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Inverted Spinal Traction

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ABSTRACT. Nosse LJ: Inverted spinal traction. *Arch Phys Med Rehabil* 59:367-370, 1978.

• The effect of inverted positioning on spinal length and electromyographic (emg) activity of superficial lumbar area musculature was investigated in 20 healthy men. Spinal length tape measurements were taken with subjects first sitting erect and after 1 minute in the inverted position. An integrated bioelectric monitoring system was used to quantify emg activity. Initially, a stable emg baseline was identified for each subject resting supine on a motorized tilt table. The randomly selected control group subjects remained supine for an additional 245 seconds. Experimental group subjects were inverted for half this duration and returned to the resting position for the remainder. Data were recorded for 10-second accumulation periods of emg activity 16 times from each subject. The 1-tailed paired *t*-test was applied to all data. The difference between the means of the spinal length measurements taken sitting and during inversion was highly significant ($p < 0.005$). The difference between the mean emg activity of the inversion period and the baseline mean was also statistically relevant ($p < 0.03$). This study concluded that inverted positioning for short periods significantly increased spinal length and reduced emg activity of the superficial lumbar area musculature of normal males. These findings complemented the clinical observations of several authors.

Sheffield¹ was the first to describe in this journal the use of the inverted position for spinal traction, reporting that of 175 incapacitated patients he treated in the inverted position, 155 were able to return to their jobs full time after an average of 8 treatments. Gray² found that 5/10 patients he treated in the inverted position in combination with manipulation experienced a reduction in symptoms. A third clinical report³ specified that 12/20 patients treated by inverted positioning experienced some degree of spinal musculature relaxation. While these clinical reports have been optimistic, little quantitative information has been offered in support of the use of this position for traction. To assess the inverted position quantitatively, an investigation was undertaken to measure the effect of the position on spinal length and electromyographic (emg) activity in the lumbar area in normal subjects.

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Methods and Materials

The recording instrumentation described by de Vries⁴⁻⁶ and others⁷⁻¹² was used. This consisted of an integrating bioelectric monitor,^a an electronic counter,^b and an oscilloscope.^c The data recorded from the counter were the averaged absolute values of the amplitude of the electrical activity generated by the muscle fibers near the recording surface electrodes during the data collecting period. Calibration of the system was such that by dividing the counter numbers by the duration of the data collection period, the mean source emg voltage could be described in units of microvoltage root-mean-square ($\mu\text{V RMS}$). All testing took place within a copper-screen enclosure during the same hours on 2 successive days.

Twenty healthy firemen, aged 25 to 50 years, volunteered for the study. Ten subjects were randomly assigned to the experimental group with the rest placed in the control group.

Each subject sat erect while the perpendicular spinal length from the spinous process of C-7 to a line connecting the posterior superior iliac spines was measured. Three 16-mm diameter silver-silver chloride emg surface electrodes^d were used. The 2 active electrodes

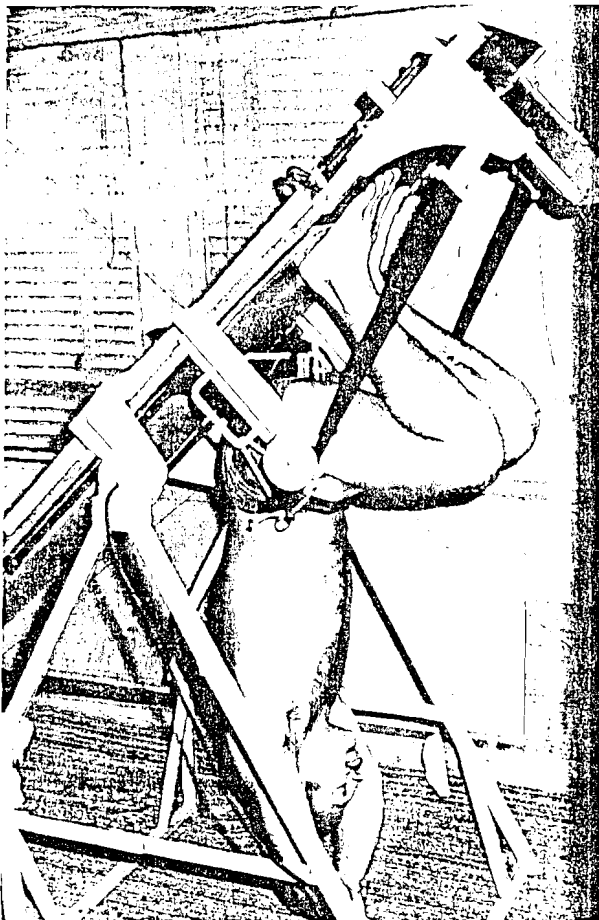


Fig 1—Experimental group subject in inverted position.

were placed over the muscle bulk midway between the 12th rib and the posterior iliac crest of the left side of the body approximately 3.5 cm lateral to the spinous process of an adjacent lumbar vertebra. An inactive electrode was attached to the volar surface of the left wrist. Skin resistance of less than 5 k-ohms was obtained prior to proceeding with the experiment.

Each subject was given a demonstration on the operation of the motorized tilt table. A padded revolving platform was attached to the table and placed against the thighs of the subject, who was positioned supine on the table with 75° of hip flexion. After the subject was relaxed, 10-second counter readings of the emg activity were taken repeatedly until no emg changes were found for 3 consecutive accumulation periods.

Each experimental subject then was asked to push a toggle switch and rotate the table until the table indicator pointed to 135° (fig 1). After the subject had been hanging in the inverted position for 1 minute, spinal length measurements were retaken. Fifty-five seconds later, the subject returned to horizontal and remained in position for an additional 115 seconds.

Each control group subject remained in the original horizontal position with hips flexed for the duration of the experiment. Emg activity was recorded from the counter for all subjects for sixteen 10-second accumulation periods during the testing session.

The computed $\mu\text{V RMS}$ values of emg activity and the measured sitting and inverted spinal length data were analyzed by 1-tailed paired *t*-test at the 0.05 significance level.

Results

The 2 groups showed no significant differences in baseline emg activity (experimental $\bar{x} = 11.1$, control $\bar{x} = 11.76$, $t = 0.24$, $SD = 2.71$). The control group emg means remained essentially unchanged throughout the testing period. In the inverted position the experimental group demonstrated a statistically significant decrease in emg activity ($\bar{x} = 6.71$, $SD = 2.0$, $t = 2.19$, $p < 0.03$), which was not sustained upon returning to the horizontal ($\bar{x} = 9.8$, $SD = 6.74$, $t = 0.2$).

By the first monitored period during the inverted positioning, the group mean had decreased 35% from the baseline mean. Activity continued to decrease in smaller amounts for 70 seconds, then leveled off with the exception of a slight increase between 1 min 15 sec and 1 min 25 sec (fig 2). Upon return to the horizontal position, the mean emg level was found to be less than the baseline mean but not enough less to approach statistical relevance. Greater variability among subjects was noted in this phase of the experiment than during any other.

The difference between the mean spinal length measurements of the experimental group subjects taken sitting erect and at the 1-minute point during inversion was highly significant ($p < 0.005$). There was a

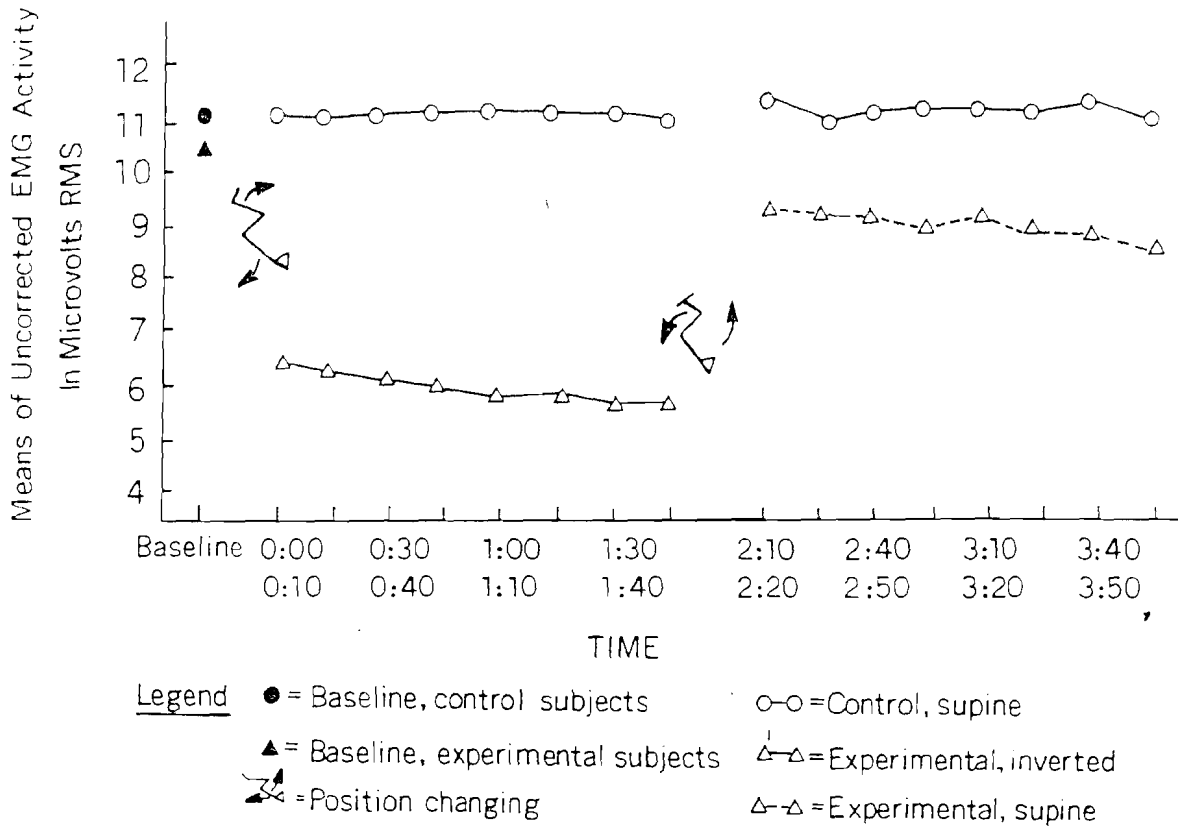


Fig 2—Means of emg activity for each of the data collecting periods.

consistent relationship found to exist between the increases in spinal length (table) and the decreases in emg activity during the inverted positioning.*

Discussion

An attempt was made to identify similarities among the 8 subjects who showed electrical activity decreases and spinal length increases. Age, height, weight, and treatment time were each compared with the percentage of changes observed. No relationships between these factors were found.

Two subjects who did not show the usual changes were interviewed after their testing sessions. They both indicated that they found the position uncomfortable but for different reasons. One subject, the largest man tested, said the platform restricted him too much and he was unable to hang freely, as his head was in contact with the floor while he was inverted. The other subject said he had eaten his lunch 30 minutes prior to being inverted and "had a lump in my stomach" while inverted.

Due to the small sample, the response of each subject had much influence on the mean levels. One

subject, who was observed to move into spinal extension in an attempt to reposition himself on the platform, influenced the 75-85 second period mean emg activity upward. Thus it is reasonable to state that the lowest mean emg level was reached during the monitoring period prior to this event and plateaued thereafter.

Wherever there were emg declines, there were also

Spinal Length Measurements of Experimental Group Subjects

Subject	Distance between C-7 and PSIS* (cm)	
	Sitting erect	At 1-minute point during inversion
A	57.8	59.7
B	55.9	55.9**
C	55.9	60.3
D	61.0	63.5
E	59.7	63.5
F	54.6	58.4
G	55.9	54.6**
H	55.3	59.1
I	53.3	55.3
J	53.3	54.6
	$\bar{x} = 56.3$	$\bar{x} = 58.5$
	$t = 3.805$	
	$p < 0.005$	

* A table of data from both groups in uncorrected µV RMS is available on request to author.

* A line connecting the posterior superior iliac spines (PSIS).
 ** Emg activity increased from baseline level.

measurable spinal length increases. Emg activity was observed to decline over 35% within 10 seconds of assuming the inverted position. This was the largest single decline. From this it was assumed that the greatest amount of spinal lengthening took place as rapidly as did the major emg decline. Because of this perfect negative correlation, the effectiveness of the inverted position on a particular individual might be determined simply, objectively, and quickly without expensive monitoring equipment.

A small pilot study (n=5) found that spinal length increases could be measured after as little as 10 seconds in the inverted position.¹² The 1-minute spinal length measurement was felt to correspond sufficiently to the period of maximal emg decline so that the supporting effect of the musculature would have been at a very reduced level.

A carryover effect from inverted positioning was anticipated from clinical reports on the use of the position in treating patients with back pathologies.^{1-3,12} The lack of a statistically significant carryover effect in the present study may have been due to the study design, which limited the duration of the postinversion monitoring to 115 seconds. It is evident that this duration was insufficient to allow the experimental group subjects to reach a plateau of emg activity. A general trend of progressively declining mean emg levels occurred and the final monitored period was lowest of all (fig 2).

It was concluded from this study that inverted positioning increases the spinal length and reduces the emg activity of lumbar area musculature in healthy male subjects. A minimum duration of 70 seconds was required for the maximal effect of the inverted position on the lumbar musculature. Both changes were statistically significant.

While the effects of the inverted position on normal subjects have been appropriately verified, and credence added to clinical observations, inverted positioning of subjects with diagnosed pathologic conditions of the back or spine has yet to be studied by similarly objective statistical means.

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Materials Manufacturers and Suppliers

- a. Integrating Bioelectric Monitor, Model 100, Newport Laboratories, Santa Ana, CA
- b. Model 5216A, Hewlett Packard Co, North Hollywood, CA
- c. Model 502A, Tektronix, Inc, Portland, OR
- d. Flight electrodes model IRI-GBE SO 24 MSC, National Aeronautics and Space Administration, Washington, DC
- e. Tilt table, Revolv-o-Trac, Milwaukee, WI

