Evaluation of Static and Dynamic Balance Tests in Single and Dual Task Conditions in Participants With Nonspecific Chronic Low Back Pain

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Abstract

Objective: The purpose of this study was to investigate static and dynamic balance tests in single, dual cognitive, and dual manual task conditions in participants with and without nonspecific chronic low back pain.

Methods: In this case control study, 40 patients (age range 18-50 years) with nonspecific chronic low back pain for at least 3 months and 40 healthy participants matched for age, weight, height, and sex participated in this study. Balance performance was evaluated using static (One Leg Stance) and dynamic (Modified Star Excursion Balance Test, 10-m walk test, and Timed Up and Go) balance tests. All tests were performed in three conditions: single task (balance only), dual cognitive task (balance and counting numbers backward), and dual manual task (balance and carrying a cup of water).

Results: The results indicated that different balance tests were impaired in dual task conditions compared with single task in each group. Cognitive and balance performances were not significantly different between nonspecific chronic low back pain and healthy participants in all clinical balance tests.

Conclusion: It seems that the static and dynamic balance performance under dual task conditions (excluding the Modified Star Excursion Balance Test) was impaired in each group. Dual tasking did not differ between nonspecific chronic low back pain participants with low level of pain and disability compared with healthy participants. (J Chiropr Med 2017;xx:1-6)

Key Indexing Terms: *Low Back Pain; Posture; Attention*

Introduction

Low back pain (LBP) is one of the serious problems that leads to loss of working days in industrial societies.[1] It has been estimated that low back pain has been the main cause of years of living with disability in 86 of 188 countries between 1990 and 2013 based on the Global Burden of Disease Study 2013.[2] Prevalence of low back pain is 65% to 80% during a human lifetime and billions of dollars are spent annually for treatment of low back pain in the United States.[1] It is estimated that approximately 70% to 85% of people have experienced low back pain with recurrent symptoms at least once during their life, and 4% to 33% of patients suffer consistently from chronic pain.[3,4]

Postural control is the control of body position in space to maintain balance and orientation.[5] Although maintenance of postural control is essential in static and dynamic conditions, dynamic postural control plays a more critical role because individuals are participant to different threats during their daily activities and dynamic states. A review of the literature indicates that improvement of postural control using rehabilitation training could alleviate pain in musculoskeletal disorders.[6,7] For example, Kent et al[8] reported that posture and movement retraining using motion-sensor biofeedback can lead to improvement of pain and functional disability in patients with chronic low back pain. Therefore, these studies indicated that the improvement in postural control may result in improvement of pain and disability symptoms.[6-8] Previous researchers have reported impaired postural control in chronic LBP.[9-11] It has been proposed that balance impairment in LBP patients may correlate with deficits in the musculoskeletal and neural systems, such as compromised lumbar proprioception and delayed muscle response, which finally decrease lumbar stabilization.[9,12]

The traditional view states that postural control is automatic and demands minimal attention.[13-15] Recently, however, researchers have suggested that it is attentionally demanding.[13-15] It is assumed that the interaction between postural and cognitive tasks depends on many factors, such

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as postural and cognitive task complexity, aging, integrity of sensorimotor system, and balance abilities.[16] Therefore, sensory motor deficit in these patients could be compensated by higher cognitive systems. When cognitive load enhances through the addition of a dual task, it would be expected to intensify impaired postural control in patients with low back pain.[17]

The dual task paradigm is a new method to investigate the attentional demand of postural control.[16,18,19] With regard to limited capacity theory, simultaneous performance of 2 tasks will compromise the performance of one or both tasks because of competition for attentional resources.[20] Salavati et al[15] studied the effect of dual tasking on static postural control in participants with nonspecific low back pain. They reported that there was no significant difference while performing a cognitive task (Backward Digit Span Task) between patients with low back pain and healthy participants using force plates.[15] On the contrary, Sherafat et al[21] reported that postural sway decreased with an increase in the level of cognitive difficulty in nonspecific LBP patients during dynamic postural control. In fact, postural control deficit in LBP is related not only to sensorimotor impairment but also to cognitive dysfunctions in terms of slow psychomotor speed and impaired short-term memory.[11,22] Therefore, the current data highlighted the importance of the role of attentional resources as the third element of postural control in LBP patients.

Considering all of these documents, it has been reported that posture maintenance plays an important role in static and dynamic situations during daily activities. On the other hand, several studies have reported that evaluation of balance under dual tasking has a priority compared with single task conditions as a result of the multitasking nature of the modern society.[23-26] In addition, Salavati et al[15] suggested that evaluation of static postural control under dual tasking might not be sensitive enough to identify attentional demand of postural control in chronic LBP patients. Thus, assessment of dynamic balance under dual tasking can better reveal subtle balance deficiency than assessment of static balance while performing dual tasks. So it is expected that we observe more attentional interference in dynamic balance task compared with static balance task.

Additionally, the assessment of postural control has been performed using both the laboratory and clinical tests. It seems that the clinical tests are more affordable and cost-effective methods to evaluate postural control in clinical environments. The most important point is that improvement of the laboratory results does not essentially lead to improved postural control while the clinical findings of improving the postural control may be a better indicator of posture performance. If the performance of balance tests is affected by dual task conditions, it can be used as a prognostic factor for individuals with chronic LBP. When balance performance is disturbed, the risk of injuries increases because it can affect the lumbar spine stability as a result of changes in postural recovery strategies.[9]

Thus, the aim of this study was to evaluate and compare the clinical balance tests in single and dual task conditions in nonspecific chronic low back pain patients. In the present study, 2 main questions were addressed:

1. Are laboratory results consistent with clinical balance tests of static and dynamic balance in chronic LBP participants under dual task conditions?
2. Did the response to dual tasking differ between participants with and without chronic LBP?

Methods

Participants

This experiment was a case control study. Forty patients with nonspecific chronic low back pain (age range 18-50 years) and 40 healthy participants (age range 18-50 years) matched for age, weight, height, and sex took part in this study. The participants were recruited by flyers through a convenience sampling method from students and staff of Shiraz University of Medical Sciences.

They were included if they had chronic LBP for at least 3 months with a pain score of 3 to 5 out of 10 on numerical rating scale (NRS; 0 = no pain, 10 = severe pain)[21] and a pain score lower than 3 at the time of testing.[15] To evaluate the nature of postural control changes under dual tasking in chronic LBP patients, we controlled the pain intensity before testing because of the effect of pain on motor and postural control dysfunction.[15] Also, they were asked to respond to Hospital Anxiety and Depression Scale (HADS) before testing. If participants had an anxiety score lower than 8, they were included in this study. Because the level of anxiety affects postural control, we included only patients with low levels of anxiety to control the confounding factors.[27,28]

Participants were excluded if they had a history of spinal surgery for at least the previous 3 months, uncorrected vision impairment, vestibular dysfunction, auditory deficits, the presence of nerve root compression resulting in neurologic symptoms, trunk or spinal deformity, spinal pathologic conditions, and use of any tranquilizer that might influence their balance and pregnancy. All participants signed an informed consent form approved by the Ethics Committee at Shiraz University of Medical Science (#11686).

Procedure

We used clinically different balance tests in different conditions: One Leg Stance (OLS), Modified Star Excursion Balance Test (SEBT), Timed Up and Go test (TUG), and 10-m walk test.

Static balance was assessed by OLS. Also, the TUG,[29] 10-m walking test,[30] and Modified SEBT[31] were used as measures of dynamic balance.