

Effects of Pelvic Skeletal Asymmetry on Trunk Movement: Three-Dimensional Analysis in Healthy Individuals versus Patients with Mechanical Low Back Pain

Al-Eisa E, Egan D, Deluzio K, & Wassersug R (2006). *Spine*; 31(3): E71-79.

Study Design.

Comparative analysis and correlational research design were used to investigate the relationship between anthropometry and biomechanical performance among asymptomatic subjects and patients with low back pain (LBP).

Objectives.

To examine the relationship between pelvic asymmetry and patterns of trunk motion in asymptomatic and LBP subjects. Secondary objective was to investigate the association between restricted trunk motion, laterality of referred pain, and pelvic asymmetry.

Summary of Background Data.

Subtle pelvic asymmetry (exhibited as either lateral pelvic tilt or iliac rotational asymmetry), which is common among normal individuals, has not been convincingly linked to abnormalities in back movements. Given the difficulty in diagnosing most LBP, a classification using pelvic asymmetry and patterns of movement could be helpful in establishing a rational treatment plan.

Methods.

Fifty-nine subjects with no history of LBP and 54 patients with mechanical unilateral LBP were tested. An anthropometric frame was used to measure pelvic asymmetry in standing. Dynamic motion data, comprised of the principal and coupled movements, were collected using the Qualysis™ Motion Capture System.

Results.

While the groups did not differ in the total range of lumbar movement, the LBP group exhibited significantly higher asymmetry in the principal motion. The groups differed significantly in the pattern of coupled rotation during lateral flexion. Asymmetry in lumbar lateral flexion was highly related to two types of pelvic asymmetry: lateral pelvic tilt (LPT) and iliac rotation asymmetry (IRA). Asymmetry in lumbar axial rotation was highly related to IRA, but weakly related to LPT.

Conclusions.

This study demonstrates objective differences in patterns of lumbar movement between asymptomatic subjects and patients with LBP. The study also demonstrates that subtle anatomical abnormality in the pelvis is associated with altered mechanics in the lumbar spine. We suggest that asymmetry of lumbar movement may be a better indicator of functional deficit than the absolute range of movement in LBP.

[Key words: pelvic asymmetry, trunk kinematics, low back pain, coupling]

Effects of Pelvic Asymmetry and Low Back Pain on Trunk Kinematics during Sitting: A Comparison with Standing

Al-Eisa E, Egan D, Deluzio K, & Wassersug R (2006). *Spine*; 31(5): E135-143.

Study Design.

A prospective study was conducted on a group of patients with unilateral non-specific low back pain (LBP) and healthy controls.

Objectives.

This study was designed to answer three questions: 1) Does pelvic asymmetry measured in standing affect the dynamics of motion performed in sitting? 2) Do LBP patients perform trunk motions differently from non-LBP participants in sitting position? 3) Do the kinematics of lateral flexion and axial rotation differ between sitting and standing positions?

Summary of Background Data.

The effect of pelvic asymmetry on trunk motion while sitting remains unclear. LBP has been associated with altered trunk kinematics in standing; however, there is limited information available describing trunk kinematics in sitting position in comparison to standing.

Methods.

Pelvic asymmetry was measured in 54 patients with unilateral non-specific LBP and 59 control subjects. A motion-analysis system was used to test the range and symmetry of lateral flexion and axial rotation in sitting and standing positions. Bi-variate correlations, regression, MANOVA, and paired sample t-tests were used to test for associations between variables and differences between groups.

Results.

We found significant: 1) correlations between pelvic asymmetry and asymmetrical trunk motion performed in sitting, 2) differences between the LBP and control groups in patterns of trunk motion performed in a sitting posture, and 3) differences between kinematics of motions performed in sitting versus in standing postures.

Conclusions.

This study demonstrates a link between pelvic asymmetry and altered trunk motion in sitting position. We suggest that people with LBP may have a distinct compensatory mechanism, secondary to pelvic asymmetry, which puts the lumbar spine under greater stress. Movement asymmetry, rather than range of motion, may be a better indicator of disturbed function for people with LBP. Structural and functional asymmetries are factors that may be taken in consideration in the seating design and work environment.

Key Words: Pelvic asymmetry, low back pain, posture, sitting, trunk motion.

Fluctuating Asymmetry and Low Back Pain

Al-Eisa E, Egan D, & Wassersug R (2004). *Evolution and Human Behavior*; 25: 31-37.

Abstract:

Fluctuating asymmetry (FA), a pattern of bilateral variation that is normally distributed around a mean of zero, appears to correlate inversely with fitness and health. In this study, we compared the FA of normal asymptomatic subjects (n = 51) and patients with low back pain (n = 44). We measured eight traits, from the upper and lower limbs, and used them to obtain asymmetry indices for each subject. We also measured pelvic asymmetry in standing subjects. The low back pain (LBP) group showed significantly higher asymmetry in the pelvis, and in ulnar length and bistyloid breadth. Our results demonstrate a link between LBP and asymmetry not only in a weight-bearing trait (i.e., pelvic configuration), but in two traits that are functionally not related to the back (i.e., ulnar length and bistyloid breadth). We can now consider LBP as another health and fitness measure correlated with FA.

Keywords: Fluctuating asymmetry; Low back pain; Pelvic structural asymmetry.

The Association between Lateral Pelvic Tilt and Asymmetry in Sitting Pressure Distribution

Al-Eisa E, Egan D, & Fenety A (2004). *Journal of Manual and Manipulative Therapy*; 12: 133-142.

Abstract: Physical therapists commonly associate lateral pelvic tilt (LPT) with a variety of musculoskeletal adaptations, syndromes and altered function. Such musculoskeletal adaptations have been suggested in many reports to cause unequal sitting pressure distribution (SPD) at the buttock/chair interface. However, those reports have failed to provide objective evidence to support that hypothesis. This study was conducted to examine the relationship between LPT and SPD in a sample of healthy female volunteers.

Subjects were tested for pelvic symmetry using an anthropometric frame, then assigned to two groups: symmetrical (n = 36) and LPT (n = 9). SPD was measured in an upright sitting posture using an interface pressure mat. Although the results indicated that there were no significant differences between the two groups in the magnitude and position of the peak pressure, there was a greater variability among subjects in the LPT group than the symmetrical group. This observation is worth further investigation as it tends to indicate that persons with LPT are less likely able to maintain a steady sitting position.

Key Words: Pelvic asymmetry, lateral pelvic tilt, interface pressure mapping.

Pelvic Skeletal Asymmetry, Postural Control, and the Association with Low Back Pain: A Review of the Evidence

Egan D, & Al-Eisa E (1999). *Critical Reviews in Physical and Rehabilitation Medicine*; 11: 299-338.

Abstract:

A substantial amount of subjective information shows that asymmetry within the pelvic girdle (PSA) frequently has been thought to be a cause of altered function and low back pain. Numerous interventions have been described for correcting these spatial asymmetries, ostensibly for preventing potential sequelae and for promoting symptomatic relief and return to normal function. A search of the evidence revealed that the types, incidence, associated tissue changes, and effects of PSA, including postural control, were confusing and conflicting. This was due in large part to a lack of consistency, accuracy, reliability, validity, and generalizability of the various methods used to measure asymmetry. Furthermore, the widely perceived association between PSA and low back pain (LBP) could not be unequivocally supported or rejected on the available evidence. There are a dearth of reports that attempt to objectively examine the possible associations between PSA, function, LBP, and discomfort, and evidence of the use of normative data and combined measurement systems to investigate these parameters is very scarce. It is concluded that a strong case could be made for the need to more objectively reinvestigate the possible associations between these parameters, especially through the use of longitudinal and combined measurement studies.

Measurement of Sitting Pressure under the Ischium: A Reliability Study

Al-Eisa E, Fenety A, Egan D, & Crouse J (2000). In: Winters J, editor. *Technology of the New Millennium*. Proceedings of the RESNA 2000 Annual Conference. Arlington (VA): RESNA Press; 357-359.

Abstract:

Locating areas of high pressure, at the chair buttock interface, is useful in predicting the site at risk of developing tissue breakdown or sitting discomfort. Before making such predictions, it is necessary to identify reliable sitting pressure parameters for objective critical evaluation of pressure distribution. This paper describes a methodology that provides a reliable representation of the pressures within the rectangular region under the ischial tuberosities. The mean peak pressure of nine sensors, with the greatest pressures, over a 3x3 block, has been found to be a very reliable measure (ICCs ³ 0.80) for the use of locating high pressure regions and is therefore superior to taking a single reading of each sensor.