



Original Research Article

Normative data of postural sway by using sway meter among young healthy adults

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Abstract

Background: Postural control involves controlling body's position in space for dual purpose of stability and orientation. Postural stability or balance is defined as the ability to maintain the projected Center of motion (COM) within the limits of Base of Support (BOS). During quiet stance there is a separate Center of Pressure (COP) under each foot. The net center of pressure lies between the feet and depend on each limb support. Normally no one stand erect, instead the body sways in small amount, mainly forward and backward. Thus quiet stance is characterized by small amount of spontaneous postural sway. The device (sway meter) consists of inflexible 40 cm long rod with vertically mounted pen at its end. The rod was mounted 20 cm wide metal plate which will be fitted at the level of PSIS (Posterior superior iliac spine) over lower back region of participants by firm belt. A low tech Sway meter was designed to address the needs of clinicians and researchers with limited resources (e.g. no access to force plates or motion laboratories). It is a useful field test, as it is compact, lightweight, has short administration and data processing time. Unlike other lightweight and easily applied systems, such as accelerometers and gyroscopes, the Sway meter involves no electronics or computer processing. Thus, assessment can be conducted in a variety of community settings and health care facilities. Several research groups have found the Sway meter to be feasible for use in different populations of young and older people. The Sway meter has been used in numerous studies of balance as well as retrospective and prospective investigations of falls risk in older people. The purpose of study was to find out normative data of postural sway by using sway meter in among young adults and the validity of the Sway meter against the floor and foot print.

Aim and objectives: To study the normative data of postural sway by using sway meter among young healthy adults, to study the normative data of postural sway by using sway meter among young healthy adults with eye open and eye close, to study the normative data of postural sway by using sway meter compare with the normal values of the lord's and Sherrington's study.



Material and methods: The subjects were instructed to keep their hand by their sides during standing. Subjects were informed about procedure before starting. Duration of each trial was 30 second. A starting point was marked on the graph paper. At end of the 30 seconds, the rod of the sway meter was taken away from the graph sheet. 5-10 seconds rest was given during trial, but they were not allowed to move away from the foot print. The procedure was repeated for each trial. A total of six trials were taken including, 3 trial with eyes opened and 3 for eyes closed. Maximum duration for all trial was 6-7 minutes and maximum deviation in 3 trials was taken for analysis.

Results: In eye open condition, in anterior direction, total 60 (100%) subjects are had sway in 0.1 to 2 cm. In Posterior direction, total 60 (100%) subjects are had sway in 0.1 to 2 cm. In right lateral direction, total 59 (98%) subjects had sway in 0.1 to 2 cm; remaining 1 (2%) subject had sway in 2.1 to 3 cm. In left lateral direction, total 56 (95%) subjects had sway in 0.1 to 2 cm; remaining 2 (3%) subjects had 2.1 to 3 cm sway and 2 (2%) subjects had 3.1 to 4 cm sway in left side. In eye closed condition, in anterior direction 57 (95%) subjects had 0.1 to 2 cm sway in anteriorly, but remaining 2 (3%) subjects had 2.1 to 3 cm sway, and 1 (2%) subject had 3.1 to 4 cm sway. In posterior direction 59 (98%) subjects had 0.1 to 2 cm sway in posterior; rest 1 (2%) subject had nil sway in posterior. In right lateral direction 56 (93%) subjects had 0.1 to 2 cm sway, and rest of the 2 (4%) subjects had nil sway, and 2 (3%) had 2.1 to 3 cm sway in right direction. In left lateral direction 57 (95%) subjects had 0.1 to 2 cm sway, and 1 (2%) subjects had nil sway, rest 2 (3%) subjects had sway in 2.1 to 3 cm.

Conclusion: It has been concluded that this study support the self constructed sway meter as a clinical tool for identifying sways in various directions (anterior, posterior, right lateral and left lateral). Similarly 100% of sway was seen in anterior and posterior direction with eye open.

Key words

Postural sway, Sway meter, Eye open, Eye close.

Introduction

Postural sway is defined that the movement of the body in still position. Normally no one stand erect, instead body sways in small amount, mainly forward & backward. This quite stance is characterized by small amount of postural sway. Balance is generally defined as a person's ability to maintain or restore the equilibrium state of upright stance, without having to change the base of support [1]. Balance is often assessed as the amount of postural sway (also called body sway) of the human body. Studies have suggested falls in the elderly are attributed to difficulties adapting one's balance in response to changes in sensory information [2], as well as increased sway in the anterior-posterior and medio-lateral directions compared to young adults [3].

Postural control involves controlling body's position space for dual purpose of stability and orientation [4]. Postural stability or balance is defined as the ability to maintain the projected center of motion (COM) with in limit of Base of support (BOS). During quite stance there is separate center of pressure (COP) under each foot. The net COP lies between the feet and depends on each limb supports. Some research on stance postural control have shown that no one stands absolutely still, instead the body sway in small amount mostly forward and backward. There are some methods to measure postural sway to employee postural grid [5] like lord sway meter [6], inclinometer [7].

In our study, we used sway meter which was self-made and constructed on the guidelines of lord and Sherrington's sway meter. It was low technology Sway meter designed to address the needs of clinicians and researchers with limited resources.

It is a useful field test, as it is compact, lightweight, has short administration and data processing time. Thus, assessment can be conducted in a variety of community settings and health care facilities. Several research groups have found the Sway meter to be feasible for use in different populations of young and older people and to see the reliability of self made sway-meter, comparing the value of sways with lord and Sherrington's sway meter. Self made instrument which is made up of with firm belt and 40 cm rod which is attached to it. Firm belt tie over the level of PSIS (posterior superior iliac spine) and that 40 cm rod with pen pointer attach to it. Normally postural sway are seen anterior, posterior, right, and left. According to lord and Sherrington's study [8].

Aim and objectives

- To study the normative data of postural sway by using sway meter among young healthy adults.
- To study the normative data of postural sway by using sway meter among young healthy adults with eye open and eye close.
- To study the normative data of postural sway by using sway meter and compare with the normal values of the lord's and Sherrington's study.

Materials and methods

Study design: Observational study.

Sampling technique: Simple random sampling.

Sample size: 60

Study setting: Physiotherapy OPD, PDVVPF's, Ahmednagar.

Study duration: 5 month

Selection criteria

Inclusion criteria

- Individual age group of 18 to 26 years.
- Both genders.
- Willing to participate in study.

Exclusion criteria

- Any musculoskeletal injuries like fracture.
- Any neurological condition like PNI.
- Subject with recent surgery.

Material

- Sway meter (**Photo – 1**)
- Graph paper (**Photo – 2**)
- Foot print (**Photo – 3**)
- Cardiac table (**Photo – 4**)
- Pen

Photo – 1: Sway meter (40 cm long rod and firm soft belt).



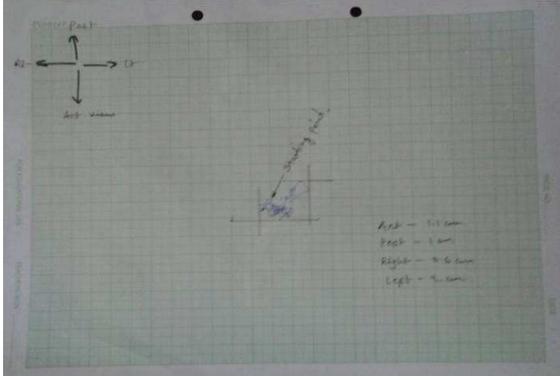
Procedure

The study was planned to note the normative data of postural sway by using sway meter among young healthy adults. Perquisite permission and approval were obtained from the head of Institution and Institutional Ethical Committee before the Commencement of

research work. Study synopsis approval was obtained.

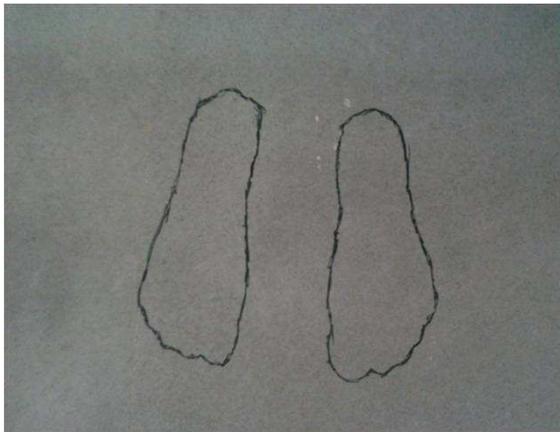
The device (sway meter) consists of inflexible 40 cm long rod with vertically mounted pen at its end. The rod was mounted 20 cm wide metal plate which will be fitted at the level of PSIS (Posterior superior iliac spine) over lower back region of participants by firm belt. Sway meter offers 1 degree of freedom between belt and pen as it's free to move. The pen recorded participants' postural sway on sheet of graph paper which is placed over the table.

Photo – 2: Graph paper.



The distance between the feet was around 3 inches. The graph sheet was placed behind the subject. Graph sheet was level in such a way that, the rod of sway meter will maintained in horizontal position when starting the measurement. Graph sheet secured during measurement to prevent displacement. The individuals asked to remove their foot ware and stand on foot prints.

Photo – 3: Foot print.



The subjects were instructed to keep their hand by their sides during standing. Subjects were informed about procedure before starting. Duration of each trial was 30 second. A starting point was marked on the graph paper. At end of the 30 second, the rod of the sway meter was taken away from the graph sheet. 5-10 seconds rest was given during trial, but they were not allowed to move away from the foot print.

Photo – 4: Cardiac table.



The procedure was repeated for each trial. A total of six trials was taken including, 3 trial with eyes opened and 3 for eyes closed. Maximum duration for all trial was 6-7 minutes with maximum deviation in 3 trials was taken for analysis. (Photo – 5, Photo – 6)

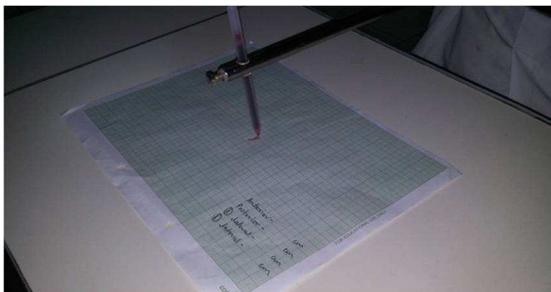
Results

The data collected for sway in all four directions was analyzed with eye open and eye closed conditions. It was found that all 60 subjects having nearly equal sway on all four directions with eye open and eye closed.

Photo – 5: Procedure.

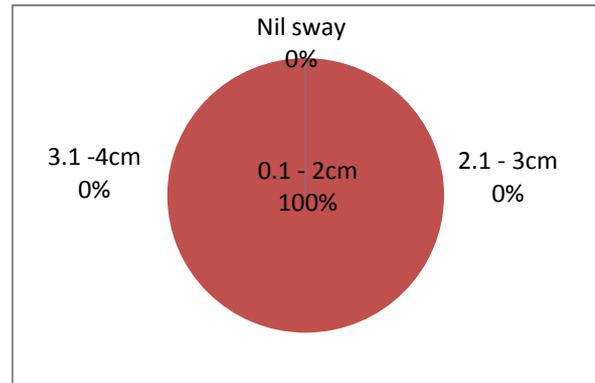


Photo – 6: While measuring the sway with the help of graph paper-1.

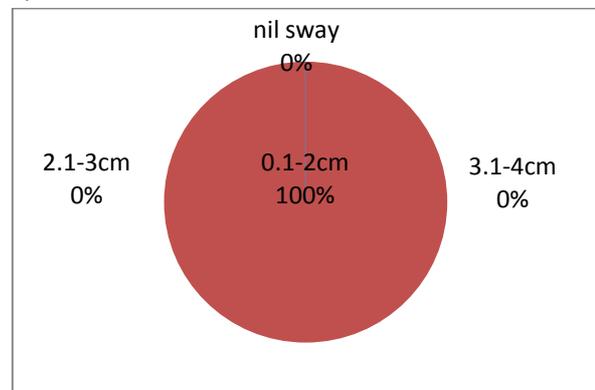


Sway in anterior direction with eye open was as per **Graph – 1**. Sway in posterior direction with eye open was as per **Graph – 2**. Sway in right lateral direction with eye open was as per **Graph – 3**. Sway in left lateral direction with eye open was as per **Graph – 4**. Sway in anterior direction with eye closed was as per **Graph – 5**. Sway in posterior direction with eye closed was as per **Graph – 6**. Sway in right lateral direction with eye closed was as per **Graph – 7**. Sway in left lateral direction with eye closed was as per **Graph – 8**.

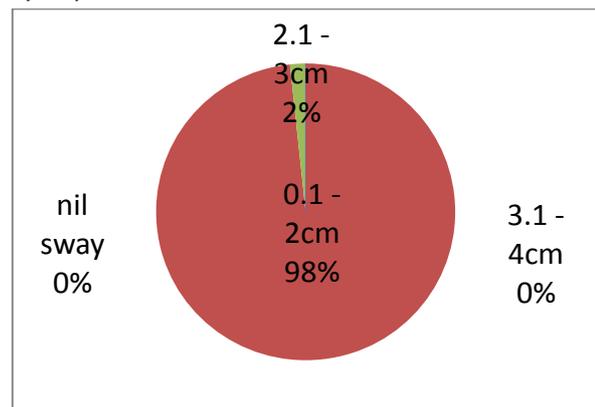
Graph – 1: Sway in anterior direction with eye open.



Graph – 2: Sway in posterior direction with eye open.



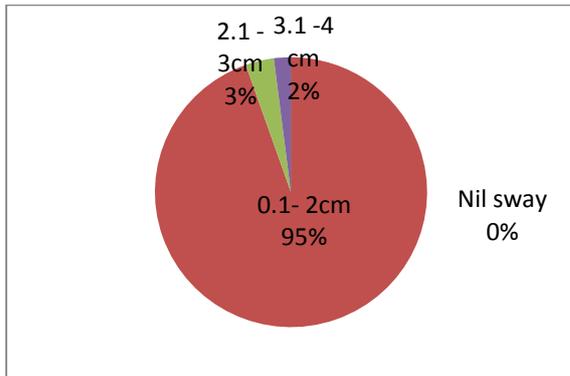
Graph – 3: Sway in right lateral direction with eye open.



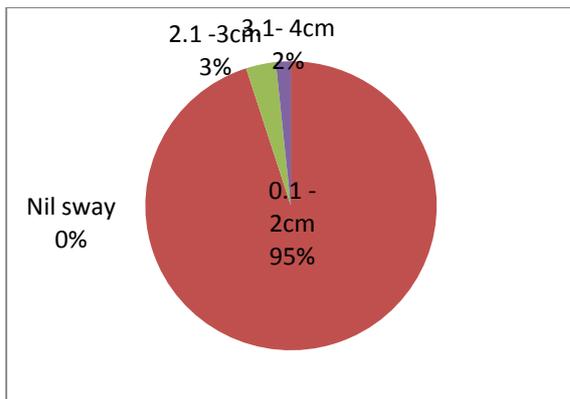
In eye open condition, in anterior direction, total 60 (100%) subjects are had sway in 0.1 to 2 cm. In Posterior direction, total 60 (100%) subjects are had sway in 0.1 to 2 cm. In right lateral direction, total 59 (98%) subjects had sway in 0.1 to 2 cm; remaining 1 (2%) subject had sway in

2.1 to 3 cm. In left lateral direction, total 56 (95%) subjects had sway in 0.1 to 2 cm; remaining 2 (3%) subjects had 2.1 to 3 cm sway and 2 (2%) subjects had 3.1 to 4 cm sway in left side.

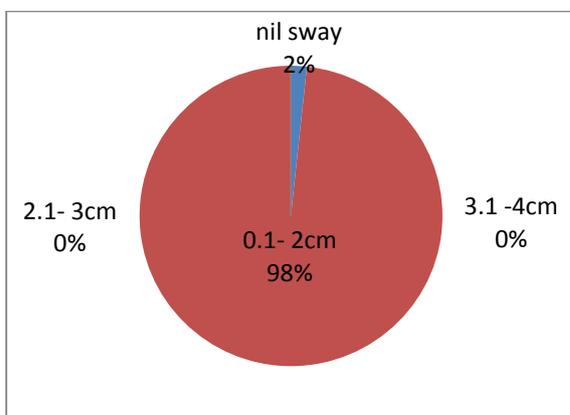
Graph – 4: Sway in left lateral direction with eye open.



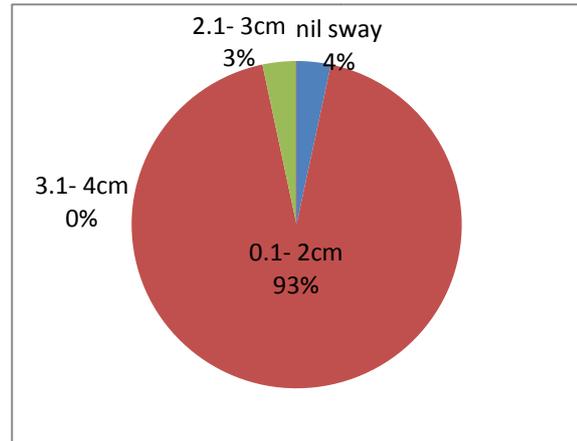
Graph – 5: Sway in anterior direction with eye closed.



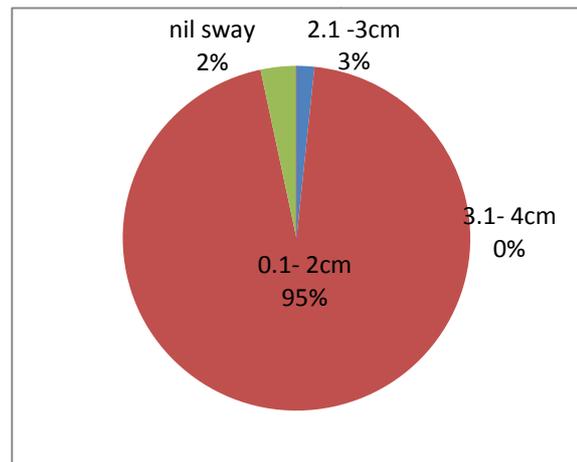
Graph – 6: Sway in posterior direction with eye closed.



Graph – 7: Sway in right lateral direction with eye closed.



Graph – 8: Sway in left lateral direction with eye closed.



In eye closed condition, in anterior direction 57 (95%) subjects had 0.1 to 2 cm sway in anteriorly, but remaining 2 (3%) subjects had 2.1 to 3 cm sway, and 1 (2%) subject had 3.1 to 4 cm sway. In posterior direction 59 (98%) subjects had 0.1 to 2 cm sway in posterior; rest 1 (2%) subject had nil sway in posterior. In right lateral direction 56 (93%) subjects had 0.1 to 2 cm sway, and rest of the 2 (4%) subjects had nil sway, and 2 (3%) had 2.1 to 3 cm sway in right direction. In left lateral direction 57 (95%) subjects had 0.1 to 2 cm sway, and 1 (2%) subjects had nil sway, rest 2 (3%) subjects had sway in 2.1 to 3 cm.



Discussion

The self constructed sway meter were used in all the subjects of which 12 males and 48 females. The measurement was taken on the flat surface with eye open and eye closed, in all four directions. (Anterior, posterior, right lateral and left lateral). In our study, with eye open anterior direction (100%) 0.1 to 2 cm sway was observed. In posterior direction (100%) 0.1 to 2 cm was observed, In right lateral direction (98%) had 0.1 to 2 cm and (2%) had 2.1 to 3 cm, now in left lateral direction (95%) had 0.1 to 2 cm, (3%) had 2.1 to 3 cm and (2%) had 3.1 to 4 cm.

With eye closed anterior direction had (95%) 0.1 to 2 cm, (3%) had 2.1 to 3 cm and (2%) had 3.1 to 4 cm. in posterior direction (98%) had 0.1 to 2 cm and (2%) had nil sway. Now in right lateral direction (93%) had 0.1 to 2 cm, (4%) had nil sway, and (2%) had 2.1 to 3 cm, in left lateral direction (95%) had 0.1 to 2 cm, (2%) had nil sway, and (3%) had 2.1 to 3 cm.

Similar study was done by Ramchanran, et al. (2011) they obtained result on the normal individual, which were in eye opened condition with anterior direction (90%) had 0.1 to 2 cm and rest had more than 2 cm to maximum 3 cm. in posterior direction (91.6%) had 0.1 to 2 cm and rest had 2 cm to maximum 4 cm. in right lateral and left lateral direction, (61.6%) and (46.6%) had sway in 0.1 to 2 cm. and 4.5 to maximum 5 cm were observed [8].

With eye closed condition with anterior direction (61.6%) had sway in 0.1 to 2 cm were observed and rest had 2 to maximum 5 cm sway. In posterior direction (83.3%) had 0.1 to 2 cm and rest had 2 to maximum 4 cm sway. In right lateral and left lateral direction had (60%) and (55%) in 0.1 to 2 cm respectively and maximum observed in right lateral and left lateral directions were 6 cm.

In our study the sway was measured in two different conditions i.e. eye open and eye closed. There was 100 % postural sway was seen on anterior and posterior direction as compared to right lateral direction (98%) and left lateral direction (95%) in eye open condition, where as in eye closed condition postural sway is (98%) on posterior direction and (95%) on anterior direction is more as compared to right lateral direction (93%) and on left lateral direction (95%).

Conclusion

From the above study, it has been concluded that this study support the self constructed sway meter as a clinical tool for identifying sways in various directions (anterior, posterior, right lateral and left lateral). Similarly 100% of sway was seen in anterior and posterior direction with eye open.

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