EFFECTS OF AN UPPER BODY HARNESS TETHERING SYSTEM ON EMG ACTIVITY OF THE LOWER BACK DURING WALKING

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INTRODUCTION

This study examined the effects of 30 minutes of walking at 2.5 mph while supported by the Conva-Lift prototype in an upper body vest at traction levels of 0%, 25%, or 50% body weight on the EMG activity of the low back in adult males with chronic low back tightness.

METHODOLOGY

Eight adult males were administered traction at either 0%, 25%, or 50% body weight in a Kinney upper body vest for 10 minutes, then they walked for 30 minutes at 2.5 miles per hour (mph) with different graduations of traction while being supported in an active traction prototype (Conva-Lift). EMG activity of the low back was recorded after ten minutes of traction and in 10 minutes intervals for a total of 30 minutes of walking.

Standard EMG techniques were used with Motion Control pre-amplified electrodes to record eight seconds of EMG activity of the right longissimus (at lumbar 2-3 level) by an Ariel Performance Analysis System (APAS) at a sampling rate of 1000 hertz (Hz) after zeroing the A/D board and A/D range channels. A typical 2 second interval was selected for spike analysis and a spike threshold of .005 millivolts (mv) was utilized to identify an action potential.

The mean peak EMG activity, mean action potential duration, and motor unit pulse frequency were analyzed for the interval. A 3 x 5 ANOVA with repeated measures on the harness/weight factor and time factors was used to analyze the mean peak EMG, impulse duration, and stimulation frequency data.

RESULTS and DISCUSSION

The subjects' mean height was 179.5 ± 57.4 cm, the mean body mass was 89.0 ± 10.3 kg, and the mean age was 27.7 ± 10.4 years. The analysis found significant weight ($p=0.000001$) and weight by time interaction factors ($p=0.0098$). The subjects' peak EMG activity in the 25% condition started at .105 mv, decreased to 0.026 mv (-75%) after 10 minutes traction, decreased to 0.030 mv (-71%) after 10 minutes of traction/walking, decreased to 0.029 mv (-72%) after 20 minutes of traction/walking and was reduced to 0.027 mv (-74%) after 30 minutes of traction/walking (see Table 1 and Figure 1). During the 50% traction condition the peak EMG activity started at 0.094 mv, was decreased 73% to 0.025 mv after 10 minutes of traction; decreases of 81% (0.018 mv), 68% (0.030 mv), and 72% (0.026 mv) were observed after 10, 20, and 30 minutes of traction/walking, respectively.

During the normal walking condition a 23% reduction of the peak EMG was observed while walking 30 minutes at 2.5 mph. The reduction in the EMG

Table 1. Peak EMG activity of low back under varied traction conditions (mv).

	Traction Level % 0% (X ± sd)	Body Weight% 25 % (X ± sd)	Change from Rest 50 % (X ± sd)
1. Rest w/o Vest	.035 ± .009	.105 ± .119	.094 ± .104
2.Traction 10 min.	.027 ± .004 (-22.9%)	.026 ± .009 (-75.2%)	.025 ± .008 (-73.4%)
3. Walk 10 min.	.026 ± .008 (-25.7%)	.030 ± .009 (-71.4%)	.018 ± .002 (-80.9%)
4. Walk 20 min.	.026 ± .006 (-25.7%)	.029 ± .005 (-72.4%)	.030 ± .014 (-68.1%)
5. Walk 30 min.	.027 ± .009 (-22.9%)	.027 ± .013 (-74.3%)	.026 ± .006 (-72.3%)

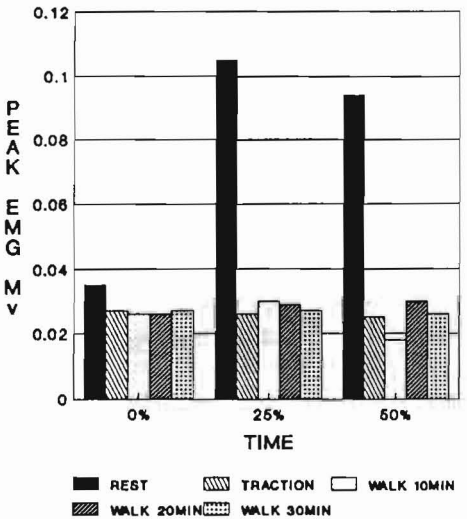

Figure 1. Peak EMG activity for low back under varied active traction conditions.

activity after exercise could be attributed to the trophotropic response of muscle to exercise producing a tranquil and relaxed muscle (deVries, 1968; deVries and Adams, 1972).

The analysis of the muscle action potential (MAP) durations found significant increases in the MAP duration with the mean durations increasing from 6.47 ± 3.14 ms to 9.77 ± 12.05 ms (+51%) after 30 minutes of walking at 25% traction. While under 50% traction the subjects' mean MAP durations increased from 5.34 ± 1.87 ms at rest to 17.76 ± 24.42 ms (+232.6%) after 10 minutes of traction/walking and to 8.03 ± 2.70 ms (+50.4%) after 30 minutes of walking (see Table 2 and Figure 2).

Table 2. MAP Duration of low Back under varied traction conditions (ms).

	Traction Level 0% (X±sd)	% Body Weight 25% (X±sd)	% Change from Rest 50% (X±sd)
1.Rest w/o Vest	6.90±1.41	6.47±3.14	5.34±1.87
2.Traction 10 min.	8.65±2.24 (+25.4%)	6.04±0.72 (-6.6%)	6.75±0.86 (+26.4%)
3. Walk 10 min.	9.12±3.17 (+32.2%)	7.96±3.02 (+23.0%)	17.76±24.42 (+22.6%)
4. Walk 20 min.	7.73±1.81 (+12.0%)	7.50±1.14 (15.9%)	14.24±15.45 (+16.7%)
5. Walk 30 min.	7.96±2.54 (+11.1%)	9.77±12.05 (+51.0%)	8.03±2.70 (+50.4%)

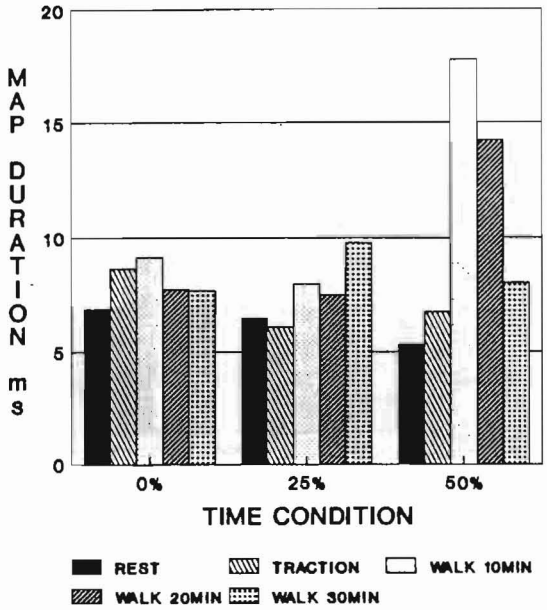

Figure 2. Average EMG duration for low back under varied active traction conditions.

The analysis of the motor unit pulse frequency data found that the stimulation frequency decreased over time for all traction/harness conditions with the largest change occurring for the 50% traction condition with the frequency slowing down from 204.8 ± 59.1 Hz to 103.0 ± 54.8 Hz after 30 minutes of traction/walking. The frequencies of stimulation were fastest for the low traction conditions (0% and 25%) (see Table 3 and Figure 3).

Table 3. MAP frequency of low back under varied traction conditions (Hz).

	Traction Level % 0% (X ± sd)	Body Weight% 25% (X ± sd)	Change from Rest 50% (X ± sd)
1.Rest w/o Vest	152.0±34.3	190.5±64.7	204.8±59.1
2.Traction 10 min.	121.2±25.5 (-20.3%)	167.5±20.2 (2.1%)	150.0±18.2 (-26.8%)
3. Walk 10 min.	120.0±36.4 (-21.1%)	140.8±46.6 (-26.1%)	122.4±62.7 (-40.2%)
4. Walk 20 min.	135.6±31.4 (-10.8%)	138.4±21.9 (-17.4%)	103.0±54.8 (-49.7%)
5. Walk 30 min.	141.4±41.6 (-7.0%)	164.4±67.8 (-13.7%)	134.3±35.3 (-34.4%)

As a result of the combination of the traction/stretching and tissue warming from walking which affects the relaxation properties of muscle, the peak EMG activity of the low back decreased, the MAP durations increased in time, and the pulse frequency was reduced during the active traction provided by the Conva-Lift which would indicate that the active traction was an effective method of reducing the excitation level of an individual's low back musculature leading to greater relaxation (Jacobson, 1936; Tuttle, 1943; deVries et al., 1976; Morgan and Horstman, 1976; deVries, 1961; Moore and Hutton, 1980; Petajan and Eagan, 1968).

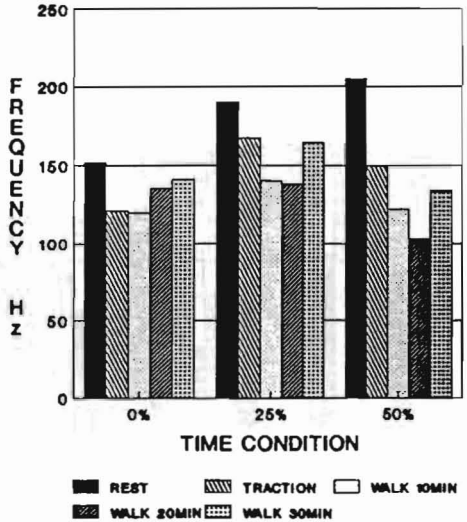

Figure 3. Average EMG frequency for low back under varied active traction conditions.

CONCLUSIONS

In summary, the greatest amount of relaxation or reduction (81%) in peak EMG activity of the low back occurred after walking 10 minutes at 2.5 mph with a traction force equal to 50% of their body weight applied by the Conva-Lift. Also, the male subjects experienced a reduction or relaxation of the musculature of at least 70% for the 25% traction condition.

The traction conditions for the subjects while walking 10, 20, and 30 minutes resulted in a longer muscle action potential (MAP) duration and slower firing frequencies.

This relaxation of the low back musculature observed while walking under various levels of traction provided by the Conva-Lift indicate that the Conva-Lift prototype is a viable device in reducing low back spasm in the treatment of chronic low back tightness while providing a cardiovascular workout.

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