Lumbar Paraspinal Muscle Activation during Back Extension Exercise on a New Home Exercise Device

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Abstract

BACKGROUND: Progressive resistance exercise on machines that stabilize the pelvis in the seated position is effective in improving lumbar extensor muscle function in healthy adults and symptoms in patients with low back pain. Existing lumbar extension machines with these features are not intended for home exercise programs, however. **PURPOSE:** To assess the lumbar paraspinal surface EMG activity during slow movement, full range of motion exercise on a new home exercise device. **METHODS**: 10 individuals (5M/5F, age 33.0+/-8.1 yr) in good general health performed lumbar extension exercise on the new home exercise device at 3 loads (1X, 1.25X, 1.5X bodyweight). Loads were increased by attaching metal plates to the device. At each load, 1 set of 3 repetitions was performed using a slow movement full range of motion protocol (i.e. 10 second concentric, 10 second eccentric). Exercise order was balanced among subjects. Surface EMG activity was collected from the L3/4 paraspinal region during exercise. The effect of exercise load and phase of movement on lumbar paraspinal surface EMG activity (normalized based on % of peak strength) was assessed with ANOVA and post hoc Tukey's procedure. **RESULTS:** No adverse events were reported. 30% (3/10) of subjects reported mild delayed onset muscle soreness in the low back. During full repetition exercise, group means for lumbar paraspinal surface EMG activity increased with load (1X: 34.9+/-16.0%; 1.25X: 42.1+/-11.8%: 1.5X: 47.1+/-9.8%; p < 0.05). 50% (5/10) of subjects did not display a progressive increase in EMG activity with exercise load. During the concentric phase, EMG activity increased from 1X to 1.25X (p < 0.05), but not from 1.25X to 1.5X (p > 0.05) (1X: 41.2+/-17.9%; 1.25X: 50.5+/-16.2%; 1.5X: 52.8+/-10.3%). During the eccentric phase, EMG activity increased with load (1X: 28.7+/-16.0%; 1.25X: 33.6+/-12.7%; 1.5X: 41.4+/-13.8%). **CONCLUSION:** Slow movement, full range of motion lumbar extension exercise on a new home exercise device safely activates the lumbar paraspinal muscles in healthy adults. Lumbar paraspinal surface EMG activity during exercise is variable among subjects and throughout the range of motion. Design modifications to the device may be needed to address this variability.

Purpose

To assess the lumbar paraspinal surface EMG activity during slow movement, full range of motion exercise on a new home exercise device at 3 exercise loads.

Methods

Participants: A convenience sample of 10 individuals (5M/5F, age 33.0+/-8.1 yr) in good general health was recruited from the general population to participate in this study.
Procedures: To assess maximum voluntary isometric contraction (MVIC) in order to normalize surface EMG data, subjects performed a lumbar extension strength test on a MedX (Altamonte Springs, FL) lumbar extension dynamometer. After a 15-minute rest, subjects performed dynamic lumbar extension exercise on a new MedX home exercise device at 3 loads based on total body weight (1X, 1.25X, 1.5X bodyweight). At each load, 1 set of 3 repetitions was performed using a slow movement, full range of motion protocol (i.e. 10 second concentric, 10 second eccentric). 5 minutes of rest was provided between each set of exercise. Exercise order was balanced among subjects.

The MedX home exercise device allows for lumbar extension exercise in the seated position and provides some degree of pelvic stabilization through various restraint mechanisms. Initial load is accommodated by gravity's action on total body weight. Load is increased by attaching metal plates to the device.

Analysis: Surface EMG activity was recorded from the L3/4 paraspinal region during dynamic exercise and the isometric strength test The effect of exercise load and phase of movement (concentric vs eccentric; flexion vs. mid-range vs. extension) on lumbar paraspinal surface EMG activity (normalized to % MVIC) was assessed with ANOVA and post hoc Tukey's procedure.

Figure 1. Real-time recording of a smoothed and rectified surface EMG signal of the lumbar paraspinal muscles (right - top; left - bottom) obtained from a representative subject during 3 repetitions of 3 sets of dynamic exercise on a new MedX home exercise device at loads of 1.00X, 1.25X, and 1.50X BW.
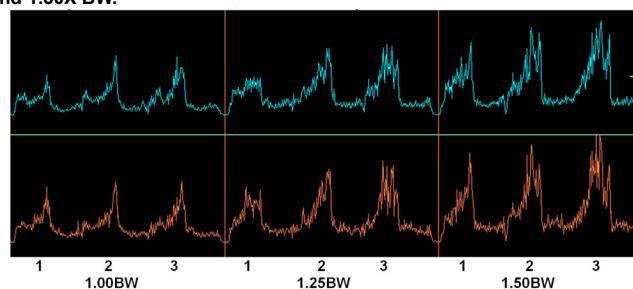
Figure 2. Normalized lumbar paraspinal surface EMG activity (% MVIC, means +/- SD, n = 10) during dynamic exercise on a new MedX home exercise device plotted by phase of movement and exercise load. Con Concentric, Ecc Eccentric.
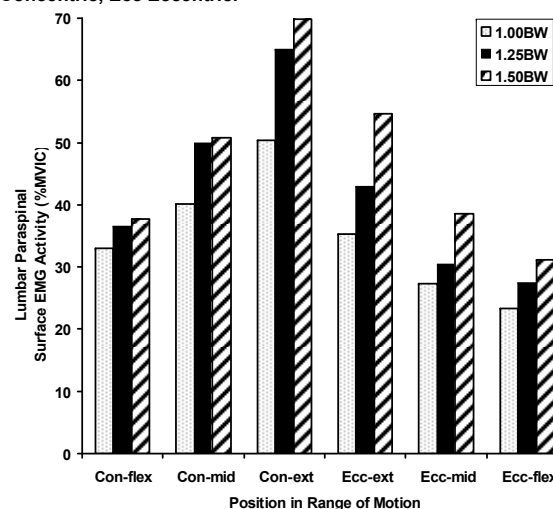
Results

No adverse events were reported. 30% (3/10) of subjects reported mild delayed onset muscle soreness in the low back, which resolved within 48 hours in all cases. Surface EMG recordings during dynamic exercise from a representative subject are shown in Figure 1. During dynamic exercise over the full range of motion (i.e. both the concentric and eccentric phases), group means for lumbar paraspinal surface EMG activity increased consecutively with load (1X: 34.9+/-16.0%; 1.25X: 42.1+/-11.8%: 1.5X: 47.1+/-9.8%; p < 0.05) (Figure 2). However, 50% (5/10) of subjects did not display a progressive increase in EMG activity with exercise load. During the concentric phase, EMG activity increased from 1X to 1.25X (p < 0.05), but not from 1.25X to 1.5X (p > 0.05) (1X: 41.2+/-17.9%; 1.25X: 50.5+/-16.2%; 1.5X: 52.8+/-10.3%). During the eccentric phase, EMG activity increased consecutively with load (1X: 28.7+/-16.0%; 1.25X: 33.6+/-12.7%; 1.5X: 41.4+/-13.8% ; p < 0.05).

Conclusion

• Slow movement, full range of motion lumbar extension exercise on a new home exercise device safely and progressively activates the lumbar paraspinal muscles in healthy adults.

• Future investigations are needed to assess the effectiveness of exercise training protocols using this device on developing or maintaining lumbar extension strength.