Comparison of the Thickness of the Neck Flexor Muscles of Subjects With and Without a Forward Head Posture on the Two Initial Head Positions During Cranio-Cervical Flexion Exercise

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Abstract

This study compared the effects of the initial head position (i.e., a HHP versus a relaxed head position) of subjects with and without a FHP on the thickness of the deep and superficial neck flexor muscles during CCF. The study recruited 6 subjects with a FHP and 10 subjects without a FHP. The subjects performed CCF in two different head positions: a HHP, with the head aligned so that the forehead and chin formed a horizontal line, and a relaxed head position (RHP), with the head aligned in a self-selected comfortable position. During the CCF exercise, the thickness of the longus colli (LCo) and the thickness of the sternocleidomastoid (SCM) were recorded using ultrasonography. The thickness of each muscle was measured by Image J software. The statistical analysis was performed with a two-way mixed-model analysis of variance. The thickness of the SCM differed significantly (p<.05) between the subjects with and without FHP. According to a post hoc independent t-test, the change in thickness of the SCM increased significantly during CCF in the subjects with FHP while adopting a HHP compared to that in the subjects without FHP. The change in thickness of the SCM was not significantly different between the two positions in subjects without FHP, and there was no significant change in thickness of the LCo muscle during the CCF exercise according to the initial position in both subjects with and without FHP. The results suggest that CCF should be performed in RHP to minimize contraction of the SCM in subjects with a FHP.

Key Words: Cranio-cervical flexion; Deep neck flexor; Initial head position; Superficial neck flexor.

Introduction

The prevalence of a forward head posture (FHP) has increased due to the increased numbers of people today who sit at a desk for extended periods (Yip et al, 2008). With a FHP, the head is in an anterior position in relation to the plumb line, which is vertical to a horizontal line through the center of gravity of the body (Griegl-Morris et al, 1992). A FHP is one of the most common types of poor head posture in patients with neck disorders (Yip et al, 2008). Johnson (1998) suggested that a prolonged FHP might increase pressure on the posterior cranio-cervical structure. Subjects with a FHP show an in-
increased degree of upper cervical extension in comparison to that of the lower cervical spine. Other effects of a FHP are shortness of the suboccipital extensors, superior obliques, inferior obliques, and rectus capitis (Page et al, 2010; Sahrmann, 2010). Ishida et al (2015) demonstrated that the muscle thickness of the longus colli (LCo) of subjects with a FHP was reduced compared to that of subjects without a FHP.

Cranio-cervical flexion (CCF) exercise aims to activate the deep cervical flexor muscles (DCFMs). DCFMs consist of LCo, which provide support to the cervical curve, segments, and longus capitis (LC) works in synergy with the LCo in CCF (Gong et al, 2012; Juli et al, 2004b). In CCF exercise, a pressure biofeedback unit (PBU) is used to monitor cranio-cervical movement caused by progressive flattening of the cervical lordosis (Mayoux-Benhamou et al, 1997). The exercise is composed of five progressive stages from a baseline pressure of 20 mmHg to 22, 24, 26, 28, and 30 mmHg. According to previous studies, the electromyography activity (Falla et al, 2003) and the change in the thickness (Jesus et al, 2008) of the DCFM increased when the stage of the PBU was increased during CCF. However, many studies have shown that the superficial cervical flexor muscles (SCFMs), such as the sternocleidomastoid (SCM) and anterior scalene, of subjects with neck pain were overactivated during CCF (Falla et al, 2004; Juli et al, 2004b; Juli et al, 2008). Juli et al (2004b) suggested that the increased activity of the SCFMs during CCF could be to compensate for the poor activation of the LCo. To prevent such compensatory movements during CCF, the activity of the SCFMs should be monitored (Falla et al, 2004; Juli et al, 2004b; Juli et al, 2008).

In previous studies (Jesus et al, 2008; Juli et al, 2008; Luch et al, 2013), the head and neck were placed in a horizontal position before CCF exercise, with the subject's forehead and chin in a horizontal position and in a midposition. However, subjects with a FHP usually have posterior neck extensor muscles tightness and lengthened DCFMs (Sahrmann, 2010). When a subject with a FHP performs CCF exercise in a horizontal head position (HHP), the subject requires more torque than does a subject without a FHP. Such torque is difficult in FHP subjects because of changes in the length-tension curve of the DCFMs. The change may result in greater activity of the SCFMs during CCF exercise with a FHP. Therefore, the purpose of this study was to determine the effects of the initial head position on the thickness of the LCo (DCFM) and SCM (SCFM) during CCF exercise in subjects with and without a FHP. It was hypothesized that a HHP would increase the change in thickness of the SCM during CCF exercise in subjects with a FHP.

Methods

Subjects
Sixteen volunteers (12 males, 4 females) aged 18–30 years were recruited from Yonsei University students (Table 1). The inclusion criteria were young age (18–30 years) and the presence or not of a FHP. A FHP was defined as a cranio-vertebral angle of 40.3°–47.5° (Subjects with FHP). No PHP was defined as a cranio-vertebral angle of 49.2°–

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>With PHP* (n=6)</th>
<th>Without PHP (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>23.8±2.0°</td>
<td>22.2±1.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177.2±4.4</td>
<td>170.6±4.8</td>
</tr>
<tr>
<td>Weight (cm)</td>
<td>84.8±9.0</td>
<td>67.2±6.8</td>
</tr>
<tr>
<td>Cranio-vertebral angle (°)</td>
<td>43.3±3.0</td>
<td>52.5±3.1</td>
</tr>
</tbody>
</table>

*forward head posture, °mean±standard deviation.