Effect of Intermittent, Supine Cervical Traction on the Myoelectric Activity of the Upper Trapezius Muscle in Subjects with Neck Pain

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This study was undertaken to compare the myoelectric activity of the upper trapezius muscle before, during, and after intermittent, supine cervical traction. Twelve people with diagnosed disease or injury of the cervical spine served as subjects. Electromyographic recordings were taken from the upper trapezius muscle with bipolar surface electrodes. The subjects were treated with 20 minutes of intermittent, cervical traction at a force of 8% of their body weight. Recordings were taken with the subjects in the supine position before the traction, during one pull and release phase of the 10th and 20th minutes of traction, and after completion of the traction treatment. An analysis of variance with repeated measures showed no significant differences in the myoelectrical activity during the six time periods measured. The results of this study do not support the clinical use of intermittent, supine traction to produce cervical muscle relaxation.

Key Words: Muscle, Neck, Physical therapy, Traction.

Individuals with neck pain commonly seek the care of physical therapists, and cervical traction is often a part of the treatment program. Disease or injury of the cervical structures is thought to result in muscle spasm of the supporting neck musculature, which may cause further pain. Cervical traction is applied in an effort to stretch the involved cervical structures to relieve spasm and pain. Stretching a muscle through cervical traction has not been well-established, however, as an effective method of relieving muscle spasm.

Although most clinicians might agree that they can feel areas of hardness and tenderness in muscles around an injury and interpret these areas as muscle spasm, the nature and etiology of muscle spasm remain controversial. Neither histological nor EMG examinations of areas of muscle spasm have provided clear evidence of its characteristics. Investigators have hypothesized many causes for muscle spasm, including the following: 1) decreased circulation to muscle fibers with ischemia and build-up of waste products, 2) muscle tearing, 3) irritation of the sinuvertebral nerve serving injured ligaments or joint capsules, 4) accumulation of irritant by-products of inflammation, 5) overstretch and hypersensitivity of muscle spindles, and 6) reflex firing of anterior horn cells in response to noxious stimuli. Many investigators, who believe muscle spasm represents continuous, involuntary muscle-fiber contraction, have sought to record spontaneous motor unit action potentials from areas of muscle spasm. In 1952, Hunt hypothesized an autogenic inhibitory role for the spindle. The group II afferents were thought to be activated when the muscle was placed in a static lengthened position. His findings have been cited as rationale for the effectiveness of muscle stretch in relieving spasm. Recent literature, however, is not conclusive regarding the role of group II muscle spindle afferents in autogenic inhibition, and they may even play a role in autogenic excitation. The success of traction has also been attributed to reflex inhibition of muscle contraction or spasm mediated by Golgi tendon organs, but the inhibition provided by Golgi tendon organs only moderates the excitatory response of the muscle to a stretch. These neurological mechanisms may not, therefore, provide explanation for inhibition of muscle spasm even if muscle fibers are actually contracting.

Jackson and DeLacerda have also suggested that rhythmic, intermittent traction reduces pain by improving circulation or by preventing or reducing adhesions and contractions of cervical structures. Traction may also reduce pain by stimulating the large afferent fibers of muscles and joints that presynaptically inhibit pain fiber transmission at the spinal cord level. Traction may, however, be harmful. One
opponent argues that neck pain is caused by damaged muscle fibers and connective tissue and that these inflamed, torn structures should not be further stretched. 12

Although several studies have been done to determine whether cervical traction separates the vertebrae and what is the best way to accomplish separation, 8, 10 only two studies have been published that measure myoelectric activity of the muscle being stretched during a traction treatment. 13, 15 One study with healthy subjects measured myoelectric activity of the lumbar muscles during inverted traction. 14 An immediate decrease from resting level EMG was observed during inversion, but it was not sustained in the supine position. This finding could be related to the tonic labyrinthine reflex, but the author did not address this point. In the other study, DeLacerda measured myoelectric activity in the upper trapezius during intermittent, supine cervical traction in healthy subjects. 16 He concluded that myoelectric activity was higher when the traction was pulling than when the traction pull released and that the larger the angle of pull, the higher the myoelectric activity. Unfortunately, DeLacerda’s interpretation of his results is misleading. The article pictures an EMG tracing that shows a 60-Hz interference signal during the pull phase. In addition, even if he did measure actual myoelectric activity and not artifact, he did not control intervening variables in the EMG recordings. 18 A third, unpublished study measured myoelectric activity in cervical muscles during sitting with cervical traction in subjects who had exercise-induced muscle pain. 19 Myoelectric activity did not significantly change during or after traction. No studies have examined the effect of cervical traction on myoelectric activity in subjects with neck pain from disease or injury.

The disparity in research findings creates difficulty in drawing conclusions on the effectiveness or desirability of cervical traction for treating patients with neck pain. Cervical traction can apply a stretch to the cervical muscles. Whether stretching those muscles by traction causes an increase or decrease in muscle electrical activity is unclear. Whether the effect of stretching on myoelectric activity is even pertinent to the relief of muscle spasm and pain seems equally unclear. Proponents and opponents of cervical traction base their arguments on conflicting and often unsubstantiated theories of the nature and cause of neck pain and its relationship to muscle spasm. The principle of using traction to provide muscle relaxation requires further study.

Assuming that one benefit of cervical traction is muscle relaxation, we hypothesized that myoelectric activity would decrease as a result of traction. Therefore, the purpose of this study was to determine if myoelectric activity of the upper trapezius muscle significantly differed before, during, or after intermittent, supine cervical traction in a group of subjects with neck pain and muscle spasm. We expected that myoelectric activity might increase during the pull phases of traction but would be less after the treatment than before.

METHOD

Subjects

Twelve subjects, five men and seven women, with diagnosed neck pain participated in the study. The subjects ranged in age from 15 to 54 years with a mean age of 38 years. All had palpable tender areas in at least one upper trapezius muscle. Cervical traction was part of an established outpatient physical therapy program for each participant. The subjects’ diagnoses included whiplash, cervical radiculitis, cervical arthrosis, and neck strain. The subjects reported a duration of symptoms between one month and 14 years. The mean duration was 2.9 years. The Sargent College Research Review Committee approved the project and the subjects signed an informed consent.

Instrumentation

Traction was applied with a Tru-trac* TT92 model traction unit and a Dura-tech traction table and head halter. Instrumentation for EMG consisted of a Grass† model 7 polygraph with a 7P3 amplifier and a 7P10 cumulative integrator. The input impedance of the 7P3 is 44 MΩ differential and the half-amplitude frequency range is 3 to 75 Hz. Common mode rejection ratio is 1,600:1 and the signal to noise ratio is 280:14. Sensitivity was set at 50 μV/cm peak to peak. The half-amplitude frequency range of integrated electromyogram (IEMG) was 10 Hz to 40 kHz. The 7P10 Grass cumulative integrator processed the EMG signal and displayed the IEMG as a ramp function with an automatic amplitude reset.

The skin where the electrodes were to be placed was rubbed with alcohol and lightly abraded. Beckman‡ miniature silver-silver chloride surface electrodes were placed 2.5 cm apart on the subject’s most painful upper trapezius muscle halfway along a line between the acromion and spinous processes of C7. The electrode impedance was less than 5,000 Ω. The ground electrode was either a plate placed on the ipsilateral wrist or a third Beckman electrode placed on the ipsilateral acromion process. The placement of the ground electrode was changed in an attempt to eliminate ECG artifact from the recording. The change, however, was not effective in eliminating the artifact. A head halter was placed on the chin and occiput in the standard way, and the subject lay supine on the traction table with a low pillow under the head.

Procedure

The subject relaxed in the supine position for 5 minutes before the traction began, and the first IEMG recording was taken during the fifth minute of relaxation. A traction force of approximately 8% of the subject’s body weight was then applied intermittently for a 20-minute period with a seven-second pull and seven-second rest cycle. The angle of pull was 25 degrees. Eight percent of the body weight was chosen because this percentage approximates the weight of the head, and neck, 20 and Harris stated that muscle relaxation can best be accomplished with a traction force that supports the weight of the head. 11 The mean traction force for all subjects was 5.9 kg (13 lb) with a range of 4.5 to 9.1 kg (10 to 20 lb). Harris also recommended a 20- to 25-minute traction treatment to achieve muscle relaxation. 11 During the treatment, we took four separate IEMG recordings: 1) a pull phase of the 10th minute, 2) a rest phase of the 10th minute, 3) a pull phase of the 20th minute, and 4) a rest phase of the 20th minute. After the traction, the subject remained in the supine position for

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‡ Beckman Instruments, Inc, 3900 River Rd, Schiller Park, IL 60176
5 minutes, and a final IEMG recording was taken during the fifth minute.

Data Analysis

To compare subjects, we normalized our data by determining the total IEMG (mm/sec) obtained during each subject’s experimental session. We then calculated the IEMG for a seven-second period under each of the six conditions described above and converted each to a percentage of the total.\(^1\) We did not ask for a maximal voluntary contraction to normalize our data because we did not wish to intensify our patients’ neck pain. The IEMG values, expressed as percentages, were then submitted for data analysis. We performed a one-way analysis of variance (ANOVA) with repeated measures to determine if there was a significant difference in the percentage of output during the six time periods.

RESULTS

The means and standard deviations of normalized myoelectric activity for each measured period of the traction treatment are presented in Table 1. The summary of the one-way ANOVA on repeated measures is displayed in Table 2. These results indicated that myoelectric activity of the upper trapezius muscle did not differ significantly before, during, or after cervical traction (\(p > .05\)).

DISCUSSION

This is the first study, to our knowledge, that has measured myoelectric activity of the neck muscles during cervical traction in subjects with pain from disease or injury. Because traction is believed to produce muscle relaxation, we were interested to see what effect it would have on myoelectric activity of the muscle being stretched. The results of our study do not support the hypothesis that intermittent, supine cervical traction, applied with a force believed to produce muscle relaxation,\(^1\) decreases myoelectric activity of the upper trapezius muscle.

In our study, once most of the subjects were lying in the supine position, we found electrical silence of the upper trapezius muscle. Electrical silence is expected in muscles at rest; yet, some studies have demonstrated resting motor unit action potentials in painful muscles.\(^5,6\) The IEMG values we obtained were reflective of ECG artifact rather than action potentials in the upper trapezius muscle. The results of this study do not support the definition of muscle spasm as being involuntary muscle contraction. Our subjects were in pain and had firm, tender areas in the muscle recorded, but there was no evidence of contraction in the upper trapezius muscle once the subject lay down. Because the cervical muscles were in a state of relaxation with the subjects in the supine position, further reduction in myoelectric activity with the application of cervical traction was impossible. Therefore, muscle relaxation may not be an adequate explanation for the reduction of pain produced by cervical traction.

Our findings also do not agree with those of DeLacerda, who found an increase in myoelectric activity of the cervical muscles during traction.\(^1\) In our study, the means of normalized EMG data for the pull phases of traction were, however, slightly higher than the means for the corresponding release phases (Tab. 1).

Higher traction forces may be needed to demonstrate a change in myoelectric activity and also may be desirable. DeLacerda used 13.6 kg (30 lb) of traction and believed that he demonstrated higher myoelectric activity during the traction pull than during the release phase.\(^1\) He stated that his findings supported the use of traction to reduce pain and suggested that the rhythmic muscle contraction and relaxation produced by the traction increased muscle blood flow, which reduced pain. Indeed, higher traction forces are believed necessary to separate the cervical vertebrae and are, therefore, used by many clinicians. Valtonen et al, however, found that in some cases, traction caused shortening of the cervical area, and they attributed this to increased muscle contraction caused by the traction.\(^8\) Both Farbman\(^2,2\) and Caldwell and Krusen\(^2,3\) found better overall improvement in patients with cervical problems when they were treated conservatively with inpatient, low-poudage traction or with no traction or manipulation at all. Higher traction forces may cause protective contraction of the muscles around the neck. Replication of our study using higher traction forces might provide important additional information, especially if vertebral separation were measured at the same time as myoelectric activity. Determining the correlation between pain reduction, vertebral separation, and myoelectric activity would also be interesting. Most of our subjects reported some pain reduction after the traction treatment, but we made no attempt to correlate this with the IEMG values.

Other reasons for our inability to record changes in myoelectric activity with traction may be related to instrumentation or electrode placement. One might argue that spontaneous myoelectric activity is limited to only a few muscle fibers directly in the area of tenderness.\(^7\) In this study, the position of the electrodes was standardized for all subjects so that the electrodes may not have been directly over the most tender area of the upper trapezius muscle. We also may not

<table>
<thead>
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<th>Source</th>
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<th>F</th>
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<td>1.43</td>
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**TABLE 2**

Analysis of Variance Summary: Normalized EMG Values During Six Time Periods of Treatment (mm/sec)

<table>
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<th>Time Period</th>
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<tr>
<td>Before traction</td>
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<td>1.17</td>
</tr>
<tr>
<td>Pull phase 10th min</td>
<td>12.94</td>
<td>1.33</td>
</tr>
<tr>
<td>Release phase 10th min</td>
<td>12.78</td>
<td>1.18</td>
</tr>
<tr>
<td>Pull phase 20th min</td>
<td>12.43</td>
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</tr>
<tr>
<td>Release phase 20th min</td>
<td>12.18</td>
<td>1.12</td>
</tr>
<tr>
<td>Five min after treatment</td>
<td>12.89</td>
<td>1.72</td>
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</table>
have recorded from the most appropriate muscle. Perhaps deeper cervical muscles are affected more by traction than the upper trapezius muscle, and we were unable to measure their electrical activity with surface electrodes. Other studies could be done that include recording myoelectric activity directly over tender areas of the upper trapezius muscle or in other cervical muscles.

Measuring EMG activity of the neck muscles in the sitting position, a functional position for the head and neck, might also reveal differences in muscle tension measured before and after traction. We did not measure myoelectric activity in the sitting position.

CONCLUSIONS AND CLINICAL IMPLICATIONS

The results of this study fail to support the use of intermittent, cervical traction in the supine position as a means of producing relaxation of the upper trapezius muscle. We also did not find spontaneous resting myoelectric activity in our subjects' upper trapezius muscles, even though the muscles were painful. Those patients for whom the goal is cervical muscle relaxation may benefit from simply lying down as much as from cervical traction. We recommend that physical therapists carefully consider this information when they decide whether cervical traction should be a part of a treatment program.

REFERENCES