ACTIVATION PATTERNS OF TRUNK MUSCLES DURING CYCLIC FLEXION-EXTENSION

Michael W. Olson and Li Li
Department of Kinesiology, Louisiana State University, Baton Rouge, Louisiana, USA
Email: molson2@lsu.edu

INTRODUCTION

A high incidence of low back injuries has been reported in individuals employed in labor intensive work environments [1]. The interactions between the active and passive tissues of the lumbar spine are important factors to consider when identifying the etiology of these injuries [2]. Behavior of the lumbar muscles is affected by the changing mechanical properties of both active and passive tissues.

In healthy individuals the myoelectric activity of the lumbar muscles decreases during deep trunk flexion [3]. This event has been termed the flexion-relaxation phenomenon [4]. Mechanical load-sharing and neural mechanisms have been used to explain this event [4]. However, compensatory mechanisms must be initiated in order to offset the flexion moment applied at the lumbar spine.

The purpose of this study was to explore the behavior of the trunk muscles to identify mechanisms used to compensate for decreased lumbar muscle activity.

METHODS

Data were collected from 13 asymptomatic males [age mean 20 (± SD 1) yrs., height 1.77 (± 0.06) m, body mass 82 (± 11) kg] who performed five separate cycles of trunk flexion-extension. Cycle duration was 10 sec and controlled with the tempo of a metronome. Once collected, the time series of each cycle was normalized to a percentage of the cycle.

EMG signals were collected on the right side by pre-gelled Ag-AgCl electrode pairs. The muscles analyzed were the lumbar paraspinal (LP) at the L3-L4 level, the rectus abdominis (RA), and external oblique (EO). The inter-electrode distance was 2.5 cm from center to center.

Reflexive spheres, 2.5 cm in diameter, were taped onto the skin on the left side at the lateral edge of the twelfth rib, lateral midline of the iliac crest, and greater trochanter. These markers were used to represent trunk inclination and lumbar flexion angles. Kinematic and EMG data were temporally synchronized.

One-way ANOVA with repeated measures was used to evaluate the changes of each variable between trials. The alpha level was set at 0.05.

RESULTS AND DISCUSSION

No trial effects were observed in the data, only means and sd are presented in here as a percentage of the cycle. The LP flexion-relaxation phenomenon occurred in all participants (cessation at 34±7% and re-initiation at 57±7%). The EMG activity of the abdominal muscles, RA (n = 5) and EO (n = 7), were detected (initiation at 42±4% and 39±5%, cessation at 54±5% and 57±%, respectively] at the deepest trunk inclination and lumbar flexion angles in about half of the

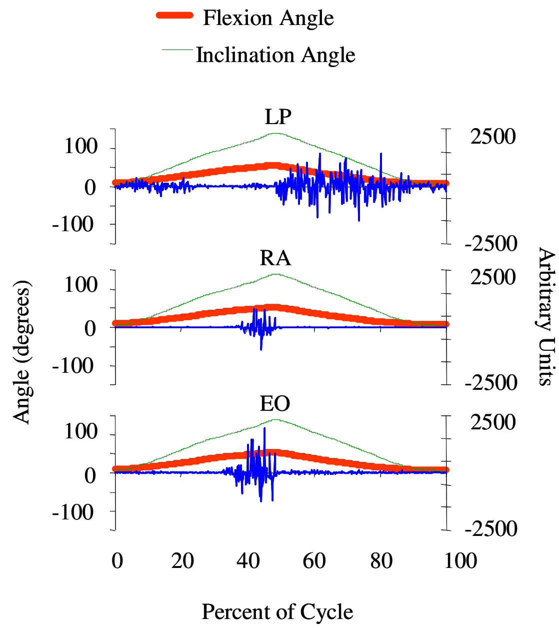

Figure 1: Exemplar EMG pattern of lumbar paraspinal (LP), rectus abdominis (RA), and external oblique (EO) muscles from one participant during a single trial of trunk flexion-extension.

participants (Figure 1). EMG activity of both RA and EO muscles was observed in four individuals. One individual had only RA activity and three had only EO activity detected during this time period.

The activation of the RA and EO muscles may serve to increase the intra-abdominal pressure (IAP). The IAP may also assist with the extension moment at the lumbar region. The involvement of the abdominal muscles leads to increased IAP support for the abdominal cavity. Elevated IAP results in a complementary reinforcement of the integrity of the lumbar vertebrae [5,6].

CONCLUSIONS

Mechanisms responsible for the flexion-relaxation phenomenon need further examination. Likewise, compensatory mechanisms that respond to this myoelectric silent period also require additional attention.

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