IJCRR
Vol 04 issue 20
Section: Health care
Category: Research
Received on: 28/08/12
Revised on:03/09/12
Accepted on:07/09/12

INTRA RATER AND INTER RATER RELIABILITY OF SWAY GRAPH IN ELDERLY SUBJECTS

Janakiraman Balamurugan[1], Paulraj Anantha Raja[1], Nagaraj S.[1]
Ramachadran Arunachalam[2]

[1]Dept of Physiotherapy, Madha Medical College and Hospital, India
[2]Srichandrasekarendra saraswathi vishwa maha Vidyalaya University, India

E-mail of Corresponding Author: bala77physio@gmail.com

ABSTRACT

Background: Accurate quantification of clinically significant changes of balance impairment is a key factor in understanding the effects of various disorders and treatment techniques on balance, the sway graph instrument is designed to measure the shift in COG in standing posture.

Objective: To test the reliability of sway graph and to develop it as an accurate outcome measure of balance impairments.

Subjects: One hundred and eighty nine community dwelling older adults (Mean age: 66 years) participated.

Study design: Prospective study design

Methods: Subjects were tested twice with sway graph by the same examiner on consecutive days to evaluate intra rater reliability and Subjects were tested by two examiners with sway graph to evaluate inter rater reliability. The reliability was calculated using intra class correlation coefficients (ICC).

Results: The ICC result for inter rater reliability and Intra rater reliability of sway deviation variables were r-0.98, r-0.96 for A-P swing and r- 0.96, r-0.97 Lateral swing. The SDD of the variable were 19.391& 19.828 for A-P swing and 13.837&14.281 for Lateral swing. Cronbach's alpha index score were very proximal to 1(0.983, 0.981) proving excellent internal consistency.

Conclusion: The study showed good reliability results for sway graph and notably minimal systematic error in measuring sway with in elderly subjects.

Key words: Centre of gravity (COG), Balance, Reliability, Sway

INTRODUCTION

The ability to balance and maintain a non-swaying posture in standing underlies the level of performance of physical activities and also minimizes the incidence of fall in potentially susceptible group of subjects. The capacities to hold and align body segments specifically depends on the ability to fix and restore Centre of gravity in optimal position.[2] There are three systems that give input to the CNS regarding status and maintenance of balance which includes Vestibular, Visual and Somatosensory. During rehabilitation of postural and balance impairments the exact role of various protocols which attempts to slow down the decline in postural control, retraining balance is yet unclear. One major obstacle to the researches involved in examining the impact of treatments, age and diseases on balance is lack of an ideal tool to quantitatively measure balance. Health care professional have thrived to invent a measuring tool/device, which can detect and quantify even a very minimal change in balance. An ideal clinical tool would be the one which has reproducibility, sensitivity, cost effective, safe and uncomplicated in procedures. Measure of balance may be highly related to other variable such as lower extremity strength due to

its force generating capacity and a thorough evaluation of the independent contribution of balance requires evaluating these other relationship to accurately determine the true magnitude of effect[1]

Several tools have been reported in literatures to measure balance which includes centre of pressure (COP), Brunel balance assessment, Berg balance scale, Trunk impairment scale, arm raise and forward reach tests, step/tap and step-up tests reached and Time up and Go (TUG) tests.[6] A recent review of literatures shows dissatisfaction with parameters of static postural recordings has led researchers to develop dynamic testing protocols using moveable plat-forms, visual images and weighted pulleys, all designed to test subjects reaction to external forces.[3, 4,] Hausdortt JM states that there seems to be a need to perform reliability assessments of postural control in groups with identified fallers and non-fallers. No reliability studies have been reported that specifically included fallers. However, since one-third of community-dwelling people over 65 years of age experience one or more falls each year, it seems important to include elderly subjects in reliability studies on balance measuring tools.[15]Clinical studies need an objective and valid measure of balance to compare groups of patient, effectiveness of treatments, prognosis and progression. We have attempted to develop a safe, less expensive and accurate outcome measuring tool (sway graph) which can quantitatively measure swaying in standing postures and the primary objective of this study is to test the reliability of sway graph in elderly population. If proven to be reliable this tool could very easily become a major innovative step towards development of new tool to measure balance in various postures.

METHODS

Subjects

A total of 189 subjects were selected from a population of 562 community dwelling old aged subjects with a mean (S.D) age of 66 years (4.0), the mean height was 159 (5.5) cm, the mean weight was 59 (10.3) kg.

The scholars involved in the study were all faculties of our medical college and none of the subjects reported any neurological condition, postural hypotension, musculo- skeletal impairments and psychological disorders. The study was approved by the institutional ethical committee and all the subjects provided written informed consent.

Raters

The study involved four raters (I, II, III, and IV) to record sway graph. The rater I and III were post graduate students of the institution and they possess an under graduate degree with at least 1 years of clinical experience and rater II &IV were consultant physiotherapist of the institution with vast experience.

Procedure

As an initial step in the beginning session, all raters tested all subjects. The order in which the raters tested the subjects was randomly assigned from a series of order obtained from a numbers encoded Latin square design. The test was demonstrated to subjects prior to commencement and standardized instructions were given. The subjects were made to wear the sway graph device, which consist of a lumbar belt, a back pointer with pen holder (matching S2 spinous process) and graph sheet to record the sway readings with two degree of freedom which measures Anterior-Posterior swing and Lateral swing. Now, the subjects were made to stand on a static platform e.g. floor for 45 seconds with their back facing the table with graph, so that the pen is in contact with the graph sheet, a standard foot position (4 inches apart) and angle (15^0 toe out) was used and the table height is adjustable in par with the subjects height. After the first reading the subjects were

turn over to the next rater and the procedures were repeated. Each rater was unaware of the scores of other raters and the marks on subjects are removed following each rater, the subjects were not shown their graph pattern after the test. To obtain intra rater data's the test was conducted again after a week period by rater I.

STATISTICAL ANALYSIS:

All data were analyzed statistically using SPSS 20 for windows software. The Intra class correlation coefficient was used as parameter of reliability and ICC model 3 was used to determine intra rater reliability, inter rater reliability was computed using ICC model 2. The 95% confidence interval was used to determine statistical significance. Cronbach's alpha reliability estimates were used as an index to determine internal consistency or average correlation and higher the score, the more reliable the generated scale is. Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient but lower thresholds are sometimes used in the literature.[18]

RESULTS

Inter rater reliability

The mean value of Anterior –Posterior swing deviation and Lateral swing deviation for both the raters were shown in Table 01.Inter rater reliability was excellent with a high ICC value of 0.98 for Anterior –Posterior swing deviation and ICC of 0.96 for Lateral swing deviation. The standard deviation for both variables A-P swing and LAT swing were 19.391 & 13.837 respectively. There was a statistically significant similarity between the data of the raters and the smaller value of SE is indicating very minimal systematic error. Cronbach's alpha reliability estimates were 0.981

Intra rater reliability

There was no significant difference between Test 1 and Test 2 of rater I in both variables. The ICC value (0.96, 0.97) and small SE value (0.5, 0.5) of table 01 clearly indicates existence of minimal random and systematic error. The standard deviation value of both variable were A-P swing 19.828 and Lateral swing 14.281.The data of both Test 1 and Test2 of the rater showed excellent similarity as suggested by r value. Cronbach's alpha reliability estimates were 0.983

DISCUSSION

Though impairment in balance is acknowledged as a major predictor of falls, there have always been limitations in recommending specific clinical assessment scales of balance.[8, 9, 10, 11] Our study suggests that Antero-Posterior swing and Lateral swing measurement by sway graph device can be reliably performed by the same therapist and also by different therapist with accuracy. The amount of measurement error being reasonably low is indicative of an evidence to support the use of sway graph as an objective measurement tool among other scales in practice.

The clinical assessment of balance is used as a means for measuring the integrity of the postural stability system, which involves the integration of information from somatosensory, musculoskeletal, visual, and vestibular systems and cognition.[12] According to Horak and Shumway-Cook evaluating balance by observing subjects response under given conditions of varying sensory input provides information on the mechanism of postural control and this approach provides a systematic evaluation. According to David Levine Chattecx balance system (CBS) has a least reliability in antero-posterior direction because the base of support is relatively short in this position, but the postural sway occurs about the ankle joint, which is physically separated by a large distance from the centre of gravity of the body.[17] The reliability found in our study may be due to the fact that the displacement of COG is recorded from close proximity to S2 unlike pressure distribution recorder which is used to measure

balance, error can be introduced from foot movements without COG displacement. The most important characteristic feature of the device has been though, there is a difference in the skill levels and experience of the therapists (raters) there exist no short fall in the repeatability of balance measurements by Sway graph. The sway graph device constructed by our team measure with only two degree of freedom and it allows only static balance measure in standing posture, which makes it rather odd to be used in certain population of patient with severe impairments. But, with the given potential uses and reproducibility of this tool to all health care professionals, further development and testing are in order.

CONCLUSION

This study clearly demonstrates the potential of the device as a clinical tool with good reproducibility; sway graph device will definitely add more cost effective objectivity to static balance measurements in standing posture. More over these results may form a basis for further research examinations of this tool with more added features and to investigate validity issues.

ACKNOWLEDGEMENT

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed. The authors are also thankful to the engineers of Anna University for helping us in constructing the device.

REFERENCES

1. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls. *Age Ageing*. 2006; 35 (suppl 2):ii7–ii11.
2. Berg K.Balance and its measure in the elderly: a review Physiother can 1989; 41:240-246.
3. Nashner .Adapting reflexes controlling the human posture. Exp Brain Res 1976;26:59-72
4. Nashner LM.Fixed patterns of rapid postural responses among leg muscles during stance.Exp Brain res 1977; 30:13-24.
5. Nashner LM, Black FO, Wall C.Adaptation to altered support surfaces and visual conditions in patients with vestibular deficits neurosci 1982; 2:536-544.
6. SF Tyson LA Connell, How to measure balance in clinical practice Clinical rehabilitation September 2009; 23: 824-840.
7. Shumway-Cook A, Horak F.B Assessing the influence of sensory interaction on balance. Suggestion from the field. Phys Ther 1986; 66:1548-1550.
8. Scott V, Votova K, Scanlan A, Close J. Multifactorial and functional mobility assessment tools for fall risk among older adults in community, home-support, long-term and acute care settings. *Age Ageing*. 2007; 36: 130–139.
9. Perell KL, Nelson A, Goldman RL, et al. Fall risk assessment measures: an analytic review. *J Gerontol A Biol Sci Med Sc*i.2001; 56:M761–M766.
10. American Geriatrics Society; British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention. Guideline for the prevention of falls in older persons. *J Am Geriatr Soc*.2001; 43:664–672.
11. National Institute of Clinical Excellence. Clinical Guideline 21: The Assessment and Prevention of Falls in Older People, 2004. www.nice.org.uk. Accessed June 21, 2005.
12. Susan W. Muir, Katherine Berg, Bert Chesworth, et al. Balance Impairment as a Risk Factor for Falls in Community-Dwelling Older Adults Who Are High

Functioning: A Prospective StudyJ Apta *Phys ther*. 2010; 90: 338-347.
13. Berg KO, Maki BE, Williams JI, et al. Clinical and laboratory measures of postural balance in an elderly population. Arch Phys Med Rehabil. 1992; 73:1073–1080.
14. Berg KO, Wood-Dauphine´e SL, Williams JI, Maki B. Measuring balance in the elderly: validation of an instrument. Can J Public Health. 1992; 83(suppl 2):S7–S11.
15. Hausdortt JM, Edelberg HK, Mitchell Sl, Goldberger AL Increased gait unsteadiness in community dwelling elderly fallers. Arch Phys Med Rehabil1997, 78:278-283.
16. Byl NN. Spatial orientation to gravity and implications for balance training. Orthopedic Physical Therapy Clinics of North America, October 1992:207-40.
17. David Levine, Michael W.Whittle, MD, Jeannette A. Beach et al Test-retest reliability of the Chattecx Balance System in the patient with hemiplegia Journal of Rehabilitation Research and development, Vol.33, February 1996, 36-44.
18. J.Reyanldo A.Santos Cronbach's Alpha: A tool for assessing reliability scale.Vol.37, April 1999.22-25.

Table: 01 Intra Correlation coefficient and description of intra and inter rater reliability in Anterior – Posterior swing scores

MEASUREMENTS (A-P Swing)	INTER RATER RELIABILITY(N=189)	INTRA RATER RELIABILITY(N=189)
ICC	0.98	0.96
Mean	36.41	37.34
Std Dev	19.391	19.828
95% CL	0.94 - 0.97	0.95-0.98

ICC –Intra correlation coefficient, SDD-standard deviation

Table: 02 Intra Correlation coefficient and description of intra and inter rater reliability in Lateral swing scores

MEASUREMENTS (Lateral-Swing)	INTER RATER RELIABILITY(N=189)	INTRA RATER RELIABILITY(N=189)
ICC	0.96	0.97
Mean	27.02	27.32
Std Dev	13.837	14.281
95% CL	0.95 - 0.97	0.96-0.98

FIGURE 01

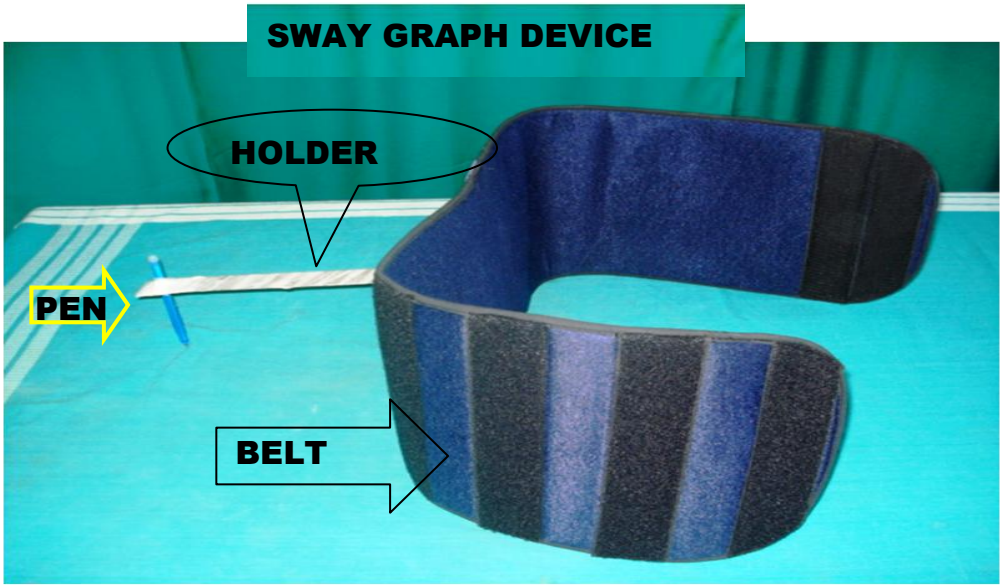

FIGURE 02

FIGURE 03