

Effects of the Inclusion Thoracic Mobilization into Cranio-Cervical Flexor Exercise in Patients with Chronic Neck Pain

TAESUNG KO¹⁾, UICHUL JEONG²⁾, KWANWOO LEE³⁾

¹⁾Department of Physical Therapy, Daewon University College: 599 Shinwol-dong Jecheon-si Chungbuk 390-702, South Korea. TEL: +82 43-649-3156, E-mail: intkts@korea.com

²⁾Department of Physical Therapy, M Training Center

³⁾Department of Physical Therapy, Samyook University Graduate School

Abstract. [Purpose] The purpose of this study was to investigate whether a cranio-cervical flexor exercise and thoracic mobilization are effective for muscular endurance (Endurance), visual analog scale (VAS) pain, and neck disability index (NDI) of patients with chronic neck pain. [Subjects] The subjects in this study were 53 patients who had chronic neck pain. [Methods] The experimental group (n=27) did both cranio-cervical flexor exercises and thoracic mobilizations and the control group (n=26) did cranio-cervical flexor exercises. [Results] A paired t-test analysis revealed significant pre-post score changes within both groups. The 2-way group time interaction for the repeated measures ANOVA was statistically significant for Endurance, VAS and NDI. The experimental group showed greater improvement in Endurance, with a between-group difference of 14.26 seconds, VAS pain, with a between-group difference of 2.02 points, and NDI, with a between-group difference of 2.07 points. [Conclusion] These results suggest that the combination of thoracic mobilization with cranio-cervical flexor exercise was more effective at increasing Endurance and reducing VAS pain and NDI.

Key words: Chronic neck pain, Cranio-cervical flexor exercise, Thoracic mobilization

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INTRODUCTION

Neck pain often develops into a chronic disease, and the pain persists for at least 6 months in 10% of men and 17% of women. In the case of car accident victims, the symptoms persist at least 6 months in 24~50% of cases¹⁾. The number of people reporting neck pain is larger than the number of people reporting back pain and in most of the cases, the importance of the pain is not perceived²⁾.

Recently, the role of deep flexor muscles in adjusting the position of the cervical spine and maintaining its stability has been more greatly emphasized³⁾, and it has been reported that, along with the shoulder girdle muscle, the cervical deep

flexor plays an important role both in supporting the weight of the head against gravity and in stabilizing the neck⁴⁾. In addition, increasing the strength and endurance of the neck flexors and neck extensors by muscle-strengthening exercises was followed by patients reporting reduced neck pain⁵⁾.

Cleand et al.⁶⁾ reported that thoracic manipulations showed immediate alleviation of neck pain, in comparison to a placebo group. Exelby⁷⁾ reported that manual therapy using joint mobilization was quite effective at enhancing functional motions and reducing pain. In addition, Cleland et al.⁸⁾ suggested that reduced thoracic mobility resulting from defective biomechanical links in the cervico-thoracic junctions might cause

neck dysfunctions. From the preceding studies, it can be seen that improvements in cervical stability and thoracic mobility, achieved through muscle-strengthening exercises or manual therapy, do reduce neck pain and improve functional motion. However, although many studies of the effects of various methods have been published, the studies that used cervical exercises together with thoracic mobilizations are few in number. Therefore, this study is examined the effects of cranio-cervical flexor exercises and thoracic mobilizations, applied to patients with chronic neck pain, on their muscular endurance, visual analog scale pain, and neck disability index.

SUBJECTS AND METHODS

Subjects

Fifty-three female neck pain patients receiving physical therapy at M training center were divided into an experimental group ($n = 27$) and a control group ($n = 26$). The control group did cranio-cervical flexor exercises, and the experimental group did both cranio-cervical flexor exercises and thoracic mobilizations. The subjects were selected from patients showing pain in the neck or the shoulder and limited ranges of joint motion for at least 3 months. These symptoms were due to damage to the neck and surrounding tissues. Excluded from the experiment were patients who contraindicated against manual therapy; those who had a history of cervical surgery; those who were diagnosed with any type of cervical radiculopathy, myelopathy, fibromyalgia syndrome, or cervical stenosis; and those who were pregnant. The selected subjects voluntarily agreed to the procedures of the experiment.

Methods

To do cranio-cervical flexor exercises, the therapist first taught each patient the method of slowly controlling cranio-cervical movements in a supine position, so that the patient could feel the movements of the posterior part of the head in the cephalad and caudad directions on the support plane. After the patient had learned this, the therapist supported the back of the neck with a rolled towel. The patient was requested to maintain the contraction of the muscle by pulling the chin downward, thereby pressing on the towel. In the 1st week, the contraction was maintained for 10

seconds and repeated 12 times; in the 2nd week, for 10 seconds, 15 times; and in the 3rd and 4th weeks, for 15 seconds, 15 times, for 3 sets. In the 5th and 6th weeks, it was repeated 15 times for 20 seconds each time, for 3 sets. There was a rest of 1 minute between each set⁹⁾.

To do thoracic mobilizations, the patient flexed his/her hip joints and knee joints and clasped his/her hands around the neck in a supine position. The therapist' right hands' thenar eminence then touched the patient's left transverse process with the index finger extended and the three other fingers flexed completely so their tips would touch the palm at a right angle, and the knuckle of the middle finger was pushed against the patient's right transverse process. Then, the therapist held the patient's upper trunk in ventral flexion while pushing the therapist's chest against the patient's elbow. The patient's joint was then prestressed in the dorsal direction at a right angle to move the patient's upper trunk in the dorsal direction¹⁰⁾. The therapist performed 30-seconds of grade II-III mobilization at T1-T6 for an overall intervention time of 3 minutes.

To evaluate the muscular endurance of the deep muscles, the time during which 50% of the maximum contraction could be maintained was measured using a pressure biofeedback stabilizer (Chattanooga Group Inc., Hixson, 17 cm × 24 cm, USA). The subjects maintained their heads in the neutral position in a supine position. The pressure biofeedback stabilizer was then placed under the neck and inflated to around 40 mm Hg in the suboccipital space. Then the subjects pressed the pressure biofeedback stabilizer, located under the neck, maximally with craniocervical flexion, to measure the maximum contraction. After resting for 1 minute and 30 seconds, the time during which 50% of the maximum contraction could be maintained was measured using a stop-watch¹¹⁾. The measurement was repeated 3 times, using seconds as the measurement unit, and the mean of the measured values was recorded.

A visual analog scale (VAS) questionnaire was used to evaluate the degrees of pain. A neck disability index (NDI) questionnaire was used to evaluate the ability of patients with neck pain to perform their daily activities¹²⁾.

All the experimental subjects exercised 3 times a week for 6 weeks: the control did cranio-cervical flexor exercises, while the experimental group did

Table 1. Demographic features of both groups

	Age (year)	Height (cm)	Weight (kg)
Experimental group (n=27)	36.56 ± 9.82	161.44 ± 5.73	56.30 ± 6.58
Control group (n=26)	38.65 ± 12.50	164.04 ± 6.05	57.42 ± 7.89

Values are expressed as mean ± standard deviation.

Table 2. Within group comparison of change scores

	Experimental group		Control group	
	Pre	Post	Pre	Post
Endurance	7.19 ± 2.63	37.41 ± 23.57*	7.23 ± 2.87	23.19 ± 15.99*
VAS	6.63 ± 1.41	3.19 ± 0.83*	6.46 ± 1.72	5.04 ± 1.88*
NDI	15.00 ± 6.59	7.04 ± 3.83*	18.35 ± 9.23	12.46 ± 8.03*

Values are expressed as mean ± standard deviation.

* : p<0.05

Table 3. Between group comparison of change scores

	Pre-post score change of the experimental group	Pre-post score change of the control group	<i>F</i>
Endurance	30.22(95% CI, 23.47–36.97)	15.96(95% CI, 9.08–22.83)*	159.28
VAS	3.44(95% CI, 3.39–3.49)	1.42(95% CI, 1.37–1.47)*	806.40
NDI	7.96(95% CI, 7.28–8.63)	5.88(95% CI, 5.19–6.57)*	199.68

Values are expressed as mean (95% confidence interval).

* : p<0.05

F value from the interaction value of the ANOVA test for time (pre, post) and group (control, experiment).

both cranio-cervical flexor exercises and thoracic mobilizations. Before the experiment and after the 6-week experimental intervention, the two groups were evaluated in terms of muscular endurance of the deep flexor, VAS pain and NDI.

Data were analyzed with the SPSS package (version 13.0). Demographic features were compared between the groups using independent t-tests for continuous data. Paired-t test were used to analyze within group changes, and a 2-way repeated-measure analysis of variance was used to analyze between group changes.

RESULTS

The experimental group (n = 27) averaged 36 years in age, 161 cm in height, and 56 kg in weight. The control group (n = 26) averaged 38 years in age, 164 cm in height, and 57 kg in weight (Table 1). There were no significant differences in these average measures between the groups, indicating

that the two groups were homogeneous.

A paired t-test analysis revealed significant within group pre-post score changes in Endurance, VAS pain and NDI in the experimental group and the control group (p<0.01) (Table 2). The 2-way group time interaction for the repeated measures ANOVA was statistically significant for Endurance (F = 159.28; p<0.01), VAS (F = 806.40; p<0.01) and NDI (F = 199.68; p<0.01). The score change in Endurance in the experimental group was 30.22, and the score change in the control group was 15.96. The score change in VAS in the experimental group was 3.44, and that of the control group was 1.42. The score change in NDI in the experimental group was 7.96, and that of the control group was 5.88 (Table 3). Subjects in the experimental group showed greater improvement in Endurance, with a between-group difference of 14.26 seconds, and VAS, with a between-group difference of 2.02 points, and NDI, with a between-group difference of 2.07 points.

DISCUSSION

Recent studies have identified a correlation between mobility at the cervicothoracic junction and thoracic spine with neck-shoulder pain¹³⁻¹⁵. Moreover, a decrease in mobility of the cervical spine is significantly related to neck pain because of the biomechanical links between the thoracic spine and the cervical spine¹³⁻¹⁴. The reason why the group treated with thoracic mobilizations showed greater improvements according to all the measured parameters can be found in the studies indicating that cervico-thoracic motions are related to neck-shoulder pain. It is also possible that impaired mobility in the thoracic spine may be a contributor to mechanical neck pain¹⁶. Therefore, although this study did not identify the range of joint motions, we think that the recovery of mobility achieved by thoracic mobilizations affected all the measured parameters. Earlier studies¹⁷⁻¹⁹ indicated that manual therapy interventions to the spine were effective in alleviating pain occurring in areas distal to the area being directly treated. It has also been reported that the reason why manual therapy conducted on the spine shows alleviation of pain is that it stimulates inhibition mechanisms²⁰. Thoracic manipulations contributed to recovery of normal biomechanics, thereby reducing mechanical stress in the cervical spine and improving the distribution of joint force⁷. It is also possible that spinal manipulative therapy has inherent qualities that can alter the biomechanics of the thoracic spine and it is likely that the affected segments are biomechanically related to the cervical spine²¹. Although the exercise methods used in this study were not the same as those used in preceding studies, the cervical flexor exercises and thoracic mobilizations, performed with patients with neck pain, yielded greater therapeutic effects. This could be seen in terms of reduced pain and improved disability index. This improvement might be the result of reducing excessive loads on the cranio-cervical extensors, which was achieved by increasing the mobility of the cervico-thoracic junction by the application of additional thoracic mobilizations, and by improving the forward head position by increasing muscle strength with deep flexor muscle-strengthening exercises. One study reported that manual therapy approaches induce reflex inhibitions of pain or reflex muscle relaxations by modifying the discharge of

proprioceptive group I and II afferents²². Further, mechanical stimulus induced by the manipulative procedure may also alter concentration of inflammatory mediators²³. Finally, activation of descending inhibitory pathways may explain the decreased cervical symptoms after the application of a manipulation in another region²⁴. As reported in preceding studies, we think that the reasons for larger improvements in muscular endurance, VAS, and NDI in the group receiving thoracic mobilizations, together with cervical flexor exercises, were the biomechanical effects on the recovery of mobility and the neuro-physiologic effects on the inhibition mechanisms. Therefore, if thoracic mobilizations were to be applied to subjects, along with neck exercises, in order to prevent neck pain, additional positive effects could be expected. In addition, it will be necessary to apply thoracic mobilizations together with diverse physical therapy interventions, in order to compare their effects. After comparisons of interventions and their results after mid- to long-term treatment are done, their positive and adverse effects over time should be studied.

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