TO MEASURE THE POSTURAL SWAY IN STROKE INDIVIDUAL USING SWAY METER

PREETI DEVI, RESEARCH SCHOLAR, JAGANNATH UNIVERSITY, JHAJJAR

Dr. R.K. MUDGIL, ASSISTANT PROFESSOR, JAGANNATH UNIVERSITY, JAHJJAR.

ABSTRACT

Background & Objectives: Stroke is caused by an interruption of the blood supply to the brain. Stroke survivors present with deficits in different systems, including sensory, musculoskeletal, perceptual, and cognitive, which decrease postural stability or postural instability. Lord's sway meter is very sophisticated and complex like force platforms are available to measure postural sway as a component of postural control. But postural sway in these patients using sway meter is not addressed adequately. Therefore the objective of the study is to evaluate efficacy of sway meter for detecting postural sway in stroke patients.

Methods: The study included a total of 30 age matched subjects within 45-65 years, Screening of neuropathy patients was done using MMSE score. Postural sway was measured using Lord's Sway meter during eyes open and eyes closed condition. A total of six trials were given with a rest interval of 5-10 seconds in between the trials but subjects were not allowed to move their feet from foot markings. Mean of the sways in anteropostrior and mediolateral directions were calculated.

Results: The mean sway for stroke patients during eyes open was .467cm and .009cm whereas during eyes closed was .687cm and .428cm in anteroposterior and mediolateral direction respectively which was highly significant. Pearson correlation coefficients were positively correlated. Discussion & Conclusion: The sway meter can be used as a reliable tool

for measuring postural sway in stroke patients There was a significant correlation between eyes close and eyes open in both direction (anteropostero & mediolateral direction)

Key Words: stroke, postural sway, sway meter

Literature Survey:

Stroke is defined as loss of neurological function caused by an interruption of the blood supply to the brain(Barclay-Goddard RE, Stevenson TJ & Poluha W et al, 2004).Stroke affects men and women equally and causes major social and economic burdens to society. The lifetime risk of stroke is estimated at one in four by age 80 years, and the lifetime risk of silent or covert stroke is likely closer to 100(Tapuwa D. Musuka Stephen B. Wilton MD, Mouhieddin Donnan G,2003). Ischemic stroke due to brain vessels occlusion and blockage includes 80%(Marx J, Hockberger R, Walls R & Rosen's,2006 ;Tintinalli JE, Kelen GD & Stapczynski JS, 2004). Symptoms include focal or non-focal symptoms, negative or positive symptoms and sudden or gradual onset result in primary segregation of stroke. Symptoms depend upon the affected region of brain, which in turn is defined by the arterial anatomy involved. Common symptoms of stroke are aphasia, hemianopia, hemispatial neglect, hemiparesis and hemianopia. The majority (90%) of strokes are supratentorial and act upon stroke using the acronym FAST, for facial droop, arm drop, speech disturbance and time. Posterior circulation or infratentorial stroke has a multitude of additional symptoms, including diplopia, bulbar palsies, dysphagia, unilateral dysmetria and incoordination, as well as reduced levels of consciousness (Tapuwa D et al,2009). Stroke survivors present with deficits in different systems, including sensory, musculoskeletal, perceptual, and cognitive, which decrease postural stability(Horak FB,1991; Duncan PW,1994; Wade D, Collen F, Robb G & Warlow C,1992). Impaired postural stability probably has the greatest impact on gait and independency in activities of daily living (ADL). Indeed, to achieve improvement in walking capacity or ADL, improvement

in standing balance is more important than improvement in leg strength. Moreover, balance impairments are a major risk factor for falls(Beyaert C, Frykberg GE, Vasa R,2015). Falling is a very common complication after stroke, with as many as 50% to 70% of the people who return home from the hospital(Tutuarima JA, van der Meulen JH, de Haan RJ, van Straten A & Limburg M.1997); or rehabilitation(Tutuarima JA, van der Meulen JH, de Haan RJ, van Straten A & Limburg M,1995; Rapport LJ, Webster JS, Flemming KL, et al,1993; Vlahov D, Myers A, Al-Ibrahim M,1990; Mayo N, Korner-Bitensky N, Becker R & Georges P,1989). center experiencing falls(Herdon JG, Helmick CG, Sattin RW, Stevens JA, DeVito C & Wingo 2 PA,1997; Forster A, Young J1995; Lipsitz LA, Jonsson PV, Kelley MM, Koestner JS,1991; Prudham D & Evans JG,1981). Postural stability or balance is to maintain body's centre of mass over the limited base of support and is achieved by synkinesis of the limbs and body trunk based on information from postural adjustment function. Anne Shumway-cook & Marjorie H. had showed that no one stands absolutely still during a stance postural control; infect there are small amounts of body sways, mostly in forward and backward directions. Hence small amounts of spontaneous postural sway characterize quiet stance. Postural control is achieved from complex interactions between various sensory inputs such as ocular, vestibular and proprioceptive and motor outputs. These sensory inputs integrate to inform the central nervous system regarding the body's position relative to the environment and interact along with musculoskeletal and neuromuscular system to ensure postural stability. An irregularity in the postural sway is usual whenever there is a disturbance in any of sensory input and/or of the motor output is present(Anne Shumway-cook & Marjorie H.Wollacott). During a bipedal stance body sway could be measured using a sway meter, which was proposed by Lord et al in 1991(Lord SR, Clark RD & Webster IW). Later in 1996 Lord et al measured the variables of sway as maximum balance range using sway meter and concluded its test-retest reliability. Therefore Sway meter used by Lord is a reliable tool in evaluating and analyzing posture without the use of expensive equipment such as force platform and motion laboratories. Balance control also involves a general neural process in central nervous system to resolve the sensory conflicts from different sensory modalities and also synthesizing information

from disparate sensory inputs and combining efferent and afferent information for sensorimotor integration to avoid fall. Post stroke patients are known to exhibit excessive reliance on visual input for balance and walking and are unable to use somatosensory and vestibular input correctly (Nashner et al,(1982).

Sources of Collection Of Data: ·

Observational data manually collected from ward-based sources by a research assistant. · Rotary physiotherapy center rohtak Apex hospital rohtak

Sample Size: 30

Study Design:Correlation study

Inclusion Criteria: · Age -45-65 ·

Gender-both male and female. · Independently mobile who are able to walk minimally for 20 m without a walking aid

Exclusion Criteria: ·

- Patients using medications which can affect the postural stability by affecting central or peripheral nervous system
- Patients enable to withhold themselves from alcohol on the day of assessment.
- Patients taking medications for drug or alcohol dependency.
- Any history of surgical procedures, fractures, severe osteoarthritis or any other.
- musculoskeletal problems likely to affect lower-extremity function and posture.
- Patients with lower extremity amputation or prosthesis .
- History of any other neurological impairment (such as multiple sclerosis, cerebral palsy, poliomyelitis,etc.).
- Subjects with respiratory dysfunction and cardiac condition..

- History of any symptoms like dizziness, vertigo leading to balance impairment.

Sampling Method: Simple random sampling Independent Variable: sway meter 18 Dependent Variables: Balance Statistical Analysis: Pearson correlation

Procedure: Patient will be selected according to inclusion or exclusion criteria. Subjects were explained about the aim and procedure of the study and inform consent was taken from each subject. All the participants who fulfill the inclusion criteria were included in the study. Sway measurement were measured using sway meter. To remove any visual inputs sway meter was placed behind the subject. Foot prints were drawn on a sheet of paper and subjects were asked to remove their footwear and stand on it. The foot imprints used was constant for all individuals. It was measured such that distance between the heel was 15 cm and angle of toe out was 250 between the second metatarsals. They were instructed to keep their hands by their sides and stand as still as possible. A total of six trials were done including, first three trials with eyes open and next three trails with eyes closed. The subject were given a 5 to 10 second rest period after each trail but they were not be allowed to move the feet away from the foot markings. Maximum duration recorded for all trials was 5-6 minutes. The sway measurement included anteroposterior (AP) and mediolateral (ML) displacements which were maximum peak-to-peak displacement in the respective direction. The sway was recorded and its value was manually determined as count of millimetre traversed by the pen. Comments from the subjects were taken at the end of the procedure regarding the application and limitations in using the sway meter.

Statistical analyses were performed using statistical package for social sciences (SPSS version 18.0 for Window) and pearson correlation was used to find out the relation between the outcome variables with statistical significance at $p \leq 0.05$. Means and SD were calculated for age, gender, MMSE and Analysis of sway measurements during eyes open and eyes closed in both directions

Result and Discussion:

Correlation between anteroposterior and mediolateral sway			
	EO(ML)cm	EC(AP)cm	EC(ML)cm
EO(AP)cm	r=.467 p=0.009**	r=0.687 p=0.000**	r=4.28 p=0.018**

This study concerned with evaluation of influence of stroke on postural sway using sway meter. The chief finding of this study is that stroke patients have significantly larger sway compared to healthy individuals during quiet standing. Postural instability in stroke can be due to lack of appropriate proprioceptive feedback from lower extremity, slowness in peripheral sensory and motor pathways, reduced lower-extremity strength, central nervous system dysfunction and visual deficits(Massion j,1992). There was a significant difference in sway measurements during eyes closed condition compared to eyes open among all patients. This shows an increase in sway during eyes closed condition. But sway in patients with stroke was more even during eyes open compared to healthy people standing with their eyes close. As there was an overall increase in the sway during eyes closed condition but These changes could be supported by stating that subjects were becoming more sensitive of their sway during eyes closed and making an effort to control it (Sivakumar Ramachandran & Roopa Yegnaswamy;2011) In our study anteroposterior and mediolateral sway were measured and it was found that sway in anteroposterior direction was more as compared to the mediolateral direction during eyes open and eyes closed condition

among all groups. Helene Corriveau et al., in 2000 found more of AP displacement than ML displacements. Lafond et al., in 2004 found the similar results in their study and stated that these measures could be due to activation of ankle strategy which involves slight intermittent contraction of ankle plantar flexors and dorsiflexors. Therefore during quite standing the sway is along the axis of rotation of the ankle joints. To maintain balance during quiet standing, both the size and position of the base of support are important. In our study foot prints were constantly same for all subjects during the sway measurements. Feet were at a distance of 15 cm and an angle of 250 toe out position which was considered to be most stable among the other foot positions given by R. Kirby et al., in their study. They tested for the various foot positions which would significantly affect the standing balance(Kirby RL, Prince NA, MacLeod DA;1987) No subjects in our study reported instability while standing on foot imprints. Rather they find it stable during standing. Comments were obtained from the subjects about discomfort regarding the application of sway meter. None of the subjects reported any discomfort with the application of sway meter on their waist.

LIMITATION OF THE STUDY:

The sample size was small. • The study was limited to age group (45-65 years) • Method of collection of sample was convenient rather than randomized. • Population was limited to a specific area which limits the demographic details

SCOPE FOR FUTURE RESEARCH:

Elderly population more than 65 years of age can also be studied. • Other variable such as Total sway, coordinated stability and voluntary sway can also be studied using sway meter in stroke patients. • Sway measurement with different head positions such as head turn to left and right or head straight and head back to check effect of vestibular system in postural

sway. In the lights of the results of the study we conclude that there is significantly larger postural sway in stroke patients using sway meter. Therefore Sway meter can be used as a reliable tool for determining the effect of balance on postural sway.

REFERENCES:

Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: results of a WHO collaborative study. Bull World Health Organ (1980) 58:113–30.

American Heart Association: Heart Diseale and stroke statistics-2004 update. Dallas, Tex, American Heart Association, 2003.

Anne Shumway-cook & Marjorie H.Wollacott, eds. Motor control: Theory and practical applications, Chapter 7. Normal Postural control. Lippincott Williams & Wilkins, 2nd Ed: 163–91.

Aronowski J, Zhao X. Molecular pathophysiology of cerebral hemorrhage: secondary brain injury. Stroke. 2011 Jun;42(6):1781-6

Barber PA, Hill MD, Eliasziw M, et al. Imaging of the brain in acute ischaemic stroke: comparison of computed tomography and magnetic resonance diffusion-weighted imaging. J Neurol Neurosurg Psychiatry 2005;76:1528-33. Barclay-Goddard RE, Stevenson TJ, Poluha W et al. Force platform feedback for standing balance training after stroke. Cochrane Reviews 2004; 4: CD004129. DOI: 10.1002/14651858

Beyaert C, Frykberg GE, Vasa R. Gait post-stroke: Pathophysiology and rehabilitation strategies. NeurophysiolClin Clin Neurophysiol. 2015; 45: 335–355

Beyaert C, Vasa R, Frykberg GE. Gait post-stroke: Pathophysiology and rehabilitation strategies. Neurophysiol Clin Clin Neurophysiol. 2015;45:335–355.

Boehm WL, Gruben KG. Post-Stroke Walking Behaviors Consistent with Altered

Ground Reaction Force Direction Control Advise New Approaches to Research and Therapy. Transl Stroke Res. 2016; 7: 3–11.

Bonita R, Beaglehole R. Stroke prevention in poor countries. Time for action.Stroke 2007;38:2871- 2872.

Broderick J, Brott T, Kothari R, Miller R, Khoury J, Pancioli A, et al. The Greater Cincinnati/Northern Kentucky Stroke Study: preliminary first-ever and total incidence rates of stroke among blacks. Stroke. 1998;29(2):415–21 Chung AG, Frye JB, Zbesko JC, Constantopoulos E, Hayes M, Figueroa AG, Becktel DA, Antony Day W, Konhilas JP, McKay BS, Nguyen TV, Doyle KP. Liquefaction of the Brain following Stroke Shares a Similar Molecular and Morphological Profile with Atherosclerosis and Mediates Secondary Neurodegeneration in an Osteopontin- 34 Dependent Mechanism. eNeuro. 2018 Sep-Oct;5

Corbetta D, Imeri F, Gatti R. Rehabilitation that incorporates virtual reality is more effective than standard rehabilitation for improving walking speed, balance and mobility after stroke: a systematic review. J Physiother. 2015; 61: 117–124.

Donnan G. What are the mechanisms of stroke? Dialogues in Cardiovascular Medicine 2003;8:15–21

Duncan PW. Stroke disability. Phys Ther 1994;74:339-407.

Forster A, Young J. Incidence and consequences of falls due to stroke: a systematic inquiry. BMJ 1995;311:83-6. Hatem, S. M., Saussez, G., Della Faille, M., Prist, V., Zhang, X., Dispa, D., & Bleyenheuft, Y. (2016). Rehabilitation of Motor Function after Stroke: A Multiple Systematic Review Focused on Techniques to Stimulate Upper Extremity Recovery. Frontiers in humanneuroscience, 10, 442.

Herdon JG, Helmick CG, Sattin RW, Stevens JA, DeVito C, Wingo PA. Chronic medical conditions and risk of fall injury events at home in older adults. J Am Geriatr Soc 1997;45:739-43.

Horak FB. Assumptions underlying motor control for neurologic rehabilitation. In: Lister MJ, editor. Contemporary management of motor control problems: Proceedings of the II Step Conference. Alexandria (VA): Foundation for Physical Therapy; 1991. p 11-27.

http://www.sancd.org/Updated%20Stroke%20Fact%20sheet %202012.pdf: stroke fact sheet India. Accessed 21 July 2013.

Kidwell CS, Alger JR, Di Salle F, et al. Diffusion MRI in patients with transient ischemic attacks. Stroke 1999;30:1174-80.

Kidwell CS, Chalela JA, Saver JL, et al. Comparison of MRI and CT for detection of acute intracerebral hemorrhage. JAMA 2004;292:1823-30.

Kirby RL, Prince NA, MacLeod DA: Influence of foot position on standing balance. J Biomechanics 1987, 20(4): 423-427.

Lipsitz LA, Jonsson PV, Kelley MM, Koestner JS. Causes and correlates of recurrent falls in ambulatory frail elderly. J Gerontol 1991;46:M 114-22.

Lord SR, Clark RD, Webster IW. Postural stability and associated physiological factors in a population of aged persons. J Gerontol. 1991;46:M 69-M76.

Lord SR, Ward JA, Williams P. The effect of exercise on dynamic stability in older women: a randomized controlled trial. Arch Phys Med Rehabil. 1996;77:232-6.

Mărgăritescu O, Mogoantă L, Pirici I, Pirici D, Cernea D, Mărgăritescu C. Histopathological 35 changes in acute ischemic stroke. Rom J Morphol Embryol. 2009;50(3):327-39.

Marx J, Hockberger R, Walls R. Rosen's Emergency Medicine, 6th edition, 2006; 1606–1619.

Marx J, Hockberger R, Walls R. Rosen's Emergency Medicine,6th edition, 2006; 1606–1619.

Mayo N, Korner-Bitensky N, Becker R, Georges P. Predicting falls among patients in a rehabilitation hospital. Am J Phys Med Rehabil 1989;68:139-46.

Nyberg L, Gustafson Y. Patient falls in stroke rehabilitation: a challenge to rehabilitation strategies. Stroke 1995;26:838-42.

Pandian JD, Srikanth V, Read SJ, Thrift AG. Poverty and stroke in India. A time to act. Stroke 2007;38:3063-3069. Prudham D, Evans JG. Factors associated with falls in the elderly: a community study. Age Ageing 1981;10:141-6.

Qiu F, Cole MH, Davids KW, Hennig EM, Silburn PA, Netscher H, et al. Enhanced somatosensory information decreases postural sway in older people. Gait & posture. 2012;35(4):630–5.

Rapport LJ, Webster JS, Flemming KL, et al. Predictors of falls among right-hemisphere stroke patients in the rehabilitation setting. Arch Phys Med Rehabil 1993;74:621-6.

Sivakumar Ramachandran,* Roopa Yegnaswamy Measurement of Postural Sway with a Sway Meter- an Analysis J.Phys Ther. 2011;2:46-53.

Sridharan SE, Unnikrishnan JP, Sukumaran S, Sylaja PN, Nayak SD, Sarma PS, et al. Incidence, types, risk factors, and outcome of stroke in a developing country: The Trivandrum Stroke Registry. Stroke 2009;40:1212- 1218

Stewart Hendry, Steven Hsiao, in Fundamental Neuroscience (Fourth Edition), 2013 Susan B. O'Sullivan,Thomas J Scbmitz Physical Rehabilitation Assessment and Treatment 4th edition Tapuwa D. Musuka MBChB, Stephen B. Wilton MD, Mouhieddin Traboulsi MD, Michael D. Hill MDTracking heart disease and stroke in Canada. Ottawa: Public Health Agency of Canada; 2009. Available: www.phac- aspc. gc.ca/publicat/2009/cvd-avc/pdf/cvd-avs2009-eng.pdf (accessed 2015 July 21).

Tintinalli JE, Kelen GD, Stapczynski JS. Emergency Medicine: A Comprehensive Study Guide, Sixth Edition.2004; 1382–1389.

Tutuarima JA, van der Meulen JH, de Haan RJ, van Straten A, Limburg M. Risk factors for falls of hopitalized stroke patients.Stroke 1997;28:297-301.

Tutuarina JA, de Haan RJ, Limburg M. Number of nursing staff and falls: a case-control study on falls by stroke patients in the acute care setting. J Adv Nurs 1993;18:1101-5.

Vlahov D, Myers A, Al-Ibrahim M. Epidemiology of falls among patients in a rehabilitation 36 hospital. Arch Phys Med Rehabil 1990;71:8-12.

Wade D, Collen F, Robb G, Warlow C. Physiotherapy interventionlate after stroke and mobility. BMJ 1992;304:609-13.

Walker MF, Hoffmann TC, Brady MC, Dean CM, Eng JJ, Farrin AJ, et al. Improving the Development, Monitoring and Reporting of Stroke Rehabilitation Research: Consensus-Based Core Recommendations from the Stroke Recovery and Rehabilitation Roundtable. Neurorehabil Neural Repair. 2017;31:877–884.