Developing a tool for objective assessment of trunk balance in people with stroke: A pilot study

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Abstract

Loss of trunk functions following stroke ranks among the major causes of balance impairment and falls. This pilot study was aimed at developing and testing a tool to objectively assess trunk balance in post-stroke individuals..

A total of 20 participants comprising 10 stroke patients from the Murtala Mohammed Specialist Hospital Kano and 10 apparently healthy individuals were recruited into the experimental and control group, respectively. A quasi-experimental study design was used to develop a tool for objective assessment of post-stroke balance.

The tool developed by the researchers was applied to assess the differences in lateral flexion of the affected and non-affected side in stroke patients (experimental group), as compared to the control group. The data obtained was summarized and analyzed using the descriptive statistics of frequency, percentage, mean and standard deviation. Moreover inferential statistics of t-test were applied for comparisons of lateral flexions between the affected and unaffected side of stroke patients and between the control and experimental group.

The mean ages were 45.70 ± 10.97 and 52.60 ± 8.55 for the experimental and control group, respectively. The study results revealed a statistically significant difference in trunk left side flexion between the control group and the affected side in the experimental group. Furthermore, the findings showed a significant difference in trunk right side flexion between the affected and non-affected side in the experimental group ($P<0.005$).

Considering the above,, the tool developed can be used to objectively discriminate between paretic and non-paretic lateral flexions in stroke patients and to determine balance impairment.

Key words: Stroke, balance, trunk, tool development

Introduction

Trunk control is the ability of the trunk muscles to allow the body remain upright, adjust weight shift, and perform selective movements of the trunk so as to maintain the body's centre of mass (COM) within the base of support (BOS) during static and dynamic postural adjustments [1][2]. Trunk control at an early stage associated with good sitting postures could predict the activities of daily living (ADL) outcome at a later stage in patients after stroke [3]. Control of the proximal trunk being the central key point of the body is a prerequisite for movement control to be preceded in order to control distal limb, balance and functional activities [1][2]. Trunk control has been found to be associated with balance and functional ability, functional change as well as destination at discharge and to be a better predictor of functional

outcome at 6 months post-stroke than ADL outcome [4].

Balance is the ability to keep COM within the limits of BOS. Balance is required for the ADL and recovery of the functions lost as a sequel to impairment [5][6]. Balance impairment is common in the population ≥70 years of age and among patients with neurological conditions, such as stroke, hence those at a higher risk of falls [6]. Balance is a common and major factor influencing independence and quality of life after stroke; therefore, interventions to address the impairment in this population are inevitable and remain a major focus of rehabilitation [6]. Assessment of balance impairment in stroke is essential for overall rehabilitation due to its relevance for accurate diagnosis, prognosis, treatment planning and evaluation of change over time [7].

Although there are numerous rating scales to assess several impairments following stroke, the tools that assess balance impairment are limited. Therefore, accurate, reliable and valid balance assessment tools are essential for outcome measurement in stroke-related research and clinical practice. The tools provide additional important information about balance performance following stroke which may not be obtained from clinical tests. Many clinical tests are relatively quick and easy to perform yet they lack sensitivity and provide limited objective information about balance, movement quality and factors required to guide the treatment plan [6]. In this pilot study, an objective tool for the assessment of trunk balance was developed and tested among stroke patients.

Materials and Methods

A total of 20 participants were recruited using convenience sampling , i.e. 10 stroke patients from the Murtala Mohammed Specialist Hospital Kano and 10 apparently healthy individuals assigned into the experimental and the control group,

respectively. A quasi-experimental study design was used to develop a tool for objective assessment of trunk balance in stroke. Ethical approval was sought and obtained; all subjects gave their written informed consent for participation in the study.

A tool developed to assess trunk balance in stroke patients used in this study consisted of an adjustable stand, base for support, and a pair of arms for contact with the shoulders of patients. The other components included a pair of a protractor and a pointer for taking readings. The tool was designed to assess the ability of a stroke patient to laterally flex the trunk to the right or left side of the body as well as instability during such flexions either through compensation, the limited range of movement, upset balance or muscle weakness.

During the procedure, each participant was instructed to sit on a couch with the assessment tool placed behind, the two arms of the tool were aligned to the lateral aspect of the participants' shoulders and the reading on the protractor was set to zero by the pointer. The participants in the experimental group were asked to laterally flex the trunk to the unaffected side and then to the affected side. In the control group, the participants were to flex first to the right side then to the left side and the readings were recorded. The other characteristics of participants of both groups, such as age, gender and the side affected, were obtained and documented.

The data collected were analyzed using the descriptive statistics of frequency, percentage, mean and standard deviation. Moreover, inferential statistics of t-test were used to compare the lateral flexions between the control and the experimental group as well as between the affected and unaffected side in stroke participants.

Results

A total of 20 participants took part in the study and were assigned into 2 groups (experimental

Table 1: Demographic and physical characteristics of participants

Variables	Experimental group	Control group
Age (Years) Mean±SD	52.60±8.55	45.70±10.96
Gender n (%)		
Male	5(50)	5(50)
Female	5(50)	5(50)
Affected side		
Right	5(50)	
Left	5(50)	

n= Frequency, %= Percentage, SD= Standard Deviation

Table 2: Mean intra- and inter-grou differences in lateral flexions among participants

Variable	Control mean±SD	Experimental mean±SD	mean diff (95% CI)	t	df	p-value
TLSF.PS	10.3 (1.583)	3.4(0.52)	-6.9(-8.007-5.793)	-13.1	18	0.001*
TRSF.NPS	10.20(1.378)	6.9(0.876)	3.3(-4.285,-2.216)	6.39	18	0.001*
PS.NPS		3.50±7.07		-15.56	9	0.001*

*significant at p<0.05, SD= standard deviation df= degree of freedom, CI= confidence interval TLSF. PS= trunk left side flexion and paretic side, TLSF.PS= trunk right side flexion and non-paretic side, PS= paretic, NPS =Non-paretic side

and control) comprising 10 stroke patients and 10 apparently healthy individuals, respectively. The mean ages were 45.70±10.97 and 52.60±8.55 for the experimental and control group, respectively; each group contained an equal number of males and females (50%) as shown in table 1.

Discussion

This study focused on developing and testing of an objective tool for the assessment of trunk balance during lateral flexion (right and left) among stroke patients. The lateral flexion of the trunk to the affected side and non-affected side was evaluated in stroke patients (experimental group) and compared with apparently healthy subjects (control group). The study results revealed a statistically significant difference between the left lateral flexion of the trunk in healthy subjects and that of the paretic side of stroke patients; moreover, a statistically significant difference was found between the trunk right lateral flexion in healthy participants and that to the non-paretic side in stroke patients (table 2). Our findings implicate that the tool used was able to discriminate the range of lateral flexion of apparently healthy individuals and stroke patients as well as to differentiate between the paretic and non-paretic side of stroke patients. Considering the above, the tool can be used to assess trunk lateral flexion in stroke patients, which is consistent with the findings reported by Hsieh, et al. and Wang et al.[3][8]

Furthermore, the study results revealed a statistically significant difference between trunk lateral flexions to the paretic and non-paretic side of stroke patients (table 2), which is consistent with the findings reported by Chiang et al. who assessed trunk balance using the mattress mobility detection system that showed significant differences between rolling performance from the supine position towards the paretic and non-paretic side among stroke participants [9]. The tool used in our study objectively assessed the trunk balance by discriminating between the lateral flexion to the paretic and non-paretic side of the trunk in stroke participants, and differentiating between apparently healthy individuals and stroke patients.

Conclusion

The tool developed to assess balance can be used to objectively discriminate between paretic and non-paretic lateral flexions in stroke patients to determine the extent of balance impairment. However, further studies are required that should evaluate the psychometric properties of the tool using a larger sample size and comparing it with other standard tools of balance assessment.

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