Original Article

Balance Recovery Reactions in recurrent non specific low back pain patients

Yasaman Etemadi*; Amir Massoud Arab, PhD.; Mahyar Salavati, PhD.
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Objectives: Altered movement strategy and postural control has been observed in Low Back Pain (LBP) patients. Objective of this study was to determine postural response following support surface translation, also correlations between postural response related measures and disability caused by LBP.

Methods: 20 healthy subjects and 20 patients with recurrent non specific LBP participated in this study. They were instructed to stand on a moveable platform with each foot placed on a separate force plate. Platform was translated backward. Center of pressure (CoP) displacement data was derived and used for calculation of postural parameters. Reaction time, Latency, mean initial Velocity and peak displacement were used as measures of postural stability. Disability was assessed by the Oswestry Disability index (ODI) and Roland-Morris disability questionnaire (RMDQ). Correlation between balance and disability measures were assesed using Pearson's correlation coefficient.

Results: Subjects with LBP had delayed reaction time, prolonged Latency and slower velocity compared to healthy subjects. Also, correlation between CoP measurments and physical function were poor.

Discussion: This study reveald altered postural response against purturbation in patients with LBP and no association between CoP measures and disability.

Keywords: Low back pain, Balance, Center of pressure, disability questionnaire

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Introduction

Low back pain (LBP) is a major public health problem causing individual suffering and high costs [1]. One of the important consequences of back pain is disability, which account for the vast majority of its related costs. A precise evaluation of LBP disability is important because it provides a measure by which the impact of the disorder is evaluated and the effectiveness of a particular treatment can be judged [2].

Well-functioning postural balance is necessary to maintain normal daily life and physical activity. Postural balance involves dynamic interactions of vestibular, visual and somato- sensory information analyzed in a complex regulatory feedback system; resulting in constantly changing output. Many factors may contribute to decrease in postural stability, including ageing, neurological or musculoskeletal disorders, e.g. LBP [3]. Postural stability has been assessed using various techniques: force platform technique addressing COP measures is among the tools frequently used [4].

The Core Sets for LBP of the International Classification of Functioning, Disability and Health (ICF) have ranked within the body function domain the categories related to sensory motor function– as highly relevant functional impairments in LBP patients [5]. Assessment of postural balance using post-urography in LBP patients has the advantage that the global functioning of the sensory motor system with its sensory input, central processing and motor output is measured [6].

Numerous researchers have reported impaired postural control during quiet standing in LBP patients compared with healthy subjects [7-10]. Deficit in either of the musculoskeletal and neural (including, sensory input and motor output) components has been proposed to be associated with poor postural control in LBP patients by these researchers. Increased lumbar lordosis, impaired lumbar and lower extremity

* All correspondences to: Yasaman Etemadi, PhD. candidate, Email: <etemadi_y62@yahoo.com>

Proprioception, and delayed trunk muscle response are some of the manifestations of such deficits associated with impaired balance [11]. But evaluation of postural control in more dynamic and challenging condition in patients with LBP is necessary to determine their ability to respond in this situation, which are common in daily life. One way for simulating this environment is perturbation of standing balance via sudden motion of platform on which the subject stands. Altered postural control in LBP subjects in mentioned situation could predispose them to further injury by limiting their ability to respond to external perturbation. Also, balance deficits, may translate into problems such as falls and fear of falling, with self-imposed restrictions on activity and participation [12-13].

So, the aims of this study were: 1) to determine if there are significant differences in postural responses following support surface perturbation between persons with recurrent non specific LBP and healthy control; 2) to investigate whether postural response parameters are related to level of perceived disability.

Material and methods

Participants 20 individuals suffering from recurrent nonspecific low back pain and 20 people matched controls participated in this study. Matching criteria were sex, age, and BMI. Patients were recruited from physical therapy clinic of Rasul-e Akram hospital with diagnosis of non specific LBP. They were eligible for the study if they were between 20 and 45 years old; suffer from recurrent LBP and moderate level of pain intensity (3-7 on visual analogue pain rating scale (VAS). Recurrent LBP was defined as experience of at least 2 episode of pain during last year which takes at least 2 days and affect functional ability [14]. They were excluded if they had pain below the knee, presence of any neurological sign, recent surgery, history of spinal complication (e.g. fracture), balance or cardiovascular disorder, severe musculoskeletal deformity or injury to the lower extremity that would interfere with testing. Control subjects were selected based on good medical history and absence of back pain during last year. Subjects in both groups should not perform sports on a regular basis. The study protocol was approved by the Ethics committee of the University of Social Welfare and Rehabilitation Sciences. Each subject gave written informed consent.

Equipment and measures - The present analysis focused on feet-in-place reactions. The Neuro- Com SMART Equi Test® (version 8.1.0), an internationally widely used post urographic examination tool, was used to produce perturbation in our study. The SMART EquiTest® utilizes a dynamic 18″×18″ dual force plate. The device quantifies the force applied by the body to platform. Force plate signals were used to determine anter oposterior (AP) CoP excursions during the postural response. Signals were sampled at a rate of 500 Hz. Data were captured for 0.5 s prior to perturbation onset, and for 2 s following perturbation onset. Post-urographic raw recordings obtained from this System were used for further processing to find temporal and magnitude characteristics of the response, including Reaction time (time between the onset of perturbation and the initiation of a subject's active postural response), Latency (time from initial active response to the first maximum CoP displacement, amplitude (amplitude of first peak in CoP displacement) and average initial CoP velocity (measured between response onset and first peak in CoP displacement). Result of another unpublished study showed acceptable reliability of these parameters using this test protocol. Figure (1) illustrates how these values were computed for a COP trace.

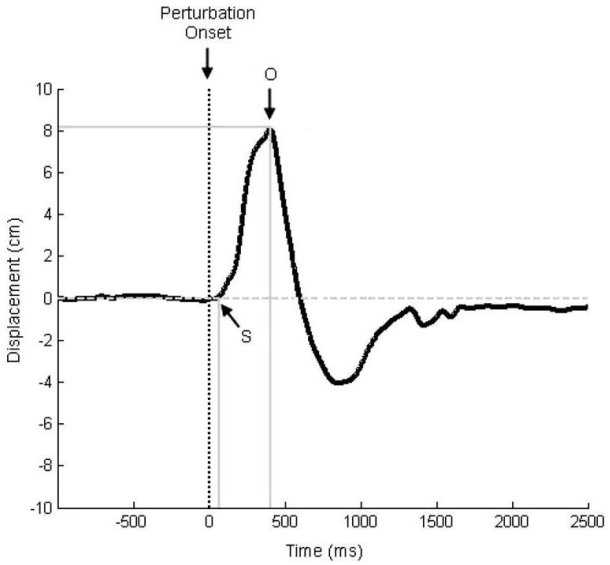

Fig.1. Computation of three dependant variables: Reaction time (onset-S), Latency (S-O), mean initial Velocity (velocity during S-O)

A key disability measure for studying patients with LBP is the functional disability questionnaire. Oswestry Disability index (ODI) and Roland-Morris disability questionnaire (RMDQ) are brief instruments measuring the impact of LBP on daily function. Both measures have been validated, tested

successfully for reliability and found to be responsive in LBP population [15]. Persian versions of the ODI and RMDQ were reliable and valid instruments to measure functional status in Persian-speaking patients with LBP [16]. Pain ratings were performed on a visual analogue scale (VAS) that ranges from 0 (no pain) to 10 (severe pain).

Experimental procedures - Before post urographic testing, all the test subjects received oral explanation of the following measurements. For post urographic measurements subjects stood barefoot in the ‘‘central resting position’’ on the force plate and faced a visual screen with closed eyes. The foot positions were traced and marked on the force platform to ensure correct repositioning of the feet following resting or stepping. In order to avoid falls, all patients and healthy controls were attached to a safety harness. During the different test conditions all subjects were asked to maintain their balance in response to the perturbation but were intentionally not given any guidance about how to respond. The trial was interrupted, when patients took a step or grabbed an object to maintain balance. These interrupted trials were not included in the analysis. Perturbations were administered unexpectedly to the upright standing subject by translating the platform into posterior direction (scaled translation amplitude according to the subject’s height). Each of translation sequences comprised of three trials. Mean of tree trials were used. After receiving 3-4 practice trials main trials were performed. In order to reduce risk of fatigue affecting CoP, subjects had 10 min breaks between trials.

Statistical analysis - Descriptive statistics were used to characterize participants. Because most of variable were normally distributed according to Kolmogorov-Smirnov Test, parametric test were used for all analysis. Differences in characteristic and postural response measures of subjects (LBP vs. no LBP) were tested with T-test. The relation between disability questionnaire and postural variables were assessed with Spearman partial correlations. Value of less than 0.05 was used to determine significance.

Results

Participants’ demographic characteristics are listed in Table (1). At the time of testing; subjects of LBP group were not significantly different from subjects of other group with regards to age, height and BMI. Besides, two groups had similar distribution of male and female participants.

Table 1. Main Demographic characteristics of subjects

Variables	Group		Comparison
	LBP (n=20)	Healthy (n=20)	
	Mean (SD)	Mean (SD)	P Value
Age	31.68 (8.63)	30.75 (8.25)	0.73
Height	171.63 (8.54)	170.55 (7.78)	0.68
Weight	67.37 (9.35)	65.05 (10.73)	0.47
BMI	22.76 (1.47)	22.26 (2.53)	0.45
Sex (M/F)	10/10	11/9	0.71

LBP subjects had delayed reaction time and prolonged latency in response to perturbation. Also, mean initial velocity was slower in this group, but Amplitude for two groups were not statically different (Table 2).

Table 2. CoP measures in anterior-posterior direction in response to backward translation

Variables	Group		Comparison
	LBP (n=20)	Healthy (n=20)	
	Mean (SD)	Mean (SD)	P Value
Reaction Time	169.55 (12.11)	161.23 (8.30)	0.05
Latency	190.75 (16.15)	160.07 (16.97)	0.03
Amplitude	4.30 (1.65)	5.72 (1.99)	0.06
Velocity	23.92 (7.71)	37.87 (8.53)	0.00

The results of Spearman partial correlations between CoP measures and disability questionnaire score are listed in Table (3). Approximately all of the correlation coefficients were not significant (p>05) and poor.

Table 3. Correlations between CoP measures and disability questionnaire score

Variables	RMDQ		ODI	
	p value	r	p value	r
Reaction Time	0/15	0/43	0/10	0/48
Latency	0/90	0/03	0/69	0/12-
Amplitude	0/48	0/22	0/60	0/16
Velocity	0/76	0/09	0/69	0/12

Discussion

This study assessed postural responses of subjects with recurrent non specific low back pain compared to healthy control. In general LBP subjects had

responses with delayed reaction time, prolonged latency and decreased velocity. Although amplitude for two groups were not statically different, but there was a tendency to have smaller amplitude in LBP group. These finding are consistent with study of Henry that reported LBP subjects had CoP responses that were delayed in onset and tendency to have prolonged latency in response to posterior perturbations [12].

Low back pain is often accompanied by deviations in motor performance [17]. LBP-related changes in control of trunk movements may be one of the factors related to impaired balance control. Adaptation of a strategy that result in stiffening of trunk and lower extremities is as a protective mechanism against anticipation of pain or fear of movement and it may limit velocity of trunk excursion [12]. But trunk movement is critical to balance maintenance. As the upper body constitutes two-third of body weight, even small, uncoordinated movements of the trunk may increase the risk of balance loss. Increased trunk stiffness may be beneficial for balance control, as it reduces the effect of mechanical perturbations on trunk posture. On the other hand, increased trunk stiffness may hamper performance of compensatory movements after a mechanical perturbation and compromise balance control [18]. Change in pattern of muscle activity is another possible factor related to altered postural response. Trunk stability requires appropriate timing and magnitude of activation of muscles and LBP is associated with altered muscle recruitment patterns (in terms of magnitude and time) which have been implicated as possible cause or consequence of back pain [19].

Finally, Change in postural strategy may underline dysfunction of peripheral proprioceptive system or central integration of proprioceptive information [20]. proprioceptive inputs are important for maintenance of balance [21]. Altered proprioceptive feedback from trunk or lower extremity and reduced sensitivity of peripheral system may decrease ability to detect motion of platform during dynamic stance and could alter timing of postural responses [12, 20]. people who have neuropathies with somatosensory loss also demonstrated postural response with similar altered temporal features [12].

Another objective of this study was to assess whether postural response variables are related to the functional disability in patients with LBP. Results indicate that the measured postural variables were not related to disability questionnaire scores. Correlations were not significant and coefficients were fairly low. Our results are in line with previous studies with same purpose that reported no association between CoP parameters and pain or functional capacity in static stance [3, 22]. These results might be biased due to population characteristics or support the idea that altered postural response has only a part in disability of patients with LBP. Besides, disability questionnaires are self evaluation of functional disability and show perception of patients about their condition. So, numerous factors, such as psychosocial or environmental factors have a major impact on this perception [2].

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