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Comparison of erector spinae and hamstring muscle activities and lumbar motion during standing knee flexion in subjects with and without lumbar extension rotation syndrome

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ABSTRACT

The aim of this study was to compare the activity of the erector spinae (ES) and hamstring muscles and the amount and onset of lumbar motion during standing knee flexion between individuals with and without lumbar extension rotation syndrome. Sixteen subjects with lumbar extension rotation syndrome (10 males, 6 females) and 14 healthy subjects (8 males, 6 females) participated in this study. During the standing knee flexion, surface electromyography (EMG) was used to measure muscle activity, and surface EMG electrodes were attached to both the ES and hamstring (medial and lateral) muscles. A three-dimensional motion analysis system was used to measure kinematic data of the lumbar spine. An independent-*t* test was conducted for the statistical analysis. The group suffering from lumbar extension rotation syndrome exhibited asymmetric muscle activation of the ES and decreased hamstring activity. Additionally, the group with lumbar extension rotation syndrome showed greater and earlier lumbar extension and rotation during standing knee flexion compared to the control group. These data suggest that asymmetric ES muscle activation and a greater amount of and earlier lumbar motion in the sagittal and transverse plane during standing knee flexion may be an important factor contributing to low back pain.

1. Introduction

Low back pain (LBP) is the most common musculoskeletal problem (Lamoth et al., 2006; Van Dillen et al., 2007; Vogt et al., 2003); approximately 80% of the population will experience LBP during their lifetime (Rubin, 2007). Due to the importance of LBP, a number of studies have investigated the cause and attempted to identify more effective interventions (Hoffman et al., 2011; Park et al., 2011; Urquhart et al., 2005; Van Dillen et al., 2003). Researchers have classified mechanical LBP into subgroups (lumbar flexion syndrome, lumbar flexion rotation syndrome, lumbar extension syndrome, lumbar extension rotation syndrome, and lumbar rotation syndrome) through movement tests, and different examination and treatment approaches exist for each subgroup (Sahrmann, 2002; Scholtes et al., 2009; Van Dillen et al., 1998, 2007).

Lumbar extension rotation syndrome comprises the highest percentage of chronic LBP (Harris-Hayes et al., 2005; Sahrmann, 2002; Scholtes et al., 2009). Lumbar extension rotation syndrome is characterized by signs and symptoms that increase during lumbar extension and rotation with repeated movement and/or sustaining the position (Harris-Hayes et al., 2005; Sahrmann, 2002). Physical examinations performed in a clinical setting are used to identify symptom-provoking motions or alignments using movement (return from forward bending, prone knee flexion, hip and knee flexion in a supine position, trunk extension while sitting, and rocking forward in a quadruped position) and alignment tests (lumbar curve while standing, sitting, and in a supine position) (Harris-Hayes et al., 2005; Sahrmann, 2002; Van Dillen et al., 2003). In previous electromyographic (EMG) and kinematic studies, clinical examinations have been performed to confirm the relationship between lumbopelvic and lower limb movement in healthy individuals and those with LBP during active knee flexion and hip lateral rotation in a prone position (Park et al., 2011; Scholtes et al., 2009). Sahrmann (2002) and Harris-Hayes et al. (2005) reported that individuals with lumbar extension rotation syndrome exhibited increased pelvic anterior tilting and rotation during knee flexion in the prone position. Through these studies, we are able to understand the movement pattern and the factors that contribute to LBP during daily activity.

Knee flexion is important movement for achieving a normal swing phase during gait (Piazza and Delp, 1996). Rowe et al.

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