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Effects of Neck Flexor Training Program on Cervical Spine Normalization, Muscle Strength, and Pain in Women

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Abstract: This study aimed to provide a neck exercise program to patients in an office work environment who visit an orthopedic clinic with neck pain and determine its effectiveness. To gather data, deep neck flexor strengthening exercise and thoracic spine movement exercise were performed for patients with neck ache for eight weeks. Research were 24 women aged 25 to 45 years. Based on the study design, the subjects were split into three groups. Eight were in control group (CG), eight deep neck flexor training exercise group (DG), and eight exercise group doing deep neck flexion training exercise and thoracic spine movement together (DTG). Each group performed an exercise program for eight weeks, doing it three times a week 50 minutes each. in this study deep neck flexor strengthening exercise and thoracic spine movement exercise were set as independent variables, and cervical spine alignment, VAS, NDI, New York State Posture Assessment Index, maximum strength of deep neck flexor muscle strength, and muscular endurance were used as dependent variables. Data were analyzed using SPSS Version 18.0. To analyze the differences between groups, ANOVA including repeated measures was performed. Duncan test was performed for post-test verification, and the main effect and the interaction effect were analyzed. Results showed that both, the neck training group, cervical and thoracic training group showed significant changes at the 0.1% level in spinal head angle, spinal rotation angle, cervical lordosis angle, New York State Posture Assessment Index, neck muscle strength and muscular endurance after the experiment. Also, in all three groups, there was a significant change at the level of 0.1% in the neck dysfunction index and pain index.

Keywords: Cervical Spine Alignment, CRA , CVA, Deep Neck Flexor Muscles, Thoracic Mobilization Exercise

1. Introduction

Recently, chronic neck pain and neck dysfunction have increased like a fad, and are emerging as a social problem. In particular, structural problems of the cervical spine due to long-term computer or long-term smartphone use at work are causing VDT(Visual Display Terminal Syndrome) and occupational diseases such as straight cervical spine[1]. Also, as a result of analyzing medical data from 2011 to 2015, the Health Insurance Review and Assessment Service (2016) revealed that the number of patients with Turtle Neck Syndrome due to 'neck disc-related diseases' had doubled from 606 in 2011 to 1,134 in 2015, Such cervical spine-related diseases have increased.since the spread of smartphones and tablet PC in 2009, and a new word, 'text neck syndrome' was coined[2]. Neck pain is primarily pain

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expressed in the neck and surrounding tissues[3], which also occurs in cervical organs such as intervertebral discs, ligaments, and nerve. ache causes a change in the function of the muscle to decrease in length and tension, which can lead to muscle imbalance, abnormal movement and limitation of range of motion of the cervical spine, furthermore abnormal posture. Neck accompanied by this posture change may worsen due to anterior head posture, straight neck, and disc herniation[4]. The forward head posture induces mechanical stress on the neck due to the head weight, and some muscles are weakened by the muscle imbalance that occurs due to this stress, and other muscles become tense and lose extensibility. This muscle imbalance shows a vicious cycle of head forward posture, bent shoulder, shoulder elevation, and abnormal posture of the scapula[5]. As a result, the lower cervical muscles such as the rhomboids, serratus anterior, and trapezius muscles are weakened, and the opposite muscles such as the pectoralis major, pectoralis minor, trapezius and elevator scapula harden, resulting in an upper crossed syndrome[6] Straight neck is a posture change that occurs in patients with neck pain. Usually, when the center of the head moves back and forth, the weight of the head supported by the neck becomes heavy. If this state persists, relative compensatory actions such as an increase in head and neck joint lordosis and abnormal and continuous muscle contractions in the suboccipital bone and shoulder muscles occur and the head and neck joint slowly change[7]. Postural alignment of the neck is maintained and supported by the long neck muscles, which are deep flexors the forth of the neck, furthermore the biceps neck muscles at the rear of the neck[8]. The muscles that make up the upper cervical spine movement segment include splenius capitis muscles the back of the neck, the suboccipital extensors seminiferous and long head muscles[9]. This imbalance of the muscles around the neck causes a forth head posture, and the extension furthermore lordosis of the upper part of the neck are increased, and the lower part of the neck is flattened with bending. Changes in skeletal alignment promote muscle elongation and imbalance of strength using uniaxial antagonists and agonists or muscle changes[10]. The curvature of the thoracic vertebrae is interfered by the body weight and movement pattern, Conversely, if the stiffness of the thoracic spine is high, unnecessary movement occurs in the lumbar and cervical spine. when the rigidity of the thoracic vertebrae is large[11]. Moreover, with long sitting life and aging, the thoracic spine is curved backwards and the related decrease in thoracic vertebrae mobility causes abnormal movements throughout the spine by compensatory action. In the EMG(electromyography)study on people with neck problems, the activity surface of the flexor of the neck was higher than that of the deep flexors, which resulted in a lower ability to maintain cranial and neck flexion. It was reported that endurance was weak[12]. Falla[13], Training that stimulates the deep muscles of the cervical spine reduce chronic pain, and that strengthening the spinal muscles and posture control training are effective in reducing ache in the trunk furthermore maintaining spinal curvature[8]. Also, Jull et al.[14] reported that cervical deep muscle stimulation exercise was effective in maintaining normal cervical spine curvature and reducing pain. It is judged that an effective neck and chest exercise program is necessary as it is said to reduce of pain. Mark et al.[15] also said that, also said that cervical spine exercise improves isometric muscle strength furthermore reduces the intensity of neck and shoulder ache, so an effective neck and chest exercise program is needed. In summary, this experiment aims to determine the effects of neck flexor exercise on normalizing the cervical spine, strengthening neck strength, and pain in women.

2. Method

2.1 Subject

This study was conducted with 24 patients with a VAS(Visual Analogue scale) index of seven or less among 24-45-year-old patients in an office work environment who came to the K orthopedic surgery department in J, G, and K for neck pain. The subjects were classified into three groups, whereas eight

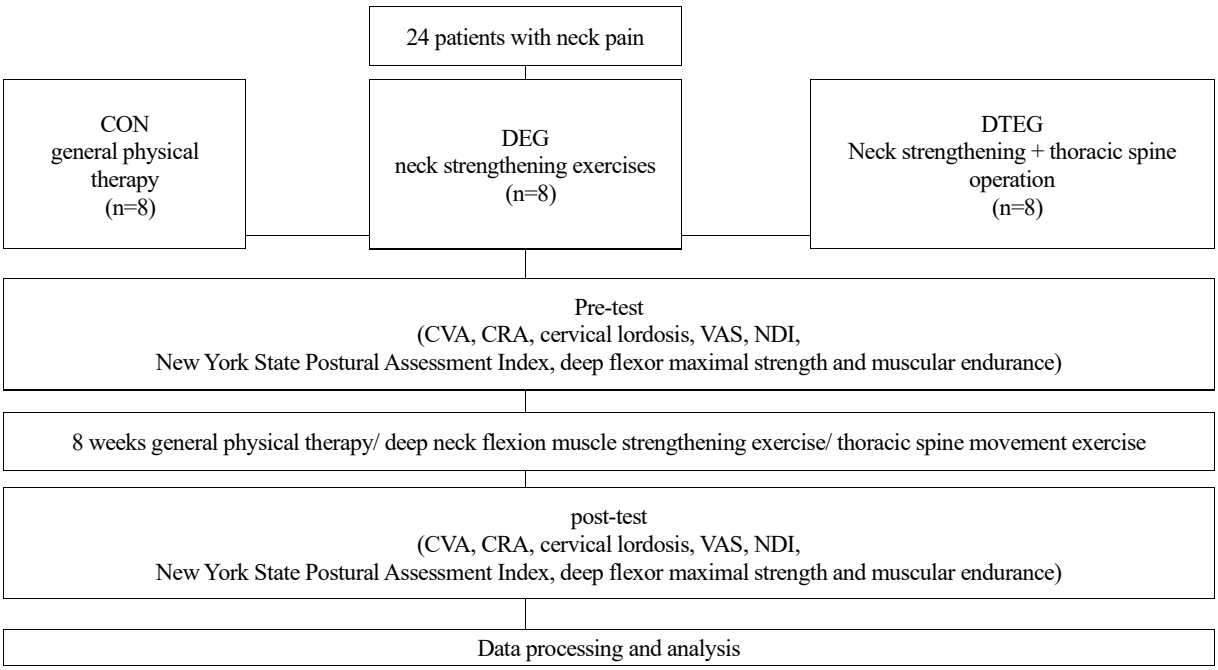
people were in the control group (CG) that only received heat and electric physical therapy, eight people in the group that progress neck flexor muscle training (DG), and eight people in the group that progress neck flexor muscle training and thoracic spine movement exercise (DTG). All subjects voluntarily consented to participate after being informed about the purpose of the experiment. When selecting subjects, to ensure fairness in physical factors, groups with similar age, gender, and physical composition were selected.

[Table 1] Characteristics

Group	Age(yr)	Height(cm)	Weight(kg)
CG(n=8)	36.25±	161.12±	51.87±
DG(n=8)	40.35±	161.37±	57.75±
DTG(n=8)	35.62±	162.23±	56.87±

2.2 Experimental Design

CVA, CRA and cervical lordosis were measured by taking X-rays as a pre-examination test. VAS and NDI were used as questionnaires, and New York State Posture Assessment Criteria Chart was used as an interview and measurement method. In addition, using a pressure biofeedback instrument, maximal muscle strength and maximal contraction force retention times of 80% and 50% of maximal contractile force were measured. After the pre-test, the deep neck flexor training group and the deep neck flexor training and the thoracic spine movement exercise group were performed 3 times a week for 8 weeks. CVA, CRA, cervical lordosis, VAS, NDI, New York State Posture Assessment Index, maximal strength, and muscular endurance maintenance time were statistically analyzed as post-mortem examinations, and physical therapy (hop pack or ice pack, tens, ultrasound) was performed. [Fig. 1] shows the experimental procedure and the exercise and treatment time of each group that were the same at 50 minutes. [Table 2] shows the deep neck flexion muscle strengthening exercise and [Table 3] presents the thoracic spine movement, wherein the exercise composition and time were varied and each 50 minutes was performed. for the thoracic spine movement, the exercise composition and time were varied and each 50 minutes was performed.



[Fig. 1] Experimental Design

[Table 2] Deep Neck Flexor Strengthening Exercise in Women(40 minutes)

Type	Exercise program	Volume	time
Warm-up	Stretching		5min
Main activities	The Chin-Tuck 1 The Chin-Tuck 2 The Chin-Tuck 3 Longus colli exercise(Towel) Advanced Longus colli exercise	5 seconds * 10 times * 3 sets	40min
	pressure bio-feedback unit exercise and measure	Measurements once a week	
Cool-down	Stretching		5min

[Table 3] Deep Neck Flexion Muscle Exercise (20 minutes) + Thoracic Spine Movement Exercise (20 minutes)

division	Exercise program	Volume	time
Warm-up	Stretching		5min
Deep neck flex or muscle exercise	The Chin-Tuck 1 The Chin-Tuck 2 The Chin-Tuck 3 Longus colli exercise(towel) Advanced Longus colli exercise	5 seconds*8 reps*2 sets	20min
	pressure bio-feedback unit exercise and measure	Measurement once a week	
Thoracic mobilization exercise	relief position Wall lean Upper back cat Back stretch(ball) Foam roll stretches prayer stretch arm elevation(with wall)	5 seconds*8 reps*2 sets	20min
Cool-down	Stretching		5min

2.3 Analysis of Data

In this study, deep neck flexion muscle strengthening exercise and thoracic spine movement exercise were set as independent variables, and cervical spine alignment, VAS, NDI, New York State Posture Assessment Index, maximum strength of deep neck flexor muscle strength, and muscular endurance were used as dependent variables. The data Analysis was performed using SPSS 18.0 (statistical program). The significance level was p=.05. To analyze the differences between groups, ANOVA including repeated measures was performed. For post-hoc verification, Duncan-test was performed and main effects and interaction effects were analyzed.

3. Results and Discussion

3.1 Changes in Cervical Spine Alignment

3.1.1 Change in CVA

[Table 4] shows the changes in CVA as a result of applying the deep neck flexor training program and the thoracic spine movement training program for 8 weeks. Found the difference ($p<.001$) with CG in the DG and DTG groups as a result of post-hoc testing between each group. didn't find any difference between DG and DTG ($p<.05$). As a result of comparing CVA within each group, there was a significant increase ($p<.001$) after the experiment compared to before the experiment in the DG and DTG groups.

[Table 4] Comparison of Head and Spine Angles by Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	46.83±1.29	49.11±1.24	8.011 (0.003)**
DG(n=8)	48.55±2.66	52.22±2.582	
DTG(n=8)	49.99±3.58	53.99±4.29a(*)	

CG, Control group, DG, Deep neck flexor exercise group
DTG, Deep neck flexor exercise + Thoracic mobilization training group, *;p< .05 **;p< .01 ***;p< .001
a. difference CG and DTG

3.1.2 Change in CRA

Changes in CRA are shown in [Table 5] the post-hoc testing results between each group revealed that Found the difference ($p<.05$) in DTG and CG. didn't find any difference between DG and DTG ($p>.05$). As a result of comparing CRA within each group, the DG ($p<.01$) and DTG ($p<.001$) groups significantly increased after the experiment compared to before the experiment.

[Table 5] Comparison of Head Rotation Angles for Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	145.66±2.03	145.46±1.69	12.707 (0.000)***
DG(n=8)	147.30±3.01	143.30±3.33	
DTG(n=8)	143.30±2.66	138.80±4.18a(*)	

Regarding CVA and CRA, a similar study was conducted in the past with students as subjects. In this study, the CVA decreased according to the weight of the bag, and the CRA increased, resulting in a head-to-head posture. In recent years, abnormal head and neck postures continue to occur due to the use of smartphones, and other electronic devices, and the number of patients with anterior head posture is increasing[16]. jeong[17]found that PNF contraction and relaxation exercise and Mackenzie exercise for five weeks induced an increase in CVA.

Shin[18] reported Found the difference increase in CVA through neck stabilization training and deep neck flexor strengthening for six weeks. Based on this study CVA, CRA, and cervical lordosis were measured by taking pre-X-ray lateral photographs in all patient groups participating in the experiment, and exercise and treatment were performed for eight weeks. As a result, within the group, CVA increased with a significant difference (DG, $p<.001$; DTG, $p<.05$) after exercise and before exercise in the case of DG and DTG, but in the case of CG, there was little change before and after exercise. In addition, it was analyzed Found the difference increase in CVA through neck stabilization training and deep neck flexor strengthening for six weeks. between the groups compared to the CG in the DG and DTG ($p<.05$) groups.

In the case of DG and DTG within the group, CRA decreased by a significant difference (DG, p<.05;TG, p<.001) after exercise and before exercise, but in the case of CG, there was almost no change before and after exercise. In addition, analyzed that Found the difference between the DG and DTG (p<.001) groups compared to the CG group.

3.1.3 Changes in Cervical Lordosis

Changes in cervical lordosis are shown in [Table 6]. The post-hoc testing results between each group revealed Found the difference (p<.001) in DG and DTG from CG. . didn't find any difference between DG and DTG (p>.05). The results of cervical lordosis comparison within each group showed that the DG (p<.001) and DTG (p<.01) groups significantly increased after the experiment than before the experiment.

[Table 6] Changes in Cervical Lordosis by Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	26.49±6.9	27.69±4.1	19.001 (0.000)***
DG(n=8)	24.38±6.9	27.36±4.9	
DTG(n=8)	26.40±6.2	28792±4.5	

Most of the study participants had straight necks and there were also patients with an inverted C-shaped turtle neck. According to a study by [19] 33.8% of the patients who came to the hospital with headaches showed a straight neck of the cervical spine.

A straight neck causes muscle fatigue, increases cervical disc pressure, and increases spinal nerve root pressure along with stimulation of the vertebral articular surface. It may also collide with neurovascular bundles and increase the risk of thoracic outlet syndrome[20]. McAviney et al.[21] reported that 277 X-ray examinations, the normal cervical lordosis angle was 31-40 degrees, and cervical lordosis less than 20 degrees was correlated with neck pain. The average angle of the three groups measured before this study was 24-27 degrees. Harrison et al.[7] reported that reported that neck exercise and exercise to maintain correct posture were more effective at Cop's angle, Jackson Physiologic Stress Line, and horizontal distance from C2 to C7.

You[22] aid that the stress on the cervical and thoracic vertebrae can be judged by the position of the gravitational line, and that the line drawn in C2 is located in front of the line drawn in C7, and that the greater the distance, the more likely the occurrence of the disc and chronic muscle pain. In the case of DG and DTG, the cervical lordosis increased with a significant difference (DG, p<.001; DTG, p<.05) after exercise and before exercise, but in the case of CG, there was almost no change before and after training. In addition, analysis revealed Found the difference between the groups in the DG and DTG (p<.001) groups compared to the CG. There was no significant difference between DG and DTG. In order to obtain a change in in the spine's curvature, Park[23] performed chiropractic and sports massage for patients with single neck syndrome and obtained significant results on the change in the curvature cervical spine.

Kim[24] reported the normal cervical lordosis was restored through manual treatment for about 4 months in patients with one neck. However, Choi[25] compared the changes in spinal curvature according to various intervention methods. didn't find any difference between the exercise group furthermore the lead group, and only manual treatment group showed increase in the Cobb angle of the neck. Considering results of this experiment, deep neck flexion muscle strengthening training and thoracic spine movement exercise were effective in correcting cervical vertebrae alignment, and it was found that thermal and electric physical therapy had no significant effect on cervical vertebrae alignment.

3.2 Changes in Deep Neck Flexion Muscle Strength

3.2.1 Changes in Muscle Strength Deep Neck Flexor Muscles

The changes in muscle strength deep neck flexor muscles are shown in [Table7]. Comparisons between groups showed differences ($p<.001$). The results revealed that DG and DTG groups had a significant difference ($p<.001$) from the CG group as a result of the post-test. didn't find any difference between the DG and DTG groups ($p>.05$). The comparison changes in the muscle strength deep neck flexor muscle within each group revealed Found the difference increase ($p<.001$) after the experiment compared to before the experiment in the DG and DTG groups.

[Table 7] Changes in the Strength of the Neck Flexor Muscles by Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	18.01±6.011	17.13±4.29	23.999 (0.000)***
DG(n=8)	17.33±5.99	23.66±6.99	
DTG(n=8)	20.00±6.12	26.33±7.00	

3.2.2 Changes in Muscular Endurance Deep Neck Flexor Muscles

[Table 8] and [Table 9] show the changes in 50% and 80% of the maximum strength deep neck flexor muscles after applying the training program for neck flexor muscles. A statistically significant result was found in the comparison between each group ($p<.001$). These results showed that difference in the DG ($p<.05$) and DTG ($p<.01$) groups from the CG group as a result of the post-test. didn't find any difference between DG and DTG groups ($p>.05$). As a result of comparing the 50% and 80% maximal strength deep neck flexor muscle each group, DG and DTG significantly increased ($p<.001$) after the experiment compared to before the experiment.

[Table 8] Comparison at 50% of the Maximum Strength of the Neck Flexor Muscle for Each Group

	Pre- inspection 50%contractile strength	Post- inspection 50%contractile strength	F
CG(n=8)	38.99±6.99	39.00±.5.00	37.999 (0.000)***
DG(n=8)	39.99±5.30	59.62±9.00$^{a(*)}$	
DTG(n=8)	43.99±7.50	63224±8.00$^{b(**)}$	

[Table 9] Comparison at 80% of the Maximum Strength of the Neck Flexor Muscle for Each Group

	Pre- inspection 80%contractile strength	Post- inspection 80%contractile strength	F
CG(n=8)	25.09±9.000	25.00±5.102	39.990 (0.000)***
DG(n=8)	27.90±4.125	41.00±7.999$^{a(*)}$	
DTG(n=8)	32.00±8.000	51.99±8.999$^{b(**)}$	

Recently, studies have been conducted on the stability of the neck and the correlation between superficial and deep muscles, furthermore another studies have shown that are a direct effect on the stability of the spinal segment[2]. As a phenomenon caused by the problem of muscle imbalance and motor control in patients with neck pain, many research cases have been reported on the decrease in muscle strength and muscular endurance. Alranta et al. [26] reported that In patients complaining of

neck pain, the muscular endurance of cervical flexors and extensors was decreased. Grimmer & Trott[27] In a experiment of groups without neck pain, patients with upper cervical lordosis reported poorer deep neck flexor endurance compared to patients without it. In addition, Gupta et al.[28] reported that four weeks neck muscle training in patients with neck pain is more efficient in terms of disability index compared to general isometric exercise, head forward posture, neck pain, and neck.

Therefore, in this study, maximal muscle strength was measured by biofeedback device, and muscular endurance was measured at 80% and 50% of maximal strength. As a result, in the case of the DG and DTG groups within the group, there was a significant increase (DG, p<.001 ; DTG, p<.001) after exercise and before exercise, but in the case of CG, there was almost no change before and after exercise. Also, it was analyzed Found the difference between the groups compared to CG in the DG and DTG groups (P<.001). didn't find any difference between DG and DTG. Muscular endurance was measured by dividing it into two categories: holding time at 80% and holding time at 50% of maximal strength, and the same result was obtained. in the case of DG and DTG groups, after exercise, Found the difference (DG, p<.001;DTG, p<.001), but in the case of CG, there was almost no change before and after exercise. In addition, it was analyzed that Found the difference between the groups in the DG and DTG (p<.001) groups compared to the CG. didn't find any difference between DG and DTG.

Results of this study, it is considered that deep neck flexor training and thoracic spine movement exercise had a positive effect on cervical stabilization Increases muscular endurance of the deep neck flexors. This is because the retraining deep neck flexor muscles of Jull et al. [14] Helps reduce symptoms in people with neck pain through increased muscle endurance, and the increased activity deep neck flexor muscles results in a neutral standing posture cervical spine. This is similar to our findings that it may improve the ability to maintain deep neck flexor muscles.

3.3 Changes in Neck Disability Index, Pain Index, and New York State Postural Assessment Index

3.3.1 Changes in Cervical Dysfunction Index

Changes in the neck disability index are shown in [Table 10]. didn't find any difference result in the comparison between each group (p>.05). Analyzing the results, it can be determined that there is no significant difference (p>.001) in all DG, DTG, and CG after post-hoc testing

However, the results of comparing the neck disability index within each group significantly increased (p<.001) after the experiment compared to before the experiment in all groups.

[Table 10] Changes in Cervical Dysfunction Index by Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	19.90±4.99	12.99±4.99	1.500 (0.256)
DG(n=8)	21.00±3.99	13.00±3.00	
DTG(n=8)	19.99±6.00	12.00±4.99	

3.3.2 Change in Pain Index

Changes in the pain index are shown [Table 11]. didn't find any difference results in comparison between groups (p>.05). Based on these results, analyzed that didn't find any difference (p>.001) in the DG, DTG, and CG groups. after the post-test. the results of comparing pain indices within each group increased significantly after the experiment compared to before the experiment in the CG (p<.05), DG and DTG (p<.01) groups.

[Table 11] Changes in Pain Index for Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	5.22±1.33	3.55±1.09	
DG(n=8)	5.19±1.60	3.33±1.30	0.800(0.460)
DTG(n=8)	5.40±1.79	3.12±1.10	

3.3.3 New York State Posture Assessment Criteria

Changes in the New York State Posture Evaluation Criteria Score are shown in [Table 12]. A result was found comparison between each group ($p<.01$). The post-hoc verification results showed that Found the difference ($p<.001$) between the DG and DTG groups. The result of comparing posture evaluation index within each group significantly increased after the experiment compared to before the experiment in the DG ($p<.001$) and DTG ($p<.01$) groups.

[Table 12] Changes in New York State Posture Assessment for Each Group

	Pre- inspection	Post- inspection	F
CG(n=8)	30.00±1.66	30.99±1.20	
DG(n=8)	29.20±1.90	33.00±1.60	10.111 (0.001)**
DTG(n=8)	29.00±1.99	32.55±1.31	

There have been many studies to establish effective clinical evidence for spinal instability that causes neck pain and dysfunction. Many studies have highlighted muscle imbalances in the neck region and motor control problems in the deep and superficial neck flexors. In particular, in patients with neck pain, loss of proprioceptive sensation and weakness of deep muscles are important epidemiological factors contributing to neck pain, and may also lead to changes in motor control such as neuromuscular inhibition[29]. Chiu et al.[30] reported that, as a result of performing deep neck flexor exercises for neck pain patients, neck dysfunction index significantly decreased study group after six weeks compared control group that did not perform the exercise. In addition, McDonnell, Sahrmann, and Van Dillen[31] conducted a scapular exercise and intervention program to reposition the misaligned scapula to the original position for cervical headache patients for three months. Found the difference in the range.

In addition, Taimela et al.[32] also reported that neck pain symptoms and psychological factors had a significant effect compared to the control group by applying cervical thoracic spine stabilization training to neck pain patients. In a domestic study, Lee. applied deep neck Flexor exercises for stabilization to patients neck pain, and six weeks later, a study of neck disability index. In this study, the visual analog scale was 5.05 before treatment and after Add a period. It is also consistent with the study result, which decreased to 3.37 points. Moreover, it is consistent with the result of a decrease in neck pain from 6.3 to 3.5 in a study of chronic neck patients by Jull et al.[14]. study of chronic neck pain patients. In this study, the anterior and posterior neck dysfunction index and pain scale were measured for eight weeks in patients aged 25-45 years who visited orthopedic surgery for neck pain. As a result, the neck dysfunction index decreased significantly after exercise and before exercise in all groups including CG, DG, and DTG(CG $p<.001$ DG $p<.001$ DTG $p<.001$). However, didn't find any difference between the groups. It is thought that physical therapy performed in the control group reduced pain and functionally recovered or that acute pain was naturally relieved over time. In all groups, including CG, the pain mapping scale decreased significantly after exercise compared to before exercise in DG and DTG groups (CG, $p<.01$; DG, $p<.05$; DTG, $p<.05$). However, didn't find any difference between groups.

4. Conclusion

In this study, pain index, cervical dysfunction index, CRA, CVA, cervical lordosis, and deep neck flexor maximal values before and after the application deep neck flexor training and thoracic spine movement exercise for cervical pain patients were investigated. The following conclusions were obtained by analyzing the effect on muscle strength and muscular endurance. First, there was a significant increase in CVA after the experiment for both DG and DTG. Second, there was a significant increase in CRA after the experiment for both DG and DTG. Third, there was a significant increase in the cervical lordosis after the experiment in both DG and DTG. Fourth, there was a significant increase in the maximum contractile force deep neck flexor muscle after the experiment in both DG and DTG. Fifth, a significant increase was also recorded in the deep neck flexor muscle and muscular endurance the experiment both DG and DTG. Sixth, the neck dysfunction index didn't find any difference between groups, however within the group, Found the difference decrease in all groups including the control group. Seventh, the pain index of the neck did not show a significant difference between groups, but within the group, decrease in all groups including control group. Eighth, increase in the New York State Posture Assessment Index after the experiment for both DG and DTG. Overall, in all factor in all factors except the neck pain index and dysfunction index, between each group, the DTG and DG groups showed compared to the CG group. However, didn't find any difference between the DTG and DG groups. Therefore, it was confirmed that deep neck flexion muscle strengthening exercises for eight weeks had a positive effect on cervical spine alignment and pain. In addition, factors that were further improved in the group that performed thoracic vertebrae movement were also identified. Clinically, it is judged to be useful for patient neck pain or patients with anterior head posture. However, in this experiment was conducted on women was conducted on women, and it could not be applied to various age groups and gender orientations and it was not possible to independently establish a thoracic spine movement group. Therefore, in follow-up studies, it is considered necessary to study the effects of various patient groups and the exercise group that did cervical and thoracic exercises as well as lumbar and pelvic exercises on the neck.

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