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Chronic low back pain sufferers exhibit freezing-like behaviors when asked to move their trunk as fast as possible

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Abstract

BACKGROUND CONTEXT: The effect of chronic low back pain (CLBP) on the kinematic parameters of trunk motion has received much more interest in this last decade. However, there are no descriptions of the motor strategies that occur when patients perform trunk movements in the three anatomical planes at different pace conditions.

PURPOSE: To investigate motor strategies used by CLBP patients and asymptomatic people while performing different go and back trunk movements in an upright standing position.

STUDY DESIGN: A comparative study.

PATIENT SAMPLE: The control group (CG, n=33) included 14 men and 19 women with no history of low back pain, and the chronic low back pain group (CLBPG, n=49) included 21 men and 28 women.

OUTCOME MEASURES: Kinematic data were analyzed during six trunk movements: flexion, extension, left and right lateral bendings, and rotations under two pace conditions (preferred and fast paces).

METHODS: A three-dimensional optoelectronic motion analysis system was used to assess static (trunk inclinations and base of support) and dynamic (range of motion [ROM] and mean angular velocity of the trunk) parameters during the go and back phases of trunk movements.

RESULTS: In the initial position, CLBPG showed a more forward-tilted trunk inclination (2.1°±1.1°, p=.013) compared with CG. The base of support was significantly higher in CG (+22.7 cm^2, p=.009) during the fast pace when compared with the preferred pace. Regardless of the pace condition, ROM and mean angular velocity of the trunk were significantly lower in CLBPG for all examined movements and the pace condition did not significantly alter ROM. At the preferred pace, both groups displayed the same motor strategy: they all went faster during the second phase of movement than during the first phase. However, at the fast pace, while CG was going faster during the first phase than during the second, CLBPG maintained the same motor strategy as at the preferred pace.

CONCLUSIONS: Contrary to CG who changed its motor behavior from a preferred pace to a fast pace, CLBPG exhibited freezing-like behaviors. This original result highlights the importance of studying the velocity. The use of this parameter may improve the diagnosis of CLBP patients and could be a key indicator for treatment progress and long-term monitoring.

Keywords: Chronic low back pain; Diagnostic; Trunk; ROM; Velocity; Motor strategy

FDA device/drug status: Not applicable.

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Introduction

Chronic low back pain (CLBP) continues to be a common and costly condition worldwide. Countless journals contain reports on new developments related to low back pain risks and prognostic factors, new clinical interventions, and suggestions for improved care [1]. However, CLBP defies diagnosis and treatment and continues to be a taxing condition to manage. This ascertainment can be explained by the prevalence of non-specific LBP patients (60%–80%) and their common recurrence [2]. Indeed, the term ''non-specific low back pain'' highlights the lack of clear pathological or physiological markers [3,4], which make diagnosis more difficult and treatment less effective [5]. Traditionally, the medical management of patients with CLBP is based on clinical history and physical findings [6]. The measurement of trunk motion is routinely used in clinical assessment of CLBP by means of different tests such as the fingertips-to-floor test, as well as the skin distension and inclinometer methods [7–9]. These measures are important to highlight physical disorders in CLBP patients and evaluate the efficiency of the proposed treatments. However, their metrological properties are strongly discussed because of the large variability between subjects, making the use of normative values impossible [10]. Besides, the majority of these tests are limited to measurements obtained only in a final static position reached at the end of the investigated movements [6]. Beyond these observations, clinicians need further information to properly understand motion dysfunctions related to CLBP [6].

Investigations to assess how CLBP patient moves are thus necessary. Within this framework, a quantitative and qualitative method for measuring spine motion that could be regularly used in clinical diagnosis and monitoring must be developed [3].

The effect of CLBP on kinematic parameters has received much more interest in this last decade. It is already well known that CLBP is associated with a loss of spinal stability [11], a decrease in trunk mobility [12], and an increase in time of movement implementation [12]. More interestingly, it has been shown that the decline in movement velocity when tasks were performed at preferred velocity was strongly correlated with the loss of functions and also with disability [13–15]. According to Larivière et al. [11], who support the belief that increasing task difficulty could help to better reveal a potential impairment, pace can be used as a condition requiring patients to perform tasks as fast as possible. For example, Marras and Wongsam [16] examined the movement velocity of the lumbar spine only in the sagittal plane. They found a 50% reduction in flexion velocity and a more pronounced reduction in extension under maximum velocity conditions (more than 90%) in CLBP patients when compared with the control group (CG). They also found that control subjects can double their velocity from normal to maximum pace condition, whereas CLBP patient recorded less than double. Moreover, Marras and Wongsam [16] showed that velocity measure had a high potential to discriminate and quantify different trunk movements. It is worth noting that all these findings have been highlighted in lumbar forward flexion only during CLBP treatment target to improve total trunk mobility in the three anatomical planes. In light of these findings, it appears necessary to confirm the relevance of assessing movement velocity [17], especially because this parameter is considered a key variable to discriminate CLBP patients from control subjects [6,12].

To the best of our knowledge, there is no information as of yet regarding the effect of pace condition (preferred pace or as fast as possible) on range of motion (ROM) when CLBP patients or controls execute trunk movements in the respective three anatomical planes. In addition, during a same trunk movement, controls and patients could exhibit different motion timings between go and back phases. In case CLBP patients would exhibit different motor strategies than asymptomatic people, one can assume that this difference may already exist during the static position preceding the different movements. For example, a specific postural adjustment could be highlighted by an increase in the base of support preceding a movement performed at a higher pace.

In light of these considerations, the main purpose of this study was to assess the impact of CLBP on trunk kinematics at both preferred and fast paces, respectively, in the three anatomical planes. Both static (base of support and initial trunk position) and dynamic (ROM and trunk's angular velocity) data were examined.

Materials and methods

Participants

This study was driven in a rehabilitation center for the selection of CLBP patients before following a 5-week rehabilitation program. From January 2011 to May 2012, 104 people complaining of low back pain have been recruited after a clinical consultation performed by the same physician specialized in rehabilitation medicine. Patients were selected if they had suffered from LBP below the 12th thoracic vertebra that was not irradiating farther than the knees for more than 3 months with non-specific symptoms. Chronic low back pain sufferers have then performed various physical and psychological tests. Based on their physical and psychological profiles, 55 persons in this group have been excluded because of both excessive physical deconditioning and/or lack of motivation that were incompatible with the 5-week rehabilitation program. In addition, a CG composed of healthy participants with no back pain history has been constituted and particular care has been taken regarding age and body mass index homogeneities between the groups. People were excluded if they had undergone previous back surgery or any structural defects of the trunk, such as scoliosis or spondylolisthesis. Eventually, 82 volunteers took part in this