The Effect of Initial Posture on The Performance of Multi-Joint Reaching Tasks: A Comparison of Joint Excursions Between Individuals With and Without Chronic Low Back Pain

Ashley McCallum, Erica Johnson, Brian Sabo, Saundra Motter and James S. Thomas

School of Physical Therapy, Ohio University, Athens, OH

Introduction

Low back pain (LBP) is a major healthcare concern and economic burden worldwide. It is one of the most common reasons individuals seek medical care secondary to the common cold (Hertling, 2006). 80% of the population will eventually experience an episode of LBP at one point in their life and 50% will experience a recurrent episode (Walker 2000; Jones, 2005). Although there have been a multitude of studies involving chronic LBP, fundamental questions remain unanswered. Prior research has explored differences in standing or sitting postures as well as ergonomics of different postural conditions, however few studies have evaluated movement patterns in regards to standing and sitting postures during dynamic conditions in conjunction with comparing both the healthy and LBP population. Therefore, the purpose of this study was to determine the effect of initial posture (i.e. standing vs. sitting) on movement strategies in individuals with and without chronic LBP during a reaching paradigm. The first question investigated was: does initial posture influence trunk kinematics during a reaching paradigm? The second question addressed was: is there a difference in trunk kinematics displayed by individuals with chronic LBP compared to those individuals without LBP?

Methods

Thirty participants between the ages of 18-37 (18 healthy, 18 chronic LBP) were recruited for the study. Participants performed three trials of each reaching movement; first with the right hand, then with the left hand, and finally with both hands to the high, middle, and low targets across two conditions: 1) standing and 2) sitting for a total of 54 reaching trials (See Figure 1). In the sitting condition, participants were seated in a Balans Chair, which was chosen because its ergonomic design provided elimination of the DOF of the ankle and knee joints without altering the neutral erect posture that individuals display in standing. The height and AP distance of the chair was adjusted so that the height of the greater trochanters and target distance was kept constant between the sitting and standing conditions, the only difference being the elimination of the ankle DOF. Prior to beginning the reaching paradigm, the following measurements were taken: participant height, trunk length, pelvic length, hip height, and arm length. Target location was determined based on these measurements in order make relative distance constant across participants. For example, each participant could theoretically reach the high target with their upper extremity fixed in 90° of shoulder flexion, hips flexed 15° with respect to the vertical plane with no movement of the spine, knees, or ankles. Middle and low targets could be reached with 45° of hip flexion and 15° of hip flexion, respectively (See Figure 3). For the reaching trials, a fork sensor was used to detect the initiation of the reach and the point at which the participant returned from the target. The “go” signal was a light emitting diode and an accompanying audible beep at which the participants would break contact with the fork sensor and make contact with the target. Target contact was determined by interruption of a laser beam crossing the target. The participants remained at the target for 2 seconds until a red light emitting diode was lit. Following an accompanying audible beep, the signal the participant returned to their neutral upright position with their index finger returned to the fork sensor. Motion of the trunk and limb segments was recorded using Motion Monitor, a magnetic based kinematic system.

Data Analysis

Mixed Model ANOVAs were used to analyze joint excursions across the conditions of group and initial posture.

Results

There was no significant difference between participants with and without chronic low back pain in terms of age, height, and weight (See Table 1). The two groups also had an equal number of male and female participants (10 females, 8 males). There was no significant effect of group on joint excursions. LBP is one of the most prevalent musculoskeletal problems in the U.S. (Jones, 2005; Walker 2000; Dagenais, 2008). More research needs to be conducted to examine the influence of initial posture on movement patterns between individuals with chronic LBP compared to healthy individuals without LBP. However this study revealed that there was a significant effect of group on joint excursions. LBP is one of the most prevalent musculoskeletal problems in the U.S. (Jones, 2005; Walker 2000; Dagenais, 2008). More research needs to be conducted to examine the influence of initial posture on movement patterns between individuals with chronic LBP compared to healthy individuals without LBP. However this study revealed that there was a significant effect of group on joint excursions.

Conclusions

The present study examined the effect of initial posture on the performance of multi-joint reaching tasks that may not have been evident in the participants of this study. Conclusions of this study are that while sitting conditions may not be as effective in reducing the risk of LBP as standing conditions, there was no significant effect of group on joint excursions. It is important to understand and gain further clarification on whether individuals with chronic LBP adapt their movement strategy under different postural conditions and if those adaptations differ from those observed in individuals without LBP. Further research needs to be conducted with a more symptomatic group of LBP sufferers in order to identify any differences in movement patterns during forward reaching tasks that may not have been evident in the participants of this study.

Table 1

<table>
<thead>
<tr>
<th>Age</th>
<th>22.17±1.48</th>
<th>23.78±3.70</th>
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<tr>
<td>Weight (kg)</td>
<td>67.35±16.35</td>
<td>67.35±16.35</td>
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