PELVIC AND THORAX KINEMATICS AND CHRONIC LOW BACK PAIN

RJ Burgess, S Hillier & D Keough
University of South Australia

INTRODUCTION

Spinal kinematic studies of subjects with chronic low back pain (CLBP) provide valuable information on the motion characteristics of CLBP aiding definition, diagnosis and treatment of this condition. The trunk is a multi-linked kinematic chain with both local and global models as determined by skeletal and muscular anatomical relations of the pelvis, lumbar spine and thorax (Bergmark 1989). This study was designed to determine displacement and angular kinematics of the pelvis and thorax during sagittal pelvic tilt in supine and the kinematics of the lumbar spine and thorax during standing sagittal and frontal plane movements of the trunk (trunk flexion to the knees, extension and left and right lateral flexion) for subjects with CLBP and no low back pain (NLBP). It was hypothesized that pelvic and thorax kinematics would be affected as well as lumbar kinematics in subjects with CLBP.

METHOD

Fifty subjects participated (25 NLBP subjects, 11 females/14 males, mean age = 36 ± 8 and 25 CLBP 10 females/15 males, mean age 40 ± 9 years). CLBP subjects had low back pain without radiation for at least 6 months with incomplete recovery and had time off work or treatment for back pain. NLBP subjects had no history of back pain. All subjects gave written informed consent and ethical approval to conduct the study was obtained.

The Tracker® (Polhemus, Vermont, U.S.A) was utilised to record the position and orientation of sensors with respect to a source. Data was sampled for a 10 second period at 10Hz. For pelvic tilt sensors were attached to the right anterior superior iliac spine (ASIS) and the manubrium and the source was taped to the table. For standing trunk movements sensors were attached to T12 and the sternum while the source was placed on the sacrum.

Data were time normalized to 100. Coefficient of variation (CV) for repeated trials for 14 subjects was calculated to determine intra-subject variability. CV scores for all 50 subjects determined inter-subject variability. Three-way ANCOVA with repeated measures was used to compare pelvic, lumbar and thorax kinematics (significance level $p < 0.05$).

RESULTS

Intra- and inter-subject CV scores for all pelvic and lumbar spine kinematics were low (≤ 0.52). All CV scores for thorax kinematics in the sagittal plane were generally high (≥ 0.59) but low in the frontal plane (≤ 0.41).

Anterior pelvic tilt displacement kinematics but not posterior tilt kinematics were significantly less for CLBP subjects compared to NLBP ($p = 0.005$, $p = 0.37$) (Figure 1). Sternal displacement was not affected by pain ($p > 0.05$).

Only backward displacement for CLBP subjects exhibited significantly less thorax and lumbar motion compared to NLBP subjects ($p = 0.04$ and $p = 0.00$, respectively) (Figure 2). Thorax but not lumbar

displacement kinematics were diminished in the frontal plane for CLBP subjects (Lumbar; Left p = 0.25, Right p = 0.36, Thorax; Left p = 0.02, Right p = 0.01) (Figure 3).

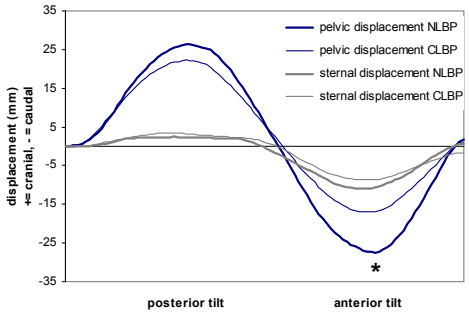

Figure 1. Mean Pelvic and sternal displacement kinematics with pelvic tilt (* significant).

Pelvic and sternal angular kinematics were not affected by pain ($p \geq 0.62$). Lumbar but not thorax extension was significantly less for CLBP subjects compared to NLBP subjects (p = 0.01, p = 0.37).

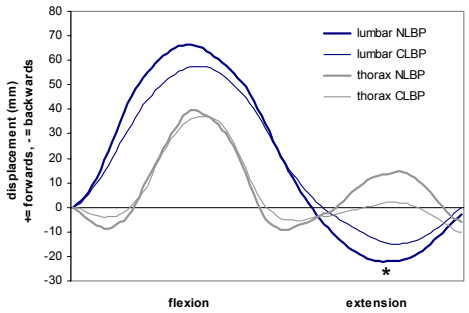

Figure 2. Lumbar spine and thorax sagittal plane displacement kinematics (* significant).

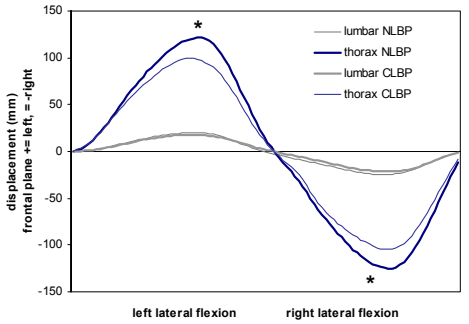

Figure 3. Lumbar spine and thorax frontal plane displacement kinematics (* significant).

Left lumbar lateral flexion (p = 0.01) was less for CLBP subjects compared to NLBP (right p = 0.20). Thorax rotation in the frontal plane there was not affected by pain (p = 0.58 and p = 0.20).

DISCUSSION

High variability and low mobility for the thorax in the sagittal plane and low variability and high mobility in the frontal plane suggest an adaptable mobile structure with varied motor control depending on the task. Variability for thorax angular kinematics in the sagittal plane is consistent with previous findings (Tully and Stillman 1997).

Diminished displacement of the pelvis with anterior tilt, and diminished thorax displacement and angular kinematics in the frontal plane are new findings for the spinal motion characteristics of subjects with CLBP. Limited lumbar extension, lateral flexion and backward lumbar displacement for CLBP are comparable with previous studies (Dvorak et al 1991; Waddell et al 1992). Pelvic and thorax displacement kinematics may be useful in the diagnosis and rehabilitation of CLBP. Spinal motion studies and back pain treatment programs may need to consider displacement and angular kinematics contributions of all trunk segments.

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