Biofeedback traction versus conventional traction in cervical radiculopathy

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ABSTRACT

Objective: The objective of this study was to investigate the effect of the cervical traction modality with and without electromyographic (EMG) biofeedback for neck muscles in patients with cervical radiculopathy.

Method: This study was carried out at the Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia between February and May 2002. Twenty patients with cervical radiculopathy were randomly divided into 2 equal groups. Group A was treated by a conventional traction modality and group B was treated by a conventional traction modality with EMG biofeedback (to obtain relaxation of paraspinal neck muscles). The average EMG activity was recorded pre and post treatment at cervical (C) 5-6 level for both groups during pull, rest and post traction for a period of 6 weeks.

Results: Comparison of the average EMG activity of the paraspinal C5-6 muscle in different phases of cervical traction showed significant decrease of EMG activity during the pull phases of traction as well as after traction, especially with group B which was treated by the EMG biofeedback modality.

Conclusion: Electromyographic biofeedback with cervical traction showed a significant effect in avoiding muscle spasm and decreasing root compression during traction.

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Cervical traction is used in treating various neck disorders. The 2 general objectives in applying cervical traction are 1) to stretch the posterior cervical region and 2) to enlarge the interspaces at the intervertebral foramina. Although many researchers have reported that cervical traction in the supine position is superior to traction in the seated position, both positions are currently used. Different studies found that the interspaces of the intervertebral foramen become narrower with application of cervical traction.

This narrowing is often attributed to muscle guarding and poor relaxation of the patient during traction, it has been postulated, but not proven, that prolonged pull on the cervical spine with adequate force leads to fatigue of the paraspinal muscles. De lacerda suggested that rhythmic, intermittent traction reduces pain by improving circulation 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.

However, another opponent argued that neck pain is caused by the damaged muscle fibers and connective tissue and these inflamed structures should not be further stretched. The increase or decrease of myoelectric activity of the cervical muscles as a result of stretching was unclear.

The purpose of this study was to compare the effect of cervical traction modality with and without...
emergent electromyographic (EMG) biofeedback for the neck muscles in patients with cervical radiculopathy.

**Methods.** Twenty patients diagnosed with cervical radiculopathy according to clinical examination and EMG studies participated in this study, which was carried out at the Department of Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia between February and May 2002. The 20 patients were selected according to an established outpatient physical therapy program and reported a history of symptoms for one month to one year. Their ages ranged from 38-51 years, and body weight ranged from 58-65 kg. They were divided randomly into 2 equal groups: conventional (group A) and new EMG biofeedback traction modality (group B).

**Instrumentation.** 1. Conventional traction with a digit-Trac E 90KA traction unit and head halter (Ever Prosperous Instrument Inc., Taiwan). 2. Polygraph apparatus 360 NEC connected with a computer system physteach "4" with the Microsoft windows 3.1 with AID card to convert the EMG interference pattern to digital form. 3. Hydrocollator hot pack. The subject was positioned in a comfortable sitting position. A hydrocollator hot pack was placed on the neck for 20 minutes. Baseline EMG signals at the C5-6 level were recorded. Both the conventional traction modality and EMG biofeedback traction modality were applied intermittently for a 20 minute period with a 10 second pull and 5 second rest cycle. The angle of pull was 25° from the vertical plane. 12

A traction force of approximately 8% of the subject's body weight was applied at the onset of traction. 9 The average time to safely raise the traction force from the start (one-eighth of the subjects' total body weight) to optimum (one-fourth of the subject's total body weight) for the conventional traction group was approximately 4 weeks. The EMG biofeedback group, however, only took approximately 2 weeks to reach the optimum force. Mean traction force for all subjects was approximately 25% of body weight according to patient tolerance. It ranged from 12-18 kg. Patients received traction sessions for 20 min/day every other day for a period of 6 weeks and C5-6 paraspinous EMG signals were obtained at pull, release, and post-traction phases. 7

**Results.** Comparison of average EMG activity of the paraspinal C5-6 muscle in different phases of cervical traction is shown in Table 1. From the paired t-test, significant decrease of EMG activity was identified during the pull phase of traction as well as after traction in the cervical muscle tension, especially with patients using EMG biofeedback traction modality. There was a higher tendency of decreased EMG activity after traction in patients treated with biofeedback traction modality than in those patients treated with conventional traction.

The change of average EMG activity during the 6 weeks course of traction is shown in Table 2. All patients treated by cervical traction were noted to have a gradual decrease in myoelectric activity during the 6 week period. During the 6 week period, patients showed that the average EMG activity in the conventional traction group was significantly lower than that of the biofeedback traction group.

**Table 1** - Comparison of average EMG activity in microvolts between 2 groups during the treatment period.

<table>
<thead>
<tr>
<th>Week</th>
<th>Group A</th>
<th>Group B</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.68±0.14</td>
<td>6.47±0.20</td>
<td>0.056</td>
</tr>
<tr>
<td>2</td>
<td>5.92±0.32</td>
<td>5.34±0.19</td>
<td>0.0005</td>
</tr>
<tr>
<td>3</td>
<td>5.18±0.31</td>
<td>4.53±0.19</td>
<td>0.045</td>
</tr>
<tr>
<td>4</td>
<td>4.79±0.22</td>
<td>3.48±0.27</td>
<td>0.0005</td>
</tr>
<tr>
<td>5</td>
<td>4.21±0.33</td>
<td>2.04±0.16</td>
<td>0.001</td>
</tr>
<tr>
<td>6</td>
<td>3.64±0.20</td>
<td>1.83±0.10</td>
<td>0.005</td>
</tr>
<tr>
<td>F</td>
<td>29.40</td>
<td>27.77</td>
<td>15.37</td>
</tr>
<tr>
<td>P</td>
<td>0.0005</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Group A - patients using the conventional traction modality
Group B - patients using the EMG biofeedback traction modality

**Table 2** - Changes of average EMG activity in microvolts at C5-6 level in different phases of cervical traction.

<table>
<thead>
<tr>
<th>Week</th>
<th>Before traction</th>
<th>During pull</th>
<th>Traction release</th>
<th>After traction</th>
<th>Before traction</th>
<th>During pull</th>
<th>Traction release</th>
<th>After traction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.86±0.31</td>
<td>5.72±0.28</td>
<td>5.58±0.29</td>
<td>5.73±0.28</td>
<td>5.52±0.39</td>
<td>5.6±0.42</td>
<td>5.64±0.41</td>
<td>5.52±0.46</td>
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<tr>
<td>2</td>
<td>5.47±0.40</td>
<td>5.36±0.32</td>
<td>5.41±0.37</td>
<td>5.39±0.37</td>
<td>4.99±0.38</td>
<td>4.92±0.37</td>
<td>5.08±0.33</td>
<td>4.84±0.37</td>
</tr>
<tr>
<td>3</td>
<td>5.04±0.46</td>
<td>4.77±0.44</td>
<td>4.94±0.42</td>
<td>4.96±0.42</td>
<td>4.35±0.38</td>
<td>4.31±0.37</td>
<td>4.35±0.39</td>
<td>4.22±0.32</td>
</tr>
<tr>
<td>4</td>
<td>4.68±0.54</td>
<td>4.58±0.48</td>
<td>4.64±0.40</td>
<td>4.64±0.48</td>
<td>3.62±0.36</td>
<td>3.56±0.32</td>
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<td>3.53±0.35</td>
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<tr>
<td>5</td>
<td>4.40±0.62</td>
<td>4.23±0.51</td>
<td>4.34±0.45</td>
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<td>3.03±0.31</td>
<td>3.10±0.31</td>
<td>2.96±0.22</td>
</tr>
<tr>
<td>6</td>
<td>4.01±0.54</td>
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<td>3.97±0.39</td>
<td>3.89±0.44</td>
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<td>2.52±0.27</td>
<td>2.55±0.27</td>
<td>2.35±0.19</td>
</tr>
</tbody>
</table>

Group A - patients using the conventional traction modality
Group B - patients using the EMG biofeedback traction modality

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reduced by 45.5% (from 6.68 to 3.64 ~V), whereas the new EMG biofeedback traction group B showed a 71.7% (from 6.47 to 1.83 ~V) decrease. The statistics indicate a significant difference.

**Discussion.** Electromyographic biofeedback has been well studied in previous researches.\(^9\)-\(^{15}\) The application of EMG biofeedback in relaxation, motor training, gait correction, and prosthetic control have been reported.\(^11\) However, this study reports the implementation of EMG biofeedback for adaptive cervical traction force control recorded at the cervical spine paraspinal level.

The weight of the human head is approximately 8.1% of an individual's body weight; effective cervical traction force must be greater than that weight.\(^3\) Weignberger\(^10\) reported that a traction force of at least 11.25 kg was needed to separate the cervical intervertebral space in the sitting position. Colachis and Strohm\(^7\)-\(^8\) found that the most effective cervical traction force was 13.5 kg and that an even greater traction force would result in a larger separation of the intervertebral space.

In the conventional traction program, the weight of traction was set at one-eighth of the subject's total body weight, and then gradually increased to a maximum force of one-fourth of the subject's body weight according to the subject's compliance. Usually, a force of 0.5 kg/day took approximately 3-4 weeks to achieve the optimum traction force according to the physical therapy guidelines. When the EMG biofeedback cervical traction modulation was used, however, the average time to safely raise the traction force from start to optimum was shortened by 2 weeks to achieve the same effective outcome.

In this study, a decrease of average EMG activity during the pull and relax phases of traction was not obvious in patients with cervical radiculopathy in the neck muscle tension who underwent conventional traction. This may indicate that application of moist heat at the neck for 20 minutes before traction still does not completely relax neck muscles during the whole course of traction in patients with cervical radiculopathy. A decrease of EMG activity was identified during the pull phase as well as after traction in the neck muscle tension when this new biofeedback traction modality was used. It may suggest that through the adaptive EMG biofeedback traction protocol, patients could be in a more relaxed state during traction. Cumulative effects in the decrease of myoelectric activity were possibly attributable to reflex inhibition of muscle contraction or spasm by autogenic inhibition. However, other literature\(^3\)-\(^5\) has stated that the role of Group II afferent muscle spindles in autogenic inhibition may even play a role in autogenic excitation. Success of traction depends on the proper stretch of the cervical structures. Involuntary muscle fiber contraction and muscle spasms may be avoided through continuous EMG monitoring or biofeedback.

In conclusion, cervical traction modality with close loop traction weight control based on EMG biofeedback was applied. The clinical trial for patients with cervical radiculopathy indicated that the raised traction force from the start to optimum was shortened from 4 to 2 weeks in achieving the same effective outcome by the biofeedback traction modality in comparison to the conventional traction modality.

**References**