As shown in table 1, FR was different between normal and hemiplegic subjects indicating that baseline balance ability of hemiplegic patients was inferior to the balance control of normal subjects. The significant difference in COP trajectory between groups(Table 1) suggested that control of COP during whole body reaching could be an indicator of level of balance. Descriptive analysis showed that the amount of WTP, MML and MAP was larger in hemiplegic patients than in normal subjects, indicating that hemiplegic patients was not able to shift their COP according to the target location as much as normal subjects did. Targets locations were found to imposed graded dynamic balance challenge for both group [3].

Table 1. Comparison of group differences.

	S of MS	DF	F	P
10MWTP	0.001	1	30.602	**0.000**
MAP	0.003	1	42.147	**0.000**
MML	0.220	1	7.889	**0.008**
30MWTP	0.000	1	16.033	**0.000**
MAP	0.001	1	89.607	**0.000**
MML	0.258	1	6.101	**0.018**
10L WTP	0.002	1	8.075	**0.008**
MAP	0.004	1	41.976	**0.000**
MML	0.227	1	5.736	**0.023**
30LWTP	0.000	1	25.940	**0.000**
MAP	0.001	1	75.414	**0.000**
MML	0.278	1	5.468	**0.025**
FR	0.059	1	30.811	**0.000**

The correlation coefficients between FR and COP trajectory were negative, significant and moderate, indicating that the subjects with shorter FR shifted COP less in both frontal and sagittal directions than subjects with longer FR distance [4]. The correlations between FR and COP trajectory in frontal direction were the lowest indicating that FR might not be able to measure the balance control in frontal direction.

CONCLUSIONS

The results of this study suggested that analysis of COP trajectory during WBR can distinguish subjects with different level of balance ability as measured by FR, indicating that WBR could be a dynamic balance training and evaluation tool for hemiplegic patients. Questioning of FR in measuring balance control in frontal direction [4] was supported by the correlation analysis in this study. Analysis of muscle activation patterns might be valuable for interpretation of balance mechanism.

REFERENCES

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Table 2: Pearson correlation coefficients between FR and parameters during whole body reaching.

	10MWTP	10MAP	10MML	30MWTP	30MAP	30MML	10LWTP	10LMAP	10LMML	30LAWTP	30LMAP	30LMML
FR	**-0.492**	**-0.569**	-0.285	**-0.381**	**-0.579**	-0.231	-0.314	**-0.526**	-0.266	**-0.472**	**-0.554**	-0.118