Original Article

Physical Therapy Rehabilitation Science

https://doi.org/10.14474/ptrs.2019.8.3.125
pISSN 2287-7576
eISSN 2287-7584

Phys Ther Rehabil Sci
2019, 8 (3), 125-133
www.jptrs.org

Comparison of postural control between subgroups of persons with nonspecific chronic low back and healthy controls during the modified Star Excursion Balance Test

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Objective: To compare the postural control between non-specific chronic low back pain (NSCLBP) subgroups and healthy people during dynamic balance performance using a modified Star Excursion Balance Test (mSEBT).
Design: Cross-sectional study.
Methods: Eighteen NSCLBP subjects (9 active extension pattern [AEP], 9 flexion pattern [FP]), and 10 healthy controls were enrolled in this study. All subjects performed mSEBT on their dominant leg on a force plate. Normalized reach distance and balance parameters, including the center of pressure (COP) displacement and velocity, were recorded.
Results: There were significant differences in mean reach distances in both posterolateral and posteromedial (PM) reach directions between AEP and healthy subjects (p<0.001) and between FP and healthy subjects (p<0.001). However, there were no significant differences among the three groups in the anterior reach direction. Also, the results showed no significant differences in mean COP variables (velocity and displacement) between pooled NSCLBP and healthy subjects. However, the subjects were reclassified into AEP, FP and healthy groups and the results showed a significant difference in mean COP velocity in the PM direction between AEP and FP subjects (p=0.048), and between AEP and healthy subjects (p=0.024).
Conclusions: The findings in this study highlight the heterogeneity of the individuals with NSCLBP and the importance of identifying the homogenous subgroups. Individuals with AEP and FP experience deficits in dynamic postural control compared to healthy controls. In addition, the findings of this study support the concept of the Multidimensional Classification System.

Key Words: Human body, Low back pain, Musculoskeletal diseases, Postural balance, Posture

Introduction

Low back pain (LBP) is one of the most common musculoskeletal disorders with more than 80% of individuals experiencing LBP at one time in their life [1]. Nonspecific chronic low back pain (NSCLBP) is considered to be one of the most common LBP classifications [2]. NSCLBP is defined as LBP for more than three months without known specific sources of pain and with no evidence of pathoanatomic and abnormality with imaging [3]. However, NSCLBP could result from different factors, such as biomechanical, psychosocial, and genetic factors or the interactions between some or all of them [4]. In addition, NSCLBP is considered as a disabling condition that limits daily activities of the affected people [5]. Therefore, understanding the mechanism of NSCLBP disorders may assist healthcare providers

Received: 20 June, 2019 **Revised:** 7 July, 2019 **Accepted:** 9 July, 2019

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to develop proper interventions.

Postural control is required to safely and effectively perform a wide range of daily activities [6]. Postural control is defined as the ability of the human body to maintain the center of gravity within the base of support [7]. However, studies have identified postural control changes in people with LBP especially in terms of center of pressure (COP) parameters (e.g., COP velocity and displacement) [8,9].

Numerous factors may contribute to postural control alterations in people with NSCLBP [10]. Deficits in the neuromusculoskeletal systems, such as a reduction in somatosensory input, processing, or motor output, have been found to contribute to alterations in postural control in people with NSCLBP [11]. In addition, studies revealed that LBP could affect postural stability through numerous co-existing factors such as pain, alteration in movement strategies, and fear of pain [10].

Different methods are used to detect postural control and dynamic balance deficits. However, many of these methods are complicated and costly [12]. The Star Excursion Balance Test (SEBT) is a simple tool that has been used to measure functional and dynamic balance [13]. The SEBT has been used to detect dynamic balance impairments that may lead to lower extremity injuries [14,15]. Recently, several studies have utilized the SEBT to detect dynamic balance impairments in people with LBP [13,16]. Also, SEBT is considered a challenging task for people with LBP. Therefore, the SEBT may provide clinicians with valuable information regarding postural control impairments and movement strategies in people with LBP [17]. The modified version of the SEBT (mSEBT) is used to reduce the potential fatigue effect and the redundancy among the eight directions in the original SEBT [18]. The mSEBT consists of three directions including the anterior, posteromedial and posterolateral directions. The mSEBT has shown to have excellent interrater reliability and strong intra-rater and test-retest reliability in detecting dynamic balance impairments [19,20].

The force plate has been used to quantify the COP oscillations during static and dynamic postural control in people with LBP [9,10]. Despite the large number of studies investigating postural stability in people with LBP, the results have been inconsistent with contradictory findings [9,10]. One reason behind these inconsistencies may be related to the complexity and heterogeneity of people with LBP [9,21]. Therefore, classifying people with NSCLBP into subgroups, according to the type of dysfunction, may be important in order to identify the adaptive postural control strategies within each subgroup [22].

Attempts have been made to classify individuals with NSCLBP [23,24]. One of these classification systems is the Multidimensional Classification System (MDCS) [24]. The MDCS outlines five motor control impairment (MCI) subgroups with the flexion pattern (FP) and active extension pattern (AEP) being the most common in the clinical setting [25,26]. Based on O'Sullivan [24], MCI subgroups exhibit full range of motion (ROM) in the direction of pain provocation. Also, MCI subgroups utilize modifications in body postures and movement strategies to deal with the expected pain.

Previous studies have investigated the physical characteristics between these two MCI subgroups (AEP and FP) and healthy subjects in terms of kinematics and muscle activity during static and functional tasks [27-29]. However, there is limited information about postural control and dynamic balance characteristics in these subgroups. Therefore, the purpose of this study was to examine postural control and dynamic balance performance between MCI subgroups (FP and AEP) compared to the healthy subjects using the mSEBT. The mSEBT is considered an extension activity that is based on the MDCS and include aggravating factors in AEP. Therefore, we hypothesized that postural control and dynamic balance during performance of mSEBT would be different in AEP subjects.

Methods

Subjects

A total of 28 subjects participated in this study from Loma Linda University Medical Health and the surrounding community. Subjects were recruited using fliers. LBP subjects were included in the study if they were between 18 and 60 years old, had LBP for more than 3 months, and the pain was localized to the low back and/or buttock regions only. The control subjects were healthy individuals who have been free of LBP for at least two years and have similar characteristics to subjects with LBP. The exclusion criteria for both groups were: signs of serious spinal pathology, fracture, malignancy, history of spinal surgery, lower extremity injury in the previous two years, vestibular dysfunction, or balance disorders. In addition, females were excluded from the study if they were breastfeeding or pregnant (self-reported) to avoid potential complications or side effects.

Measurement procedure

All tests were performed at the Physical Therapy Department in the School of Allied Health Professions, Loma Linda University, CA, USA. Data collection took approximately 60 minutes to complete. The study protocol and procedures were explained to the subjects in details by the primary researcher. After that, all subjects read and signed the informed consent. Then, demographic data such as age, weight, height and dominant leg, defined at the limb used to kick a ball, were obtained prior to the data collection session. All subjects completed a medical history questionnaire and the International Physical Activity Questionnaire-Short Form to measure the physical activity level. Subjects in the LBP groups were asked to report the measures for pain using the Visual Analogue Scale, disability levels caused by LBP using the Roland-Morris Disability Questionnaire and the presence of pain-related fear of movement using the Tampa Scale of Kinesiophobia (Table 1).

MCI subgroup classification

AEP and FP were chosen in this study because of their high prevalence [25,26]. To establish MCI subgroups classification (AEP and FP), comprehensive subjective and objective assessments were conducted. In the subjective assessment, the full history of the subject's LBP was taken as well as the pain behaviors, such as the easing and aggravating postures and activities. In the objective examination, the battery of postures and spinal ROM were observed. In addition, usual standing and sitting, full trunk flexion, extension, and side bending were evaluated. Finally, the Passive Physiological Intervertebral Movements at, above, and below the provoking lumbar segment were performed to assess the existence of joint hypo-mobility or hypermobility [28]. Previous research has identified that clinicians have good inter-rater reliability in applying the subclassification system [30,31]. Therefore, MCI subgroups (AEP and FP) subjects were examined and classified independently by two physical therapists based on MDCS criteria [24], and only subjects who had an agreement of both clinicians were included in the study.

Test description

The mSEBT is a measure of dynamic balance [18]. The original version consists of eight strips of tape placed at 45° angles to each other from the center of a grid. The subject stands on one leg at the center of the "star" created by the intersection of the tape pieces. Each strip of tape is labeled based on the excursion direction relative to the stance leg. Hertel *et al*. [18] found that there is considerable redundancy among the eight directions of the original SEBT and they proposed a modified version of the SEBT which was used in this study. The mSEBT consists of three directions including the anterior, posteromedial, and posterolateral directions. Strong intra-rater and test–retest reliability have been reported regarding this tool [19,32]. In addition, the predictive and construct validity of the test was supported in previous studies [18,33].

Data collection procedures

Verbal and visual demonstration of proper performance of the mSEBT were provided to the subjects. Then, the subjects were instructed to align the lateral malleolus of the dominant leg at the intersection point of the three directions with the

Table 1. Mean (SD) of baseline characteristics by study subgroups (N=28)

Characteristics	Study subgroups			
	AEP (n=9)	FP (n=9)	Healthy (n=10)	*p*-value[a]
Female[b]	5 (55.6)	8 (88.9)	7 (70.0)	0.290
Age (y)	28.8 (5.0)	27.2 (3.6)	26.8 (2.6)	0.510
BMI (kg/m^2)	25.8 (5.0)	23.5 (2.7)	23.8 (3.0)	0.370
Physically active[b]	9 (100.0)	9 (100.0)	9 (90.0)	0.760
Pain level[c]	2.8 (1.6)	4.4 (2.0)	-	0.070
TSK[c]	34.9 (8.2)	37.3 (3.7)	-	0.430
RMQ[c]	5.6 (0.9)	5.4 (0.5)	-	0.750

Values are presented as n (%) or mean (SD).
AEP: active extension pattern, FP: flexion pattern, BMI: body mass index, TSK: tampa scale for kinesiophobia, RMQ: Roland-Morris Disability Questionnaire, –: not available.
[a]One-way analysis of variance. [b]Chi Square test of independence. [c]Independent t-test.

foot oriented toward the anterior direction with their hands placed on their hips. After that, the subjects were instructed to reach as far as possible with the non-stance leg and pointing with their big toe to the marked tape and return to the starting position [34]. Subjects performed 6 practice trials prior to the actual test trials to minimize the learning effect [19]. Next, the three test trials were recorded in each direction (Anterior, PM and PL) with 15-second rest periods between each trial [18]. The subjects performed the mSEBT on the force plate without wearing shoes to eliminate the influence of varying footwear (Figure 1) [35]. The trial was considered invalid if one of the following situations occurred; the subjects removed their hands off of their hips, the heel of stance limb lost contact with the ground during reaching, the subject put weight onto their reaching foot on the ground, or lost their balance during reach out or return [36]. The leg length (from the anterior superior iliac spine to the medial malleolus) was measured with the subject in supine lying [36]. This measurement was used in normalizing the mSEBT reach distance for each subject [37]. The maximum reaching distance in every direction was normalized as a percentage of the stance limb length using this equation; maximum reach divided by leg length and the results were multiplied by 100. The mean value of normalized reach in each direction was calculated for analysis [36].

Data analysis

A single force plate (AMTI Optim; Advanced Mechanical Technology Inc., Watertown, MA, USA) was used to evaluate the postural control parameters. The COP data were sampled at 2,000 Hz and force plate movements were described as the following: Antero-posterior movement was represented by the Y-axis, while the medio-lateral (ML) movement was represented by the X-axis. ML and anterior-posterior (AP) displacements and velocity of COP were used for analysis. Visual 3D software (C-Motion Inc., Rockville, MD, USA) was used for raw data processing and analysis. COP data was filtered using a fourth order low-pass Butterworth filter with a cut off frequency of 5 Hz.

Statistical analysis

Large effect sizes were reported in prior SEBT studies in participants with knee and ankle disorders [15,35]. The sample size was determined using α=0.05, power=0.80, and an effect size f=0.65. According to power analysis, nine subjects are required in each group.

Data were summarized using mean and standard deviation for quantitative variables and counts (%) for qualitative variables. The normality of continuous variables was examined using Shapiro Wilk's test and Box plots. The characteristics of the subjects were compared among the study groups using chi-square for qualitative variables, and one-way ANOVA or independent t-test for quantitative variables.

Mean outcome variables were compared among the three groups (FP, AEP, and healthy) using one-way ANOVA. If the results of the test were statistically significant, post hoc testing using Bonferroni test was conducted. The level of significance was set at alpha=0.05. Statistical analysis was

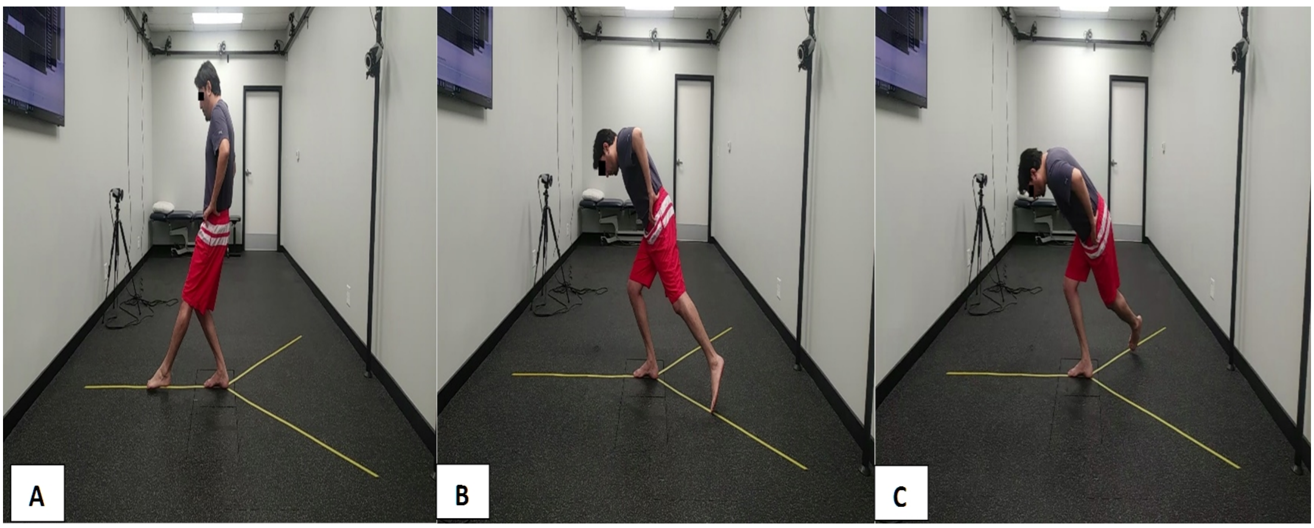

Figure 1. The modified Star Excursion balance Test. Subject reaches in the (A) anterior, (B) posteromedial, and (C) posterolateral directions.

performed using IBM SPSS Software version 25 for Windows (Chicago, IL, USA).

Results

A total of 28 subjects (18 with LBP and 10 healthy) with a mean age of 27.6±3.8 years and body mass index 24.3±3.7 kg/m^2 participated in the study. The demographic characteristics of the subjects by the study group are shown in Table 1. There were no significant differences in the characteristics among the three groups ($p>0.05$). In addition, results showed that there was no significant difference in baseline characteristics between pooled NSCLBP and healthy subjects ($p>0.05$, Table 1).

There was no significant difference in mean reach distance among the three groups ($F_{2,27}=1.0$, $p=0.38$, $\eta^2=0.07$) in the anterior direction. However, there was a significant difference in the mean reach distance in the PL and PM directions, by study group ($F_{2,27}=17.6$, $p<0.001$, $\eta^2=0.58$, and $F_{2,27}=9.3$, $p<0.001$, $\eta^2=0.43$, respectively). In the PL direction, there was a significant difference in mean reach distance between AEP and healthy (73.4±8.4 vs. 90.7±5.2, $p<0.001$), and FP and healthy (75.4±7.3 vs. 90.7±5.2, $p<0.001$). Similarly, in the PM direction, there was a significant difference in mean reach distances between AEP and healthy (81.3±10.9 vs. 93.3±4.5, $p=0.018$), and FP and healthy (76.7±9.8 vs. 93.3±4.5, $p=0.001$). However, there was no significant difference in mean reach distances between AEP and FP in PL and PM directions ($p>0.05$, Figure 2).

The results showed no significant differences in mean COP variables (velocity and displacement) between pooled NSCLBP and healthy subjects (Table 2). However, when the subjects were classified into AEP, FP and healthy groups, the results showed a significant difference in mean AP COP velocity in the PM direction between AEP and FP subjects (71.2±17.2 vs. 56.4±9.3, $p=0.048$), and between AEP and healthy subjects (71.2±17.2 vs. 55.1± 8.5, $p=0.024$) (Table 3).

Discussion

This study examined the differences in the mSEBT scores in two subgroups of NSCLBP compared with healthy subjects. In addition, it examined the dynamic postural control using the COP parameters during the performance of the mSEBT. We hypothesized that postural control and dynamic balance during performance of mSEBT would be different in AEP subjects. The results supported our hypothesis and there were significant differences in mean reach distances in both posterolateral and posteromedial reach directions between AEP and healthy, and between FP and healthy subjects. Also, there was a significant difference in mean COP velocities in the posteromedial direction between AEP and FP subjects, and between AEP and healthy subjects. In addition, our findings validate the MCI subclassification and provide more evidence regarding postural control compensatory strategies that may occur in these subgroups of individuals with NSCLBP. To our knowledge, this is the first study to examine the dynamic postural control deficits in people with NSCLBP by subgroups using the modified SEBT.

The results of this study indicated that the reach distances in the PL and PM directions were significantly lower in both AEP and FP groups compared to healthy group. However, there was no significant difference in mean reach distance in the anterior direction among the three groups. Subjects in both AEP and FP subgroups may have a limited pelvic anterior tilt compared to healthy subjects, which leads to de-

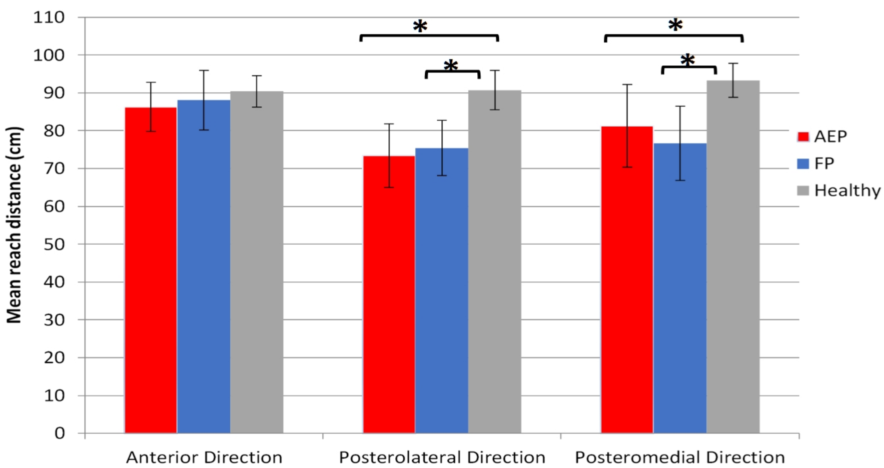

Figure 2. Mean reach distance (cm) by study group (N=28). AEP: active extension pattern, FP: flexion pattern. *Significant difference ($p<0.05$). Values are presented as mean (SD).

Table 2. Comparison of COP displacement and velocity between pooled LBP and healthy subjects (N=28)

Direction	COP parameter	Pooled LBP (n=18)	Healthy (n=10)	Cohen's d	*p*-value[a]
		Mean (SD)	Mean (SD)		
Anterior	Velocity (mm/s)				
	AP	64.2 (15.2)	64.8 (16.7)	0.040	0.930
	ML	40.6 (11.8)	37.5 (6.8)	0.300	0.459
	Displacement (mm)				
	AP	245.4 (54.2)	275.4 (59.8)	0.540	0.187
	ML	170.8 (48.7)	192.0 (72.6)	0.370	0.364
Posterolateral	Velocity (mm/s)				
	AP	60.1 (14.0)	62.1 (11.6)	0.150	0.713
	ML	50.0 (12.9)	51.3 (9.5)	0.110	0.786
	Displacement (mm)				
	AP	234.3 (65.6)	263.3 (19.6)	0.540	0.096
	ML	216.6 (55.5)	249.2 (79.7)	0.510	0.214
Posteromedial	Velocity (mm/s)				
	AP	63.8 (15.4)	55.1 (8.5)	0.660	0.065
	ML	45.6 (15.4)	46.4 (10.9)	0.060	0.886
	Displacement (mm)				
	AP	243.6 (68.5)	263.7 (80.5)	0.280	0.491
	ML	198.6 (66.8)	231.1 (67.2)	0.490	0.230

COP: center of pressure, LBP: low back pain, AP: anterior-posterior; ML: medio-lateral.
[a]Independent t-test.

Table 3. Comparison of COP displacement and velocity among the three groups (N=28)

Direction	COP parameter	AEP (n=9)	FP (n=9)	Healthy (n=10)	η^2	*p*-value[a]
		Mean (SD)	Mean (SD)	Mean (SD)		
Anterior	Velocity (mm/s)					
	AP	67.2 (18.4)	61.2 (11.4)	64.8 (16.7)	0.026	0.721
	ML	40.7 (12.0)	40.5 (12.3)	37.5 (6.8)	0.021	0.764
	Displacement (mm)					
	AP	244.4 (53.2)	246.4 (58.3)	275.4 (59.8)	0.066	0.425
	ML	160.8 (66.2)	180.8 (20.9)	192.0 (72.6)	0.052	0.515
Posterolateral	Velocity (mm/s)					
	AP	62.3 (17.6)	58.0 (9.8)	62.1 (11.6)	0.024	0.737
	ML	52.6 (12.0)	47.5 (13.9)	51.3 (9.5)	0.035	0.643
	Displacement (mm)					
	AP	233.2 (61.6)	235.4 (73.2)	263.3 (19.6)	0.066	0.425
	ML	221.8 (53.8)	211.4 (60.1)	249.2 (79.7)	0.063	0.444
Posteromedial	Velocity (mm/s)					
	AP	71.2 (17.2)	56.4 (9.3)	55.1 (8.5)	0.285	0.015[b]
	ML	49.4 (15.1)	41.8 (15.6)	46.4 (10.9)	0.051	0.519
	Displacement (mm)					
	AP	245.9 (57.6)	241.3 (81.5)	263.7 (80.5)	0.019	0.786
	ML	185.4 (57.3)	211.8 (76.3)	231.1 (67.2)	0.081	0.350

COP: center of pressure, AEP: active extension pattern, FP: flexion pattern, η : effect size, AP: anterior-posterior, ML: medio-lateral.
[a]One-way analysis of variance. [b]Significant difference between AEP and FP and between AEP and Healthy (p<0.05).

crease in the PL and PM reaching distance [38]. Also, reaching in posterior directions in the mSEBT are more challenging compared to anterior reaching due to excessive lumbar lordosis that is required to finish the task which stresses the postural control system in NSCLBP groups to a point that limits the subjects' reach [39]. In addition, people with

NSCLBP are more dependent on visual feedback due to altered proprioceptive input [40]. Reaching in posterior direction requires subjects to rely on proprioceptive input and the vestibular system to maintain the single leg balance compared to reaching forward where the subjects can use their vision for assistance. Therefore, there was no significant difference in reaching forward among groups [41].

Another explanation could be related to the pain avoidance behavior in both AEP and FP subjects [24,42]. Subjects in both MCI groups may anticipate pain during posterior reach which may lead them to avoid performing the task vigorously and consequently this results in poor performance in mSEBT in PM and PL directions compared to healthy subjects [39].

These findings are consistent with the Hooper *et al*. [43] study, that found significant differences in reach distances between the LBP subgroups (current LBP vs. LBP history) compared to healthy subjects in the PL and PM directions but not in the anterior direction. On the other hand, Ganesh *et al*. [13] found that people with LBP have a significant decrease in reach distances in the PM, PL, and the anterior directions. However, Appiah-Dwomoh *et al*. [36] did not find any significant differences in any reach directions between healthy athletes and athlete with LBP. The inconsistency in the findings of the above studies can be explained by many factors. First, the heterogeneity of the LBP subjects in the previous studies may lead to the differences in the postural stability strategies that each subject used to maintain their balance. In other words, findings in one subgroup of subjects were counteracted by other subgroups when the people with NSCLBP were studied heterogeneously (the washout effect phenomenon) [44]. Second, LBP subjects' characteristics, such as age and physical activities were different which may contribute to these differences in the results [45],

Our results showed no significant difference between the pooled NSCLBP and healthy subjects in mean COP measures (displacement and velocity). After subgrouping NSCLBP subjects into FP and AEP groups, the results showed a higher mean COP sway velocity in AEP subjects compared to the FP and healthy subjects in PM direction. This finding confirms the presence of washout effect and establishes the need for studying the homogeneous subgroups of NSCLBP in order to better understand the NSCLBP disorder [46].

Our findings support the findings by Seraj *et al*. [21], who found no significant differences in postural control variables between the pooled NSCLBP subjects and healthy subjects during lifting task. However, when NSCLBP subjects were classified into AEP and FP, the results revealed that AEP subjects had a significant difference in postural control compared to FP and healthy subjects during lifting task.

In our study, AEP subjects had a higher sagittal COP velocity as compared to FP and healthy subjects during PM direction of mSEBT. One of the reasons behind this finding may be the nature of the required task. Reaching in the PM direction requires anterior pelvic tilt and stresses lumbar spine resulting in excessive lordosis or hyperextension of lumbar spine. Based on the MCI classification, the standing and extension positions are more likely to aggravate pain in the AEP group as compared to the FP group [26]. According to the pain adaptation model, the normal response of the body is to increase paraspinal muscle activity in the AEP subjects, which may increase the load on the trunk structure [46]. These changes in proprioception and the muscle activity may result in more postural sway velocity in the AEP subjects as compared to the FP and the healthy subjects.

Subjects in the AEP group will tend to move slower in the PM direction as pain-avoidance behavior to finish the task with less pain. Slower movement in the PM direction will result in longer duration of the single leg stance and more activation of the lumbar extensor muscles resulting in fatigue which leads to the increase in body sway [47]. As noted earlier, the subjects in this study were young. Therefore, the nervous system will have a faster reaction in order to correct body sway, and to maintain stability. According to Newton's third law, each action has a reaction that is equal in magnitude and opposite in direction. Also, according to the pendulum theory, anterior acceleration will be corrected by posterior acceleration, which results in body sway. Since the correction of body sway was fast, we expect that the repeated sway action will be fast as well resulting in the increase in COP sway velocity.

We did not find any significant differences between the FP and the healthy subjects in COP displacement and velocity, suggesting that the FP and the healthy subjects may adopt similar strategies for postural control during the dynamic balance test [46]. Also, it could be that the mSEBT was not challenging enough to aggravate the pain in the FP group to exhibit different postural control strategies compared to the healthy subjects. In addition, it is expected to have no significant difference in the mean displacement of COP among the groups due to the fact that all subjects were young and physically active [36].

This study presents several unique contributions to the

LBP literature. First, this study was the first to examine mSEBT in homogenous subgroups of NSCLBP (AEP and FP) and compare them to healthy subjects. In addition, our results showed that reaching distance alone is not enough to show the whole picture of the postural control deficits in NSCLBP subgroups, and it is important to investigate other variables, such as COP velocity in order to identify the postural control deficits those population.

There were some limitations in this study. First, the sample size was small requiring future research needs to recruit a larger sample size to investigate the postural stability differences between NSCLBP subgroups. Second, the pain and disability level in NSCLBP subgroups were relatively low. Subjects with NSCLBP with high levels of pain and disability may exhibit different postural stability strategies. Third, trunk muscle activation or trunk kinematics was not measured. This information could assist in better understanding of the compensatory movement patterns that each subgroup uses during dynamic balance. In addition, the number of the subjects in pooled NSCLBP was higher than healthy subjects. Therefore, this should be put into consideration during interpretations the findings of this study.

In conclusion, the findings in this study highlight the heterogeneity of the subjects with NSCLBP and the importance of identifying the homogenous subgroups. The findings showed that the dynamic balance and postural control were significantly different between AEP and FP, and AEP and healthy subjects during dynamic balance using the mSEBT. The AEP subjects exhibited more body sway velocity in the posteromedial direction of the mSEBT. However, there were no significant differences observed between FP and healthy subjects, suggesting that FP and healthy individuals may adopt similar postural control strategies during dynamic balance. Clinically, the mSEBT should be incorporated into a NSCLBP rehabilitation program to evaluate dynamic balance and monitor rehabilitation progression of NSCLBP homogenous subgroups.

Acknowledgements

The authors would like to thank Prarthana Dhotre for her assistance in data collection.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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