Altered Postural Sway and Fear of Fall in Patients Suffering from Non-specific Low Back Pain

Sadhana Verma[1*] and **Ajay Bharti**[2]

[1]Physiotherapy Department of Saaii College of Medical Science and Technology, Kanpur, UP, India

[2]Physiotherapy Department of Saaii College of Medical Science and Technology, Kanpur, UP, India

[*]**Corresponding author**: Sadhana Verma, Assistant Professor, Physiotherapy Department of Saaii College of Medical Science and Technology, Kanpur, India, Tel: +919599961160; E-mail: vermasadhana85@yahoo.com

Abstract

Objective: The purpose of this study is to determine whether balance response of low back pain patients is different from healthy controls under various up right standing conditions, and also to find out whether body sway is related to the fear of fall in low back pain individuals.

Method: A sample of 130 subjects was taken in the study through convenient sampling. The postural sway of the subjects was analyzed by using a Sway meter and Fear of Fall was calculated by using a Fall Efficacy Scale.

Result: The results show that greater sway occurs in the patients suffering with Low Back Pain than compared to healthy control group, and FES value and TSOFEC value are correlated to each other (r value=0.23).

Conclusion: Thus the study concludes that patients with low back pain exhibit greater postural sway than healthy controls and the decreased postural stability in people with low back pain is correlated with fear of fall when extra stress has been laid on the balancing system.

Keywords:

Introduction

Human postural balance relies on information from somatosensory, vestibular and visual systems. Postural stability depends also on the efficiency of the motor function: joint stability and muscle activity. The performance of the postural balance system is affected by age, neurological dysfunctions, cerebro cranial injuries, and motor organ diseases [1].

A vital role in maintaining balance is played by the spine. Dysfunctions of the spine influence on control of posture in upright position. Lower back pain is a significant social problem. Low back pain is usually defined as pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, with or without leg pain (sciatica) [2].

Low back pain (LBP) is a substantial health problem. It affects up to 80% of the adult population and accounts for considerable healthcare and socioeconomic costs [3].

The most used classification for pain in the lumbar spine by clinicians is specific or nonspecific LBP. A specific low back pain diagnosis (about 1-2% of all patients with early low back pain) is attributed to Low back pain, referring to any diagnosis from a systemic disease, infection, injury, trauma, cauda equine or structural deformity. Nerve root pain usually represents about 5% of the pain in patients with a disc prolapses and spinal stenosis [4].

Approximately 90% cases of back pain have no identifiable cause and are designated as Nonspecific. Non-specific low back pain means that the pain is not due to any specific or underlying disease that can be found. It indicates the structure problem of spine. It is thought that in some cases the cause may be a sprain (an over-stretch) of a ligament or muscle [5]. And other common cause like unaccustomed activities, poor posture, muscular, strain, obesity arthritis of spine and occupational cause [6].

Low back pain can be acute sub-acute or chronic patients with acute low back pain is usually defined as the duration of an episode of low back pain persisting for the less than 6 week; sub-acute low back pain as low back pain persisting between 6 to 12 week; chronic low back pain persisting for 12 week or more [5].

Posture sway in quite standing is often studied as a measure of posture control. Many instrument ranging from the simple once like lord's sway to the more sophisticated instrumentation, post urography, utilizes force plate to measure Ground Reaction Force, are used to measure the postural sway [7].

The purpose of this study is to determine whether balance response of low back pain patients is different from healthy controls under various up right standing conditions. It is also determined in the present study whether body sway is related to the fear of fall in low back pain individuals.

Methodology

A collective sample of 130 human subjects between age group 40-73 years, was selected by convenient sampling. The subjects were recruited from the orthopedics department of LLR Hospital Kanpur. An approval by the Institutional Review Board was granted and an informed consent was obtained from each subject.

Inclusion criteria

- Person with nonspecific low back pain for at least 6 weeks age 40-73 year.
- Participants should have at least 1 episode of low back pain prior to study [8].
- Normal lower extremity in neurological examination.
- Low back pain more severe than leg pain [9].
- Faller and non-faller low back pain patients are included in the study [10].
- Both male and female patients participated in study [10].

Exclusion criteria

- More prominent radicular leg pain.
- Previous spinal surgical application.
- Pregnant ladies are excluded.
- Patients with herniated disc (PIVD) [9].
- Specific spinal pathology (e.g. malignancy inflammatory joint, infection) [8].

Protocol

This is an experimental study performed in LLR hospital Kanpur. A sample of 130 subjects (100 in LBP Group and 30 in healthy Control Group) was taken in the study. The participants were selected on basis of exclusion and inclusion criteria. A signed consent was obtained from each participant then procedure was fully explained to the patients.

Procedure

The participants were explained about the need of the study. Then the details required for responding to the scale were given to the subjects. One data collection session included two tests.

- Sway determination by using a sway meter
- Fear of fall determination by using a FES (fall efficacy scale) scale.
- Sway was calculated in our study by using a sway meter and in this one data collection session included tasks which were performed 3 times to test for reliability. The participants stood barefoot on the floor as well as on the foam with their feet no more than 3 inches apart while the Fear of fall was calculated by using on FES Scale consisting of 10 questionnaires.

Sway

130 subjects participated in the study, among which 100 participants belonged to the LBP group, while 30 participants belonged to the healthy control group. In this study postural sway in standing was analyzed with sway meter for both the groups. Sway meter was snugly fit at the ASIS sway meter was placed posterior to subject. Subjects were asked to stand on floor as well as on foam, maintaining a distance of 3 inches between the feet. A graph sheet was placed behind the subject. Graph sheet was leveled in such a way that the rod of sway meter was maintained in horizontal position when starting the measurement graph sheet was secured to prevent displacement during measurement. Subjects were instructed to keep their hands by their sides and stand in erect position. Starting point is marked in graph sheet before taking sway. Each trial was 30 sec subject was given rest period after each trial. Total four tasks were performed by the participants by challenging either the proprioception or the visual system as shown in Table 1.

S.no.	Visual	Proprioception
1	Eyes open	Stable support
2	Eyes closed	Stable support
3	Eyes open	Foam
4	Eyes closed	Foam

Table 1: Four tasks combination with challenged visual and proprioception system.

Then for each task 3 trials were taken. Total 12 trials were taken among which, 6 trials on foam with eyes open and eyes closed and six trials on floor with eyes open and eyes closed. After taking the sway, the small boxes in graph sheet were being counted, in vertical length and horizontal length.

Fall efficacy scale

The participants were explained about the aim of study. The scale known as FES (Fall Efficacy Scale) was used for the assessment procedure. In this patients were asked 10 questions, in which, one quoted as very confident, whereas ten as not confident at all. A total score of greater than 70 indicated that the person had a fear of falling while a score less than 70 showed the person had no fear of fall.

Data Analysis

The data was managed on excel sheet and was analyzed using SPSS (Statistical package for social sciences) software version 17.0. In order to analyze the sway alteration between the experimental group and the control group "t Test" was used while a "Pearson Correlation Test" was performed to find out the relation between sway and Fear of Fall. Descriptive statistics and correlation values were calculated between various variables for all statistical tests the level of significance set as $P \leq 0.01$ and $P \leq 0.05$.
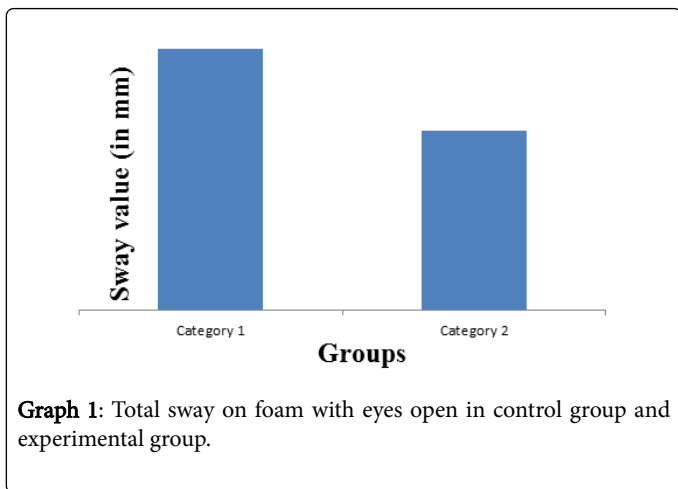
Result

The result was evaluated on the basis of the readings obtained through the scales. The minimum age of the subjects was taken as 40 ± 9.55 years and the maximum age was 73 ± 9.55 years (Table 2).

	Minimum	Maximum	S.D
Age	40	73	9.55

**Table 2**: Basic characteristic of low back pain patients.

The mean of total sway on foam with eyes open for the control group is calculated as 573.65 and the standard deviation as 300.49. The mean of total sway on foam with eyes open for the experimental group is 837.02 while the standard deviation as 632.66. This shows that the sway is more significant in the experimental group (Graph 1, Table 3).

Graph 1: Total sway on foam with eyes open in control group and experimental group.

SWAY	Mean		SD	
	Control	Experimental	Control	Experimental
TSOFOE	575.65	837.02	300.49	632.66
TSOFCE	849.27	1163.9	552.14	765.47
TSOGOE	292.86	529.28	152.99	442.26
TSOGCE	360.74	442.54	194.11	479.03
TSOFOE=Total sway on foam with eyes open				
TSOFCE=Total sway on foam with eyes closed				
TSOGOE=Total sway on ground with eyes open				
TSOGEC=Total sway on ground with eyes closed				
S.D=Standard deviation				

Table 3: Total sway in low back pain group and control group.

The mean value of total sway on foam with eyes closed for the control group is calculated as 849.27 and the standard deviation as 552.14. The mean of total sway on foam with eyes closed for the experimental group is calculated as 1163.90 and standard deviation as 765.47 (Graph 2, Table 3).

Graph 2: Total sway on foam with eyes closed in control and experimental group.

The mean of total sway on ground with eyes open for the control group is calculated as 292.86 and standard deviation as 152.99. The mean of total sway on ground with eyes open for the experimental group is calculated as 529.28 and standard deviation as 442.26 (Graph 3, Table 3).

Graph 3: Total sway on ground with eyes open in control and experimental group.
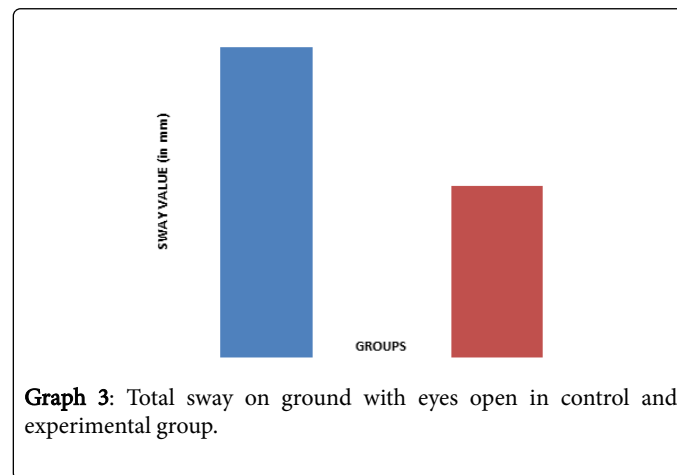
The mean of total sway on ground with eyes closed for the control group is calculated as 360.74 and standard deviation as 194.11. The mean of total sway on ground with eyes closed for the experimental group is calculated as 442.54 and standard deviation as 479.03 (Graph 4, Table 3).

Graph 4: Total sway on ground with eyes closed in control and experimental group.
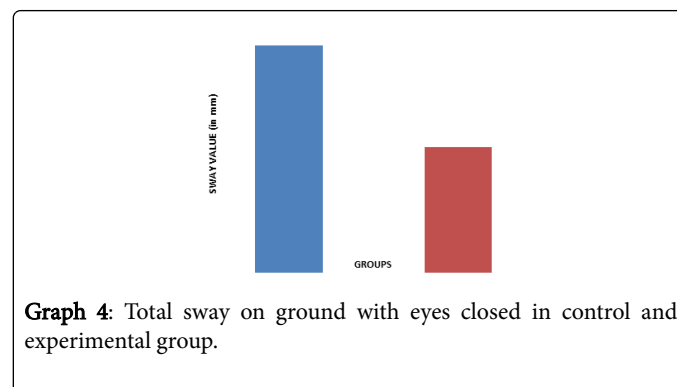
The t value for the total sway on foam with eyes open is obtained as 2.18 while the P value as 0.05, which is a significant value and this shows that the sway is more significant in the low back pain group than the control group when the level of significance is 0.05.

The t value for the total sway on foam with eyes closed is obtained as 2.09 while the P value as 0.02 this show that the sway is more significant in low back pain group than control group when the level of significance is 0.05.
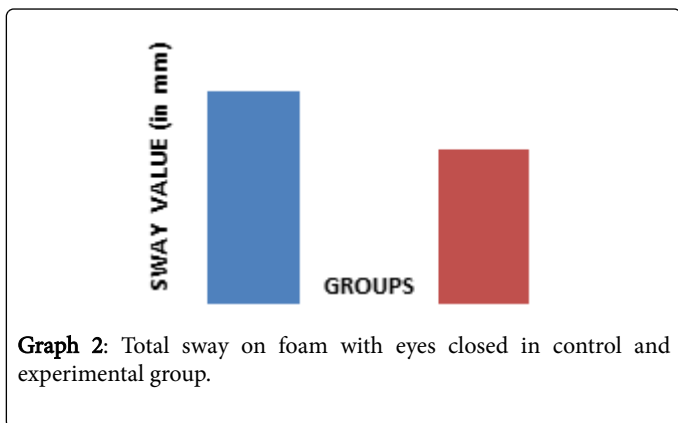
The t value for the total sway on ground with eyes open is obtained as 2.87 while the P value as 0.003 this show that sway is significant in low back pain group than control group when the level of significance is 0.01.

The t value for the total sway on ground with eyes closed is obtained as 0.91 while the P value as 0.02 this shows that sway is significant in low back pain group than control group when the level of significance is 0.05 (Table 4).

Sway	T value	P value
TSOFEO	2.18	0.05**S
TSOFEC	2.09	0.02**S
TSOGOE	2.87	0.003*S
TSOGEC	0.91	0.02**S
*Level of significance 0.01		
** Level of significance 0.05		
TSOFOE= Total sway on foam with eyes open		
TSOFCE=Total sway on foam with eyes closed		
TSOGOE=Total sway on ground with eyes open		
TSOGEC=Total sway on ground with eyes closed		
S=significance		

Table 4: Total sway in low back pain group and control group.

	TSOFEO		TSOFEC		TSOGEO		TSOGEC	
	p value	r value	p value	r value	p value	r value	p value	r value
FES	0.25	0.11	0.02**	0.23	0.17	0.14	0.21	0.13
	NS		S		NS		NS	
TSOFOE=Total sway on foam with eyes open								
TSOFCE= Total sway on foam with eyes closed								
TSOGOE=Total sway on ground with eyes open								
TSOGEC=Total sway on ground with eyes closed								
FES= Fall efficacy scale								
S=Significance and NS=Not significance								
*Level of significance 0.01 ** Level of significance 0.05								

Table 5: Correlation with total sway and FES.

The r value for the Correlation between FES and total sway on foam with eyes open is 0.11 while the P value is 0.25 which is not significant (when the level of significance is 0.05). Hence shows that FES value and TSOFOE value are not correlated to each other.

The r value for the correlation between FES and total sway on foam with eyes closed is 0.23 while the P value 0.02 which is a significant value (when the level of significance is 0.05). Hence shows that FES value and TSOFEC value are correlated to each other.

The r value for the Correlation between FES and total sway on ground with eyes open is 0.14 while the P value is 0.17 which is not significant (when the level of significance is 0.05). Hence shows that FES value and TSOGOE value are not correlated to each other.

The r value for the Correlation between FES and total sway on ground with eyes closed is 0.13 while the P value is 0.21 which is not significant (when the level of significance is 0.05). Hence shows that FES value and TSOGEC value are not correlated to each other (Table 5).

Discussion

The purpose of this study is to find the difference in sway in case of LBP group and control group (consisting of healthy subjects) as well as to find the relation between the postural sway and fear of fall in low back pain individuals. During standing an individual normally exhibits small range postural shifts or postural sway cycling intermittently from side to side and from heel to toe. In normal individuals the AP sway is approximately 12 degrees [11].

But this sway may vary in different situation as we found in our study the sway was increased in the LBP group as compared to the sway in the control group which consisted of the healthy individuals. The result showed a significant difference between the sway in the LBP group and the control group [12]. The altered sway pattern in both the groups may underline the role of "Pain Inhibition" in the observed postural response [13].

The sway was examined under four conditions on floor with eyes closed and on the foam with eyes open as well as with eyes closed in order to alter the visual proprioception and joint proprioception so as to challenge the balance system of our body. It is noted that visual deprivation caused an increase in postural sway in both the groups [1,14].

Also the results showed a positive correlation between the perceived fear of fall and sway in LBP individuals. This correlation has been found positive only in the case when the persons with LBP were standing on 'Foam' with eyes closed. The proposed reason may be when the complexity of the task increased the postural stability decreased in persons with LBP [15].

During standing on foam the CNS of the healthy person significantly up weighted the proprioceptive signals from the Paraspinal muscles and down weighted those from ankle muscles to control postural balance. As standing on foam is less reliable proprioceptive input from the ankle joint. Therefore the CNS should rely more on the proprioceptive input from other joints such as lumbosacral region to keep the postural balance. These findings

suggest strongly that the persons with recurrent LBP have altered postural control. Moreover, the CNS of the persons with LBP seemed to select the same postural control strategy (i.e. proprioceptive control at the ankles) as in normal bipedal standing on stable support surface, showing a decrease in postural control variability. This postural strategy leads to less stable postures when postures when postural demands increase and also may generate a fear of falling in the individuals [15,16].

Another reason for the positive correlation between fear of fall and sway may be fear avoidance model according to which pain related fear leads to the avoidance or escape from activity which further leads to disability and inability to maintain balance [17-19].

Thus our study aims to correlate the fear of fall and sway in LBP individuals so that in future attempts can be made through the treatment protocol to decrease or avoid these difficulties.

Strength and limitations

The strength of the current work is that it may be that only study which used a sway meter to measure sway discriminated between LBP group and non-low back pain group. The control of standing balance is a task of maintaining the body COM within the limits of BOS achieved by providing force on the support surface excursion of the COP the point of application of the ground reaction force measured by a force plate has been widely used to represented postural sway as an index of balance control. However these measures involve technical devices that can be usually and require processing protocols that can make them unfeasible for many clinics and research facilities. The need for a simple measure of postural sway exits due to the issue of balance problem and risk of fall. So this low technical sway meter was designed to address the need of clinicians and researchers with limited resources. It involves no electronics or computer processing. Thus assessment can be conducted in variety community setting and health care facilities.

The study also has a few limitations.

- First limitation is linked to the absence of cognitive status of participants.
- A final limitation is the inability to measure the alteration in sway with the orientation of the vestibular system.
- The limitation with respect to the sway include the fact that dynamic sway was not evaluated
- Absence of random sampling.

Future research

Future study should focus on the development of new experimental protocols based for example on 3D analysis to clearly verify the correlation between fear of fall and sway. These studies should evaluate the importance of the correlation for its influence on each anatomical segment of the body.

Conclusion

Patients with low back pain exhibit grater postural sway than healthy controls. Further the decreased postural stability in people with low back pain is correlated with fear of fall as extra stress has been laid on the balancing system.

References

1. Sipko T, Chantsoulis M, Kuczynski M (2010) Postural control in patients with lumbar disc herniation in the early postoperative period. European Spine Journal 19: 409-414.

2. Manek NJ, MacGregor AJ (2005) Epidemiology of back disorders: prevalence, risk factors, and prognosis. Current Opinion in Rheumatology 17: 134-140.

3. Wand BM, O'Connell NE (2008) Chronic non-specific low back pain – sub-groups or a single mechanism. BMC Musculoskeletal Disorders 9: 11.

4. Nardin M, Sci, Balague F, Cedraschi C (2006) Non-specific low back pain surgical and non-surgical low back pain. Clinical Orthopaedics and Related Research 443: 156-167.

5. Hutchinson AJP, Ball S, Andrews JCH, Jones GG (2012) The effectiveness of acupuncture in treating chronic non-specific low back pain: a systematic review of the literature. Journal of Orthopaedic Surgery and Research 7: 36.

6. Abnezar J (2006) The text book of orthopaedics, (2 edn) In: Posture Low Back Ache & disc Disease. Jaypee Brothers.

7. Ramchandran SK, Yegnaswamy R (2011) Measurement of postural sway with sway meter an analysis. Journal of Physical Therapy 2: 46-53.

8. Lehtola V, Loumajoki H, Leinonen V, Gibbons S, Airaksinen O (2012) Efficacy of movement control exercise versus general exercises on recurrent sub-acute non-specific low back pain in a sub-group of patients with movement control dysfunction. Protocol of a randomized controlled trial. BMC Musculoskeletal Disorders 13: 55.

9. Karaman H, Tufek A, Olmez G, Kavak GO, Kaya S, et al. (2011) 6 month result of transdiscal biacuplasty on patients with discogenic low back pain. International Journal of Medical Sciences 8: 1.

10. Swanenburg J, De Bruin ED, Favero K, Uebelhart D, Mulder T (2008) The reliability to postural balance measures in single and dual tasking in elderly fallers and non-fallers. BMC Musculoskelatal Disorders 9: 162.

11. O'sullivan SB, Schmitz TJ (2006) Physical rehabilitation, (5th edn) Examination of motor functions. Jaypee Brothers: Philadelphia.

12. Lafond D, Champagne A, Descarreaux M, Dubois JD, Prado JM, et al. (2009) Postural control during prolonged standing in persons with chronic low back pain. Gait and Posture Journal 29: 421-427.

13. Ruhe A, Fejer R, Walker B (2009) Altered postural sway in patients suffering from non- specific neck pain and whiplash associated disorder- A systematic review of the literature. Chiropractic and Manual Therapies Journal 19: 1-13.

14. Baldini A, Nota A, Tripodi D, Longoni S, Cozza P (2013) Evaluaton of the correlation between dental occlusion and posture using a force platform. Clinics (Sao Paulo) 68: 45-49.

15. Brumagne S, Janssens L, Knapen S, Claeys K, Johanson ES (2008) Persons with recurrent low back pain exhibit a rigid postural control strategy. European Spine Journal 17: 1177-1184.

16. Mientjes, Frank JS (1999) Balance in chronic low back pain patients compared to the healthy people under various conditions in upright standing. The 22nd Annual Conference of the north American congress on biomechanics, Waterloo, Ontario, Canada. Clin Biomech (Bristol, Avon) 14: 710-716.

17. Champagne A, Prince F, Bouffard V, DLafond D (2012) Balance, Falls related self-efficacy, and psychological factors amongst older women with

chronic low back pain a preliminary case control study. Rehabilitation Research and Practice 1155: 1-8.

18. Fritz JM, George SZ, Delitto A (2001) The role of fear avoidance beliefs in acute low back pain: relationships with current and future disability and work status. Journal of Pain 94: 7-15.

19. Leeuw M, Goosens MEJB, Linton SJ, Crombez G, Boersma K, et al. (2007) The fear avoidance model of musculoskeletal Pain: current state of scientific evidence. Journal of Behavioural Medicine 30: 77-94.