TRUNK BEND AND TWIST COORDINATION IN RUNNERS WITH LOW BACK PAIN

Joseph Seay1, Richard van Emmerik2, and Joseph Hamill1

1Biomechanics and 2Motor Control Laboratories, Department of Kinesiology, University of Massachusetts, Amherst, Massachusetts, USA

joseph.seay@us.army.mil

INTRODUCTION

Low back pain (LBP) affects at least 75% of US and Canadian citizens. Injury literature indicates that injuries to the pelvis and low back can be very debilitating [1] and that performance issues linger even after LBP has resolved [2]. Additionally, the ergonomics literature has implicated occupational tasks that combine trunk flexion and axial rotation (“bend and twist”) as contributing to LBP in the workplace [3], but these claims seem as yet unsubstantiated by empirical data.

Research utilizing dynamical systems methods, such as Continuous Relative Phase (CRP) and CRP variability (CRPvar), has demonstrated differences in transverse plane (axial rotation) coordinative patterns during locomotion for individuals with chronic LBP. Specifically, individuals with chronic LBP demonstrated diminished capacity to transition axial pelvis-trunk coordination from in-phase to anti-phase as walking speed increased on a treadmill [4]. However, from this research it is not clear whether individuals with LBP also demonstrate changes in trunk axial rotation and lateral flexion coordination during locomotion.

The purpose of this study was to examine three-dimensional trunk range of motion (ROM) and trunk sagittal motion – axial rotation (“bend and twist”) coordination during treadmill locomotion in three groups of runners classified by LBP status. We hypothesized that a group of runners currently experiencing LBP and a group of runners for whom LBP had resolved would demonstrate decreased ROM, coordination (CRP) and coordination variability (CRPvar) as compared to a control group.

METHODS AND PROCEDURES

Data were collected on three groups of runners with varying degrees of LBP. One group was currently experiencing mild to moderate LBP (LBP group, n=14), another group had recovered from a single bout of LBP and had been running pain-free for at least six months (RES group, n=14), and the third group had never experienced LBP (CTR group, n=14). All participants were recreational runners from the community, ran at least 20 km per week, and were free of lower extremity orthopaedic injuries.

After an appropriate acclimatization period, subjects ran (2.3, 2.8, 3.3, 3.8 m/s) on a treadmill for 30 sec per speed. Trunk segment 3-D kinematic data were collected using an 8-camera high speed motion capture system (240 Hz) for the last 20 sec at each speed.

Two-way repeated measures ANOVA (Group by Speed) (p< 0.05) were performed for (1) three-dimensional trunk ROM and (2) trunk sagittal-axial plane CRP and CRPvar. Effect size (ES) was also calculated to express differences relative to a pooled standard deviation.

RESULTS

T-tests revealed no significant differences among groups for age, height, body mass, or
preferred running speed (Table 1). The LBP group demonstrated significantly lower CRP (122.1 ± 28 degrees) as compared to the CTRL group (112.4 ± 21 degrees) (Figure 1), regardless of speed, with a correspondingly large ES (ES=2.84). A large ES was also noted between the RES v. LBP (ES=1.72) and CTR v. RES groups (ES=1.13). There were no differences between groups in CRPvar or three-dimensional trunk ROM during running.

<table>
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<th>Table 1. Group means (±SD) characteristics for age, height, body mass, and preferred running speed (PRS) for three experimental groups used in this study.</th>
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<tr>
<td>CTRL</td>
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<td><strong>Age (yr)</strong></td>
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<td><strong>Height (m)</strong></td>
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<td><strong>Mass (kg)</strong></td>
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<td><strong>PRS (m/s)</strong></td>
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Figure 1. Mean CRP (A.) and CRPvar (B.) of trunk sagittal (lean) and axial rotation for CTRL, RES, and LBP groups, averaged across all running speeds. Error bars represent SD, * denotes significant differences.

**DISCUSSION**

Differences were observed between groups for sagittal-transverse coordination (CRP) during running, indicating that runners with LBP had experienced difficulty moving toward anti-phase coordination. While no significant differences were reported for the RES group, large effect sizes were noted compared to LBP and CTR groups, which suggest that clinical differences may exist between all three groups [5]. Contrary to our hypothesis, no differences were observed between our groups for three-dimensional trunk ROM or sagittal-transverse coordination variability (CRPvar). These results were present despite low disability levels of our LBP group, and despite the fact that running involves relatively little “bend and twist” motion as compared to even the most common work-related tasks.

While these results are interesting in the context of the current study, the measures used in this study can be applied to job-specific tasks to examine the effect of LBP on coordination between planes. We suggest that the multi-planar coordination analysis similar to that used in this study will aid in elucidating the relationship between LBP and “bend-and-twist” motion specific to occupational tasks.

**SUMMARY**

We examined sagittal-transverse (bend and twist) coordination coupling within the trunk segment, an action that has been associated with low back injury in the ergonomic literature. We found coordination differences between individuals with and without LBP, and suggest that this measurement may prove useful for analyzing a myriad of workplace activities. These data add to a growing body of literature that is attempting to quantify kinematic and coordinative differences between individuals with and without LBP.

**REFERENCES**


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