EVIDENCE FOR THE INDUCTION OF SPINAL LIGAMENT CREEP DURING CYCLIC FLEXION-EXTENSION

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

INTRODUCTION

Feline studies have revealed that prolonged mechanical loading of the spinal ligaments adversely affect the reflexive activity of the paraspinal muscles (Solomonow et al., 2002). The initiation of spinal flexion facilitates the recruitment of paraspinal muscles to provide stability. As flexion increases, load tension is transferred to the spinal ligaments from paraspinal muscles. Myoelectric activity has been shown to decrease when this ligament tension increases (tension-relaxation phenomenon).

Current feline studies have stated that spinal ligament creep, induced by cyclic loading, produces an inhibitory effect on ligament mechanoreceptors (Solomonow et al., 2001). An increased inhibition of mechanoreceptors can reduce muscle activity and produce spasm.

The purpose of this study was to introduce cyclic low back flexion-extension motion to human subjects and examine the effect of this exercise in relation to spinal ligament creep.

METHODS

Male undergraduate students enrolled in various kinesiology courses volunteered to participate. Mean (±SD) age, height, and mass were 24.8 (± 7.0) years, 185.17 (± 5.42) cm, and 79.36 (± 10.07) kg, respectively.

Reflective markers, spheres of 8 mm in diameter, were positioned on the skin over the spinous processes of T9 to S1. Bipolar surface electrodes were positioned at the L2-3 and L4-5 levels 3.0cm lateral to the spinous processes.

Participants performed cyclic flexion-extension of the trunk for 20 min or until they became too fatigued. The duration of each cycle was 10 sec (5 sec flexion, 5 sec extension). Subjects were instructed to flex to the deepest point of flexion, determined prior to testing, during each cycle.

RESULTS AND DISCUSSION

A representation of EMG activity during the flexion-extension cycle is presented in Figure 1. EMG activity patterns through time are consistent amongst subjects. The significant events for each cycle were identified as T1, time of the starting erect position, this was always accompanied by greater level of EMG activity; as the subject flexes his trunk downwards, the EMG activity would come to a point of silence, T2 marks this time event; T3 marks the time when the trunk flexion reaches its deepest point; as the subject extends his back from the deepest flexion position to the next erect position, the EMG activity would resume, the time of this EMG activity onset was marked as T4 and next erect posture was achieved at T5.

It was observed that the time of inhibition (D1=T4-T2) prolonged linearly (P<.05) with the progress of the exercise. The time between EMG onset to the end of extension (D2=T5-T4) decreased (P<.05), and the time between deepest flexion to EMG onset (D3=T4-T3) increased (P<.05), as the exercise was carried out. Spasm was also observed in the later stages of the exercise (Figure 1).

Figure 1: Myoelectric activity of paraspinal muscles during cyclic flexion-extension from initial erect stance, through deepest flexion, and to the end erect stance. The marker position of T9 during exercise is indicated above EMG signal to demonstrate the motion of the trunk.

SUMMARY

Electromyographic evidence shows that myoelectric activity decreases over time during cyclic flexion-extension and spasm was observed in this process. These data are in agreement with previous work regarding feline spinal ligament creep. We suggest that ligament creep can be induced and quantified in humans. This method can be used for future investigations regarding low back injury.

REFERENCES