Decrease in Biceps Inhibition after Neck Adjustment in Patients with Chronic Whiplash

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Introduction
Whiplash associated disorders (WAD) result from injuries to the cervical spine, mainly motor vehicle accidents (Ackerman and Ahmad, 1999), and are characterized by cervical range of motion restrictions and chronic pain (Spitzer et al., 1995). Despite the high prevalence of chronic WAD, there is little consensus on the most effective treatment for chronic neck pain. Some evidence indicates that spinal manipulation may be effective for the treatment of chronic WAD (Woodward et al., 1996), however results of most intervention studies remain inconclusive. One hindrance in evaluating the efficacy of treatment programs is the lack of objective outcome measures to quantify WAD injuries. Patient evaluation typically consists of variables with more qualitative dimensions e.g., self-rated pain and disability questionnaires, as well as subjective physical examinations including soft tissue palpation. The purpose of the this study was i) to measure elbow flexor activation in patients with WAD using the interpolated twitch technique and ii) to assess the immediate effects of cervical spinal manipulation on elbow flexor function. It was hypothesized that patients with WAD demonstrate significant muscle inhibition in their elbow flexors, and that a manipulation of the cervical spine will result in an immediate decrease in this muscle inhibition.

Methods
Sixteen subjects (14 females, 2 males, mean age 33.8 ± 6.5 yrs) originally diagnosed as Grade II WAD (neck complaints with point tenderness and limited CROM, Spitzer et al., 1995), or Grade III WAD (neck complaints plus neurological signs such as decreased reflexes, weakness and sensory deficits, Spitzer et al., 1995), gave written informed consent to participate in this study. Activation of the biceps muscle was assessed using the interpolated twitch technique (Allen et al., 1998) and electromyography (EMG). The interpolated twitch technique requires applying a supramaximal electrical twitch to the biceps muscle during a maximal voluntary elbow flexor contraction. In case of muscle inhibition, which is characterized as incomplete voluntary muscle activation, the electrical stimulation will increase the measured force. The magnitude of the evoked twitch force is representative for the amount of muscle inhibition. EMG root mean square (RMS) values were calculated from 1-second segments during the maximal biceps contraction preceding twitch application. Active cervical range of motion (CROM) and pressure pain thresholds on six upper back and neck muscles were measured using a goniometer and an algometer, respectively. Manipulation of the cervical spine (high velocity low amplitude thrust) was applied at the level of C5/6 and C6/7, and functional assessments were repeated. Pre- and post-treatment values (means and standard deviations) for all variables were compared with paired t-tests. A significance level of α=0.05 was employed.

Results
Patients showed significant inhibition in their biceps muscles compared to normal values of 4.4 ± 5.3% (Brodino et al., submitted). Active lateral CROM was restricted, and increased pressure pain sensitivity was evident. After cervical spine manipulation, a significant reduction in biceps inhibition and an increase in biceps force occurred (Table 1). Active CROM increased between 7.6-18.9%. The pressure pain thresholds increased on average 21.5±6.3% at all six sites.
Table 1: Biceps before and after cervical spine adjustment. * indicate statistically significant differences between pre- and post-manipulation values

<table>
<thead>
<tr>
<th>Biceps function</th>
<th>Before treatment</th>
<th>After treatment</th>
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</thead>
<tbody>
<tr>
<td>Muscle inhibition left (%)</td>
<td>9.7 ± 7.6</td>
<td>5.4 ± 4.7 *</td>
</tr>
<tr>
<td>Muscle inhibition right (%)</td>
<td>16.8 ± 13.4</td>
<td>5.7 ± 6.1 *</td>
</tr>
<tr>
<td>Elbow flexor moment left (Nm)</td>
<td>35.9 ± 9.0</td>
<td>43.2 ± 10.9 *</td>
</tr>
<tr>
<td>Elbow flexor moment right (Nm)</td>
<td>34.6 ± 10.6</td>
<td>45.5 ± 11.2 *</td>
</tr>
<tr>
<td>Biceps EMG RMS left (mV)</td>
<td>0.69 ± 0.44</td>
<td>0.80 ± 0.42 (p=0.098)</td>
</tr>
<tr>
<td>Biceps EMG RMS right (mV)</td>
<td>0.54 ± 0.34</td>
<td>0.67 ± 0.35 *</td>
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</tbody>
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Discussion

Using the interpolated twitch technique, the chronic WAD patients in this study demonstrated significant inhibition in both elbow flexors, indicating that the activation of this muscle group was impaired. This finding is novel and suggests that afferent input to the elbow flexors may be altered after traumatic impact to the cervical spine. Muscle inhibition has mainly been described for knee pathologies (Young, 1993), and is thought to originate from altered afferent input. It is appealing to hypothesize that a similar muscle inhibition phenomenon exists in the upper body, and can be measured, for example, as reduced elbow flexor activation after whiplash injuries.

There is no agreement on the most effective treatment for chronic WAD, which may be related to the lack of reliable quantitative outcome measures. Using the interpolated twitch technique, an immediate reduction in muscle inhibition was measured after spinal manipulation, with a corresponding increase in elbow flexor force and EMG. This finding concurs with results from a previous study that demonstrated the effectiveness of spinal manipulation for improving muscle function in the short term (Suter et al., 2000).

Using the interpolated twitch technique to measure elbow flexor inhibition may provide valuable, more quantifiable information on the long-term dysfunction related to WAD. Further research is needed to establish whether muscle inhibition measurements may be an effective tool, which could be used to monitor progress during a rehabilitation program, or test the effectiveness of different treatment modalities in randomized, controlled trials.

References