INCREASE IN AMPLITUDE OF PARASPINAL MUSCLE REFLEXES FOLLOWING LUMBAR EXTENSOR FATIGUE

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INTRODUCTION

Low back disorders (LBDs) are one of the most prevalent and costly musculoskeletal problems in the United States. Abnormal paraspinal reflexes have been linked to low-back pain [1,2] and neuromuscular fatigue has been shown to affect reflexes in multiple muscle groups [3]. Therefore, the purpose of this study was to investigate the effect of lumbar extensor fatigue on paraspinal reflexes.

METHODS

Ten physically active males (20-22 years of age) participated in the experiment. During each experimental session, paraspinal muscle reflexes were measured both before and after a lumbar extensor fatiguing protocol. Reflexes were elicited in response to an anteriorly-directed perturbation applied at the inferior margin of the scapulae while the subjects stood quietly. Perturbation force was recorded using a load cell, and EMG was recorded from the paraspinal muscles (4cm lateral from L4). The fatiguing protocol consisted of multiple sets of back extensions and intermittent isometric MVCs on the Roman chair [4] for a period of 14 minutes to fatigue participants to 60% of their unfatigued lumbar extensor MVC. The reflex measurement began within fifteen seconds of the completion of the fatiguing protocol.

Preparatory muscle activity was computed from 250 msec of data prior to each force impact. Any reflex response after 120 msec was considered voluntary motion and not included in the analysis. Reflex delay was calculated as the time delay from the perturbation onset to the reflex onset, and reflex amplitude was calculated as the peak amplitude of the paraspinal EMG (Figure 1). A paired t-test with a significance level of $p \leq 0.05$ was used for all statistical tests.

RESULTS AND DISCUSSION

Perturbation characteristics differed between fatigue conditions with peak amplitude decreasing an average of 5.8 ± 4.9% with fatigue. Reflexes occurred in 92% of all perturbations. The mean reflex delay was 60 ± 18 msec, and was not affected by fatigue (p=0.278); however, reflex amplitude significantly increased 36 ± 32% with fatigue (p=0.017).

The aim of this study was to examine the effects of lumbar extensor fatigue on paraspinal muscle reflex in response to a sudden perturbation. The results showed fatigue was associated with an increase in reflex amplitude but no significant influence in response delay. Three aspects of the methodology warrant discussion. First, the quantified paraspinal reflexes during a task involved no external constraints on trunk angle and/or response to the perturbation. However, similar conditions have been used in other studies. In addition, analyses of conditions prior to the unfatigued and fatigued perturbation showed that preparatory EMG levels and lumbar flexion angle were not affected by fatigue. Secondly, the perturbation amplitude was not consistent across unfatigued and fatigued conditions which we feel may be due to a decrease in lumbar extensor stiffness with fatigue.

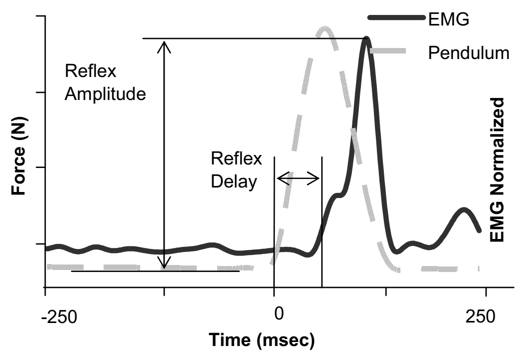

Figure 1: EMG reflex delay and amplitude after pendulum perturbation.

Third, the increase in reflex amplitude may not solely be attributed to fatigue. Dynamic fatiguing can elicit strain in paraspinal tissue in addition to fatigue. Despite this, a dynamic fatigue exercise more closely represents an occupational task.

CONCLUSIONS

Spinal stability is primarily controlled by muscle recruitment, muscle stiffness, and reflex response. Trunk fatigue has been shown to alter trunk muscle recruitment patterns and decrease the force producing capacity of muscle. The increase in reflex amplitude found here may reflect an attempt to compensate for losses in muscle force capacity with fatigue in order to maintain sufficient spinal stability.

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