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Original Article

The effect of middle and lower trapezius strength exercises and levator scapulae and upper trapezius stretching exercises in upper crossed syndrome

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Abstract. [Purpose] The purpose of this study was to determine the effectiveness of strength and stretching exercises on upper crossed syndrome. [Subjects and Methods] After measuring cervical alignment using the Global Posture System, 30 students with forward head posture were selected and divided into two groups. The experimental group (n=15) participated in strength and stretching exercises, three times per week for 4 weeks. The control group (n=15) did not participate in the exercises. The exercise program comprised middle and lower trapezius strength exercises and levator scapulae and upper trapezius stretching exercises. The temperature of the posterior neck was then measured using digital infrared thermographic imaging. [Results] There was a significant difference between the pretest and posttest results in the experimental group, and a significant difference in posterior neck temperature between the two groups. [Conclusion] This study showed that middle and lower trapezius strength exercises and levator scapulae and upper trapezius stretching exercises are more effective for upper crossed syndrome.

Key words: Strength exercise, Stretching exercise, Upper crossed syndrome

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INTRODUCTION

One of the most common postural problems is forward head posture (FHP)[1)]. The underlying cause of pain is poor posture and habits, and a slightly misaligned position can limit mobility and cause tension in muscles and other soft tissues[2)].

Janda[3)] described the problem of forward head posture (FHP) as upper crossed syndrome and argued that the syndrome occurred when a slouched sitting posture was sustained for a prolonged period. This poor posture weakens deep neck flexors and scapular retractors such as the lower trapezius fibers and rhomboids and shortens the upper trapezius, levator scapulae, pectoralis major, and pectoralis minor[4)].

Digital infrared thermographic imaging (DITI) is a noninvasive diagnostic tool used to evaluate physical functions[5)]. Regardless of the size of the area in question, DITI provides a comprehensive thermographic image of the area[6)], detecting infrared heat from the body and identifying possible dysfunction by displaying changes in body temperature in painful or diseased areas with color imaging[7)]. For this reason, DITI is widely used as an auxiliary test to examine the effect of treatment for musculoskeletal diseases[8)].

There are a number of previous studies on improving FHP. Kim and Lee[9)] conducted a study on the effect of stretching exercise to ease shoulder and neck pain associated with musculoskeletal diseases. Yoo[10)] studied the effect of thoracic stretch-

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ing exercise and exercises for cervical and scapular posture on the thoracic kyphosis angle and upper thoracic pain. Ahn et al.[11] studied the effects of stabilizing exercises using a Swiss ball on neck and shoulder pain and mobility in adults with prolonged use of video display terminals. Yang et al.[12] conducted a study on the effects of sling exercise on muscle tension and pain in subjects with FHP. However, there is a lack of research on the effects of muscle strengthening and stretching exercises on body temperature changes.

Therefore, this study aims to identify changes in posterior neck temperature in upper crossed syndrome patients after completion of muscle stretching and strengthening exercises, and to provide basic data to develop an exercise program that helps prevent chronic pain.

SUBJECTS AND METHODS

This study was conducted in 30 male students at K University in Busan for 4 weeks, beginning 26 October, 2015. The study subjects had no congenital or acquired musculoskeletal diseases, but were suspected of having upper crossed syndrome after a Global Postural System (GPS) test. All agreed to participate in the study with full understanding of its purpose and methods. This study was approved by the bioethics committee of the Catholic University of Busan.

Subjects with cervical alignments more than 2.5 cm off center were selected through a GPS test. The subjects were randomly divided into an exercise test group and a nonexercise control group, with 15 in each group. After evaluation of the two groups for homogeneity, the subjects exercised three times a week for 4 weeks. The test group performed muscle stretching and strengthening exercises. After 4 weeks of exercise, changes in body temperature were measured by DITI.

The exercise program in this study focused on self-stretching and strengthening of muscles[13]. The self-stretching exercise engaged the rhomboids and the upper trapezius. In the self-stretching exercise, the rhomboid was pulled laterally and the upper trapezius was pulled into cervical flexion. Each repetition was performed for 10 seconds, with a five-second break between each repetition. One exercise set consisted of three repetitions. The subjects performed ten sets. The muscle strengthening exercise engaged the middle and lower trapezius.

The middle trapezius exercise was performed while in a prone position with the shoulder and elbow joints at a 90-degree angle. The lower trapezius exercise was performed in a prone position with the shoulder joints at a 135-degree angle while stretching both arms upward without bending the joints. Both trapezius muscles were stretched for 10 seconds with a five-second break between each repetition. One exercise set consisted of three repetitions, and the subjects performed ten sets.

The Global Postural System (GPS400, Chinesport, Italy) was used for this study. The GPS400 measures cervical alignment by tracking changes in posture through body imaging[14]. The research methodology of Park[15] was used for lateral imaging of the standing posture of the subjects; based on the New York State Posture Rating Chart, subjects with more than 1 cm deviation from a straight line drawn from the center of the external acoustic meatus to the acromioclavicular joint were selected for the study.

A digital infrared thermographic imaging device (IRIS-XP, Medicore, Korea) was used to measure temperature of the posterior neck. In a test room with an indoor temperature between 20–25 °C and minimal air flow, subjects waited for 20 minutes before standing about 70 cm from a camera for posterior neck imaging.

For data analysis, the SPSS statistical package (version 21.0, SPSS, Chicago, IL, USA) was used. To compare changes before and after exercise, a paired t-test was used, while an independent sample t-test was used to compare changes in body temperature between the two groups after exercise. The level of statistical significance was set to $\alpha=0.05$.

RESULTS

The general characteristics of the study subjects are shown in Table 1. There were 15 subjects in the test group and 15 in the control group. The average ages of the test and control groups were 22.7 and 24.33 years, respectively. The average heights and weights of these groups were 174.15 ± 4.45 cm and 69.88 ± 9.43 kg for the test group and 175.59 ± 6.28 cm and 73.53 ± 12.65 kg for the control group. The average degree of FHP of the test and control groups was 3.97 ± 0.57 cm and 3.80 ± 0.14 cm, respectively.

To test the homogeneity of the pre-study factors between the two groups, an independent sample t-test was conducted. According to the test result, the two groups were homogenous ($p=0.939$).

There was a significant difference between body temperature in the test group before (27.50 ± 0.42°) and after (28.16 ± 0.37°) the study (Table 2). However, in the control group, there was no significant difference before (27.49 ± 0.38°) and after (27.63 ± 0.80°) the study. Moreover, the average values between the two groups after the study showed that changes in body temperature in the test group were statistically significantly greater than those of the control group ($p<0.05$).

DISCUSSION

This study aimed to identify changes in posterior neck temperature in subjects with FHP after muscle stretching and strengthening exercises for the neck and shoulders.

Changes in body temperature appear when there are structural or functional problems in blood vessels, regional effects

Table 1. General characteristics of the subjects (N=30)

Variable	Exp G (n=15)	Con G (n=15)
Age (yrs)	22.1 ± 2.3	24.3 ± 2.9
Height (cm)	174.2 ± 4.5	175.6 ± 6.3
Weight (kg)	69.9 ± 9.4	73.5 ± 12.7
FHP (cm)	4.0 ± 0.6	3.8 ± 0.1

Exp G: Experimental group, Con G: Control group

Table 2. Comparison of pre- and posttest posterior neck temperature (°C)

	Before exercise	After exercise
Exp G	27.5 ± 0.4	28.2 ± 0.4*≠
Con G	27.5 ± 0.4	27.6 ± 0.8

*significant ($p<0.05$) difference between pre- and post-test Exp Group; ≠significant ($p<0.05$) difference between Exp Group and Con Group.

such as production of inflammatory mediators, changes in thermal conduction due to burns or skin ulcers, and other factors inducing an increase of heat in tissues[16].

In previous studies, Ahn et al.[17] stated that thermographic imaging could be used as objective data to evaluate pain levels and treatment progress, regardless of the cause and onset of diseases, and Kim and Jung[18] stated that thermographic imaging could be used as an auxiliary diagnostic tool to assess and treat pain triggers. Therefore, in this study, infrared thermographic changes were measured to identify the effects of exercise.

According to Yoo[19], pain caused by turtleneck syndrome can be prevented to a certain extent by easing the muscles and ligaments of the posterior neck through stretching exercises and correction of posture. Yoo[19] identified a stretching exercise of pushing the head with a hand as the easiest to follow. In this study, stretching exercises for the rhomboids and upper trapezius and strengthening exercises for the middle and lower trapezius were performed.

Kim and Lee[9] reported that pain was eased after completing stretching exercise of the neck and shoulders. Kim et al.[20] reported that pain levels in the neck and shoulders in participants significantly reduced after 8 weeks of stretching exercises. Lee et al.[21] reported that selective neck exercise improved high-school student posture and significantly enhanced strength and endurance of deep flexor muscles. Roddey et al.[22] reported that stretching showed a statistically significant difference in people with moderate FHP. In the present study, there was a significant difference in posterior neck temperature between the beginning and end of a 4-week intervention.

Therefore, since posterior neck temperature dropped after stretching of the lower trapezius, these exercises may help improve upper crossed syndrome.

This study was not able to identify pain reduction, since it involved a small number of participants who did not exhibit pain within a short span of time. Future research should be conducted with more participants to evaluate the effects of treatment for six months or longer.

The study showed that posterior neck temperature in the test group increased after the muscle stretching and strengthening exercises, and increased significantly when compared with the control group.

In conclusion, muscle-strengthening exercises for the upper and lower trapezius and stretching exercises for the rhomboids and upper trapezius have a positive impact on upper crossed syndrome by increasing body temperature. Hence, the findings of this study can be used to prevent and treat upper crossed syndrome.

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