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THE RELATIONSHIP BETWEEN SEGMENTAL ROLLING ABILITY AND LUMBAR MULTIFIDUS ACTIVATION TIME

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ABSTRACT

Background: Segmental rolling has been utilized as an assessment and intervention tool to identify and affect dysfunction of the upper quarter, core, and lower quarter. One theory to explain dysfunctional segmental rolling is a lack of segmental spinal control / stabilization. Faulty muscle firing sequencing has been related to poor spinal stability, however to date, no assessment tool exists to evaluate a patient's motor coordination of local and global musculature.

Purpose: The purpose of this study was to assess the temporal sequence of lumbar multifidus activation associated with anterior deltoid activation, and to determine if faulty sequencing was associated with the inability to segmentally roll in subjects without mobility restrictions. The authors hypothesized that in individuals who could not roll, a multifidus muscle onset latency relative to a prime mover activation would be present. In addition, a subset of the individuals with an inability to roll were utilized for a pilot study examining the ability to address the firing pattern with corrective exercise.

Methods: Twenty healthy subjects (13 females, 7 males), ages 19-25, participated in the study. Each subject underwent an upper and lower quarter screen and assessment of thoracic spine mobility. Subjects were excluded from the study if they had previous spine surgery, or were currently experiencing back pain. In addition, subjects who had any disease, disorders, or pathology that would hinder participation in segmental rolling or who had spinal movement contraindications were excluded. Since shoulder flexion is performed during the study, participants who had shoulder pathology or contraindications to upper extremity movement were excluded as well. Subjects with less than 50 degrees of trunk rotation were excluded from the study due to a possible physical mobility limitation that would prevent proficient segmental rolling. Included subjects were assessed on their ability to segmentally roll. Subjects who could complete the rolling task were placed in cohort A ("can roll"), and subjects who could not roll were placed in cohort B ("can't roll").

Electromyographic (EMG) activity of the multifidus was recorded adjacent to the lamina of the L4 vertebrae using intramuscular fine-wire electrodes. EMG activity of the anterior deltoid was also recorded with a surface electrode during a single arm movement into shoulder flexion. While in a standing position, subjects were instructed to move their right upper arm into flexion as quickly as possible. Subjects flexed their shoulder to 90 degrees for three trials while muscle activity was recorded. Data were high-pass filtered at 30 Hz to remove baseline artifact, and the onset EMG times was selected as the point at which EMG increased two SD above baseline levels. Onset of the multifidus muscle was reported relative to that of the prime mover (anterior deltoid). Muscle onset latency was defined as the time difference between the onset of contraction of the multifidus and the anterior deltoid.

Results: Nine subjects were placed in cohort A, 11 subjects were placed in cohort B. The mean firing time of the lumbar multifidus for the cohort A was 16.67msec before the anterior deltoid, and the mean firing time of the lumbar multifidus for cohort B was 57.36msec after the anterior deltoid. There was a statistically significant difference ($p < 0.00$) in the firing time between cohorts A and B.

Conclusions: In subjects who could segmentally roll, the multifidus muscle activation always preceded that of the prime mover muscle activation. In subjects who could not segmentally roll, the results of this study confirm that there is a multifidus muscle onset latency relative to the activation of the anterior deltoid. The inability to segmentally roll may be related to faulty sequencing of lumbar multifidus firing.

Key words: Movement system, multifidus muscle, neuromuscular sequencing, segmental rolling

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