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# Effects of Dynamic Exercise Program Using Thera-Band on Craniovertebral Angle in Adults with Forward Head Posture

Background: The alignment of the neck and shoulder is important in people with forward head posture. However, previous studies have mainly conducted fragmentary studies on the neck and shoulders, and studies on the combined movement of the neck and shoulders are incomplete.
Objective: To investigate the effects of 6 week dynamic exercise program using Thera-band on craniovertebral angle (CVA) in adults with forward head posture.
Design: Quasi-experimental study.
Methods: The study was conducted on 24 adults with forward head posture and experimented with neck and shoulder exercises and divided them into groups of neck exercises, shoulder exercises, and neck and shoulder exercises to measure CVA values before and after the experiment. The neck exercise program included flexion and extension muscles of the neck and shoulder exercises included dynamic exercise of the upper extremities such as the trapezius muscles and serratus anterior muscle. The CVA results were measured using PA200.
Results: Following the interventions, neck exercise group showed significant improvement in CVA ($P<.05$), but shoulder exercise group and combined exercise group did not show any significant results ($P>.05$). However, both groups showed some positive results. Significant differences were seen in the comparisons between the three groups ($P<.05$), and the results of the post-hoc test showed significant differences in neck exercise group and shoulder exercise, neck exercise and combine exercise group.
Conclusion: This study suggested that the Thera-band neck exercise is beneficial for foward head posture patients and is expected to be used in clinical trials.

Keywords: *Forward head posture; Thera-band, Dynamic exercise; Stabilization exercise*

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## INTRODUCTION

The cause of forward head posture in many occupational groups in modern society is exposure to static loads due to maintaining an abnormal posture for a long period of time.[1] Abnormal spinal curvature is caused by asymmetry in the neck and shoulder muscles and abnormal alignment of the skeletal system.[2,3]

Forward head posture rates have also increased recently in young people in their 20s by about two-fold over four years.[4] The factors that cause forward head posture include long term computer work, abnormal alignment between the cervical and thoracic vertebrae, and aging.[5-7] Forward head posture in adolescents and school aged people is also on the rise, along with an increase in smartphone usage.[8]

The normal neck posture passes through the mid-section of the auditory foramen and the spinous

process of the 7th cervical vertebra and has mechanical efficiency when the neck bones are in their normal position.[9]

However, the abnormal alignment of the neck increases the weight of the head supported by the neck, which results in hyper extension of the upper neck and the atlanto-occiptal joints, resulting in abnormal alignment.[10] In addition, according to Jand's [11] theory, this abnormal alignment causes upper cross syndrome, with weakness of the neck flexors, rhomboids, and lower trapezius. Tightness of the neck extensors and pectoralis may also occur, resulting in forward head posture.[12] Joint stability exercises and muscle re-education to combat forward head posture are considered to play an important role in maintaining neck posture and stability.[13] For this purpose, interventions include treatment with electricity, traction, head treatment for the neck, and exercise therapy, such as Mackenzie's exercise, muscle strengthening exercises, and manual therapy have been conducted.[14,15] In addition to exercises that patients can do on their own, a variety of other exercise methods such as isometric muscle strengthening exercises using tools, stretching exercises, and endurance exercises have been implemented.[16]

Various prior studies of forward head posture have shown that the application of joint play therapy to the neck resulted in increased range of motion and decreased pain in the subjects.[17] Kendall et al[18] announced that strengthening exercises of the neck and shoulder flexor muscles and stretching exercises of neck extensor muscles and pectoralis muscles had a positive effect on neck alignment. Choi[19] reported that 4 week posture stabilized exercise on the neck and shoulder showed a significant difference in craniovertebral angle (CVA) of adults with forward head posture. It was also reported that for patients with forward head posture, dynamic exercises of the neck increase the muscle strength of the deep neck flexor muscles, significantly affecting pain and alignment.[20]

According to a study using Thera-band, six weeks of Thera-band exercise for patients with forward head posture are effective in reducing pain and increasing CVA.[21] Lee[22] showed improvements in the range of motion of the neck after the application of the dynamic exercise program using the Thera-band in patients with chronic headache due to forward head posture.

This prior study shows that there has been a lot of fragmentary research on neck and shoulders on the forward head posture, but there is a lack of research on the composite application of exercise on the neck and shoulder. Therefore, in this study, we would like to explore the effect of dynamic stabilization movements on the neck exercise, shoulder exercise, complex exercise in adults with forward head posture, comparing the changes in CVA to the effect on front head posture change.

## SUBJECTS AND METHODS

### Subjects and Study period

In this study, 24 adults were selected by randomly sorting the target group and name into opaque box. Each group was divided into a group of dynamic exercise group on the neck, shoulder and complex (neck and shoulder). The dynamic exercise groups of neck, shoulder and complex were called Group Ⅰ, Ⅱ, Ⅲ.

The selection conditions of the study subjects are as follows.[23,24]

1) A person with a forward head posture whose auditory foramen are more than 1 cm forward in the observation of the gravity line from the side ("normal" if they are in line with the gravity line, "mild" if they are not more than 0.5 to 1 cm forward, "severe" if they are not more than 1 cm forward).
2) Those who understand and agree to participate in this study.
3) A person without neurological and musculoskeletal lesions.
4) Those who can perform normal motor skills.
5) Those who do not perform any actions to cause injury during the experiment period.

### Strengthening Exercise method

The exercise program applied to the Thera-band in this study was conducted by means of Figures 1 and 2, with one moderator from each group correcting the posture during all exercises. All the groups were conducted three times a week in six weeks. The neck dynamic movement was performed 15 times in 3 sets, and the shoulder dynamic movement was performed 10 times in 3 sets. The dynamic exercise program on the neck consists of muscular movement of the neck's denigration and flexion muscle, while the dynamic exercise program of the shoulder consists of muscle movement of the trapezius muscle, serratus anterior muscle and the muscles around the shoulders.[16] The complex exercise program on the neck consists of neck and shoulder exercise.

### Measuring equipment

#### Shisei innovation system (PA200)

The Shisei innovation system (PA200, The Big Sports Co., Osaka, Japan) used in this study is an instrument for measuring body posture. As the human muscle can be measured, the incline angle of the neck can be analyzed by analyzing the abnormal alignment of the position and measuring in four direction. As the number increases to zero, it is located at the center point (Figure 3).[25]

### Measuring method

In order to enhance the reliability of this experiment, one researcher averaged out the results obtained from two shots and used the following methods of measurement.

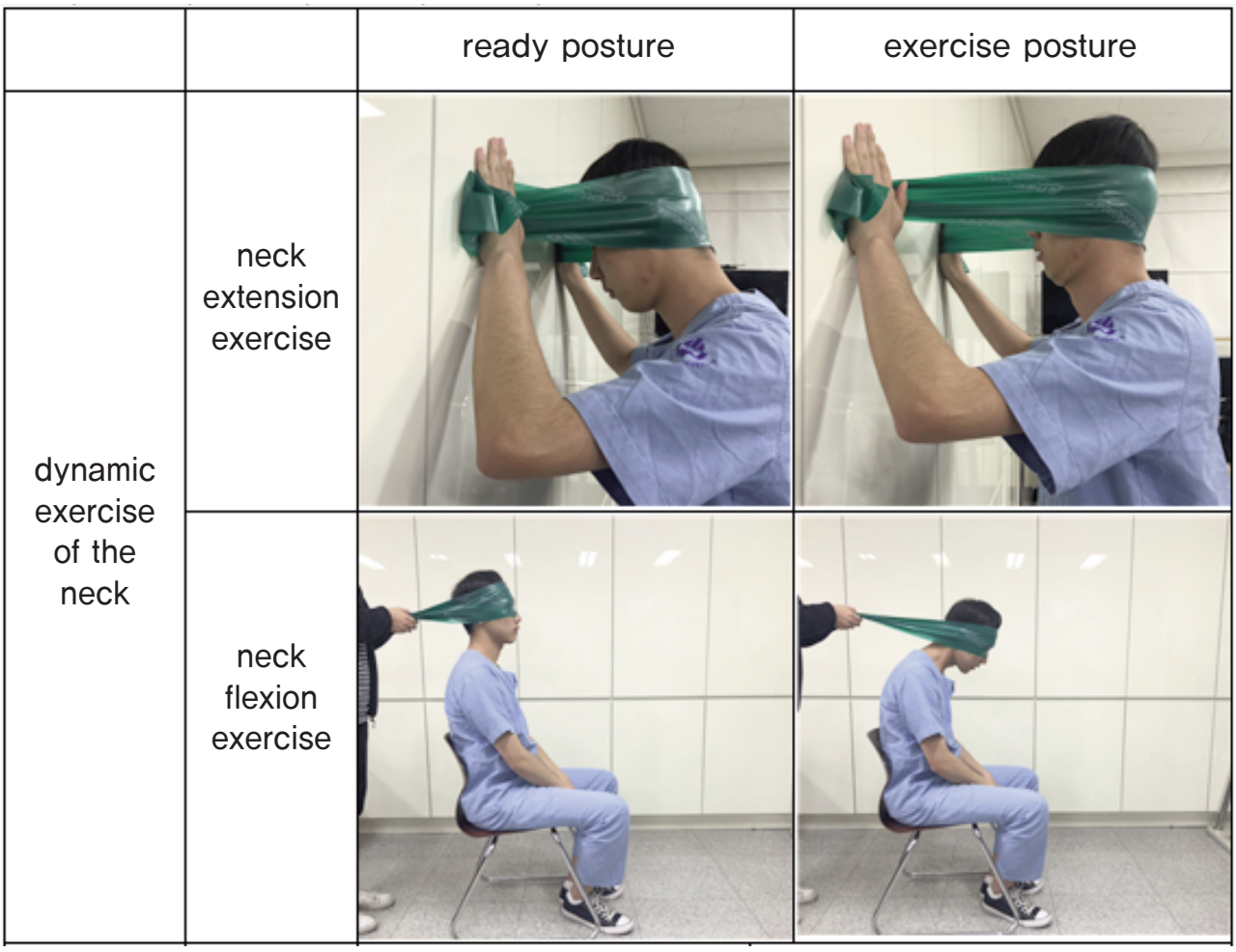
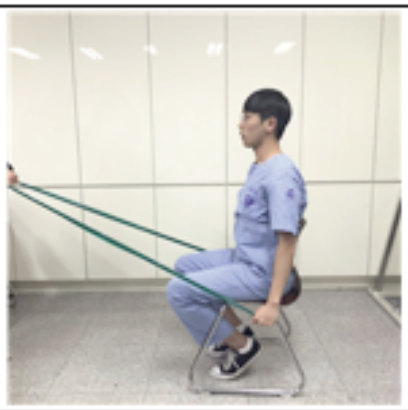
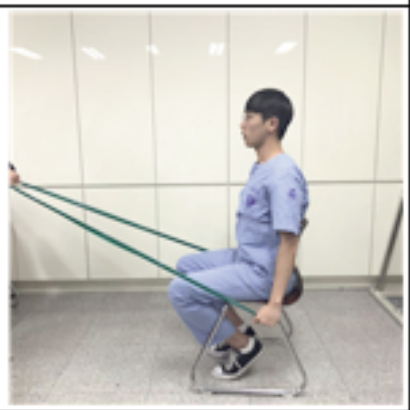
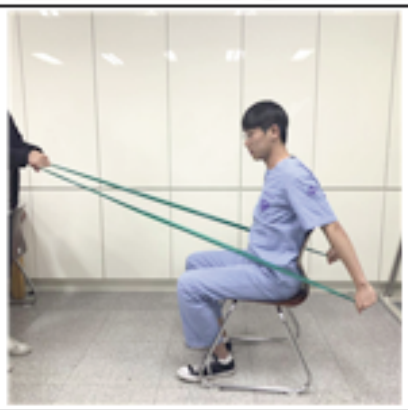
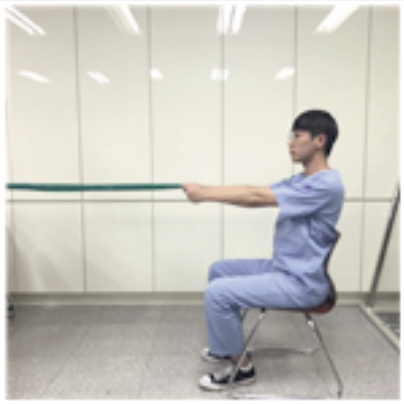
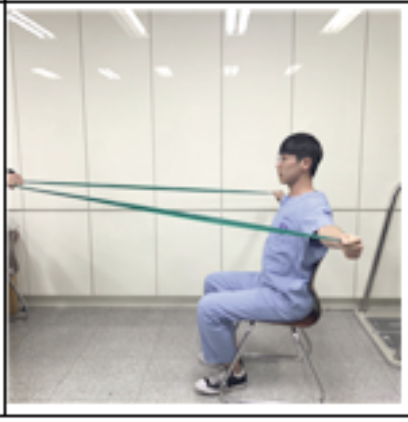



**Figure 1.** Dynamic exercise of the neck.

| | | ready posture | exercise posture |
|---|---|---|---|
| dynamic exercise of the shoulder | scapula upward rotation |  |  |
| | scapula downward rotation |  |  |
| | scapula adduction |  |  |

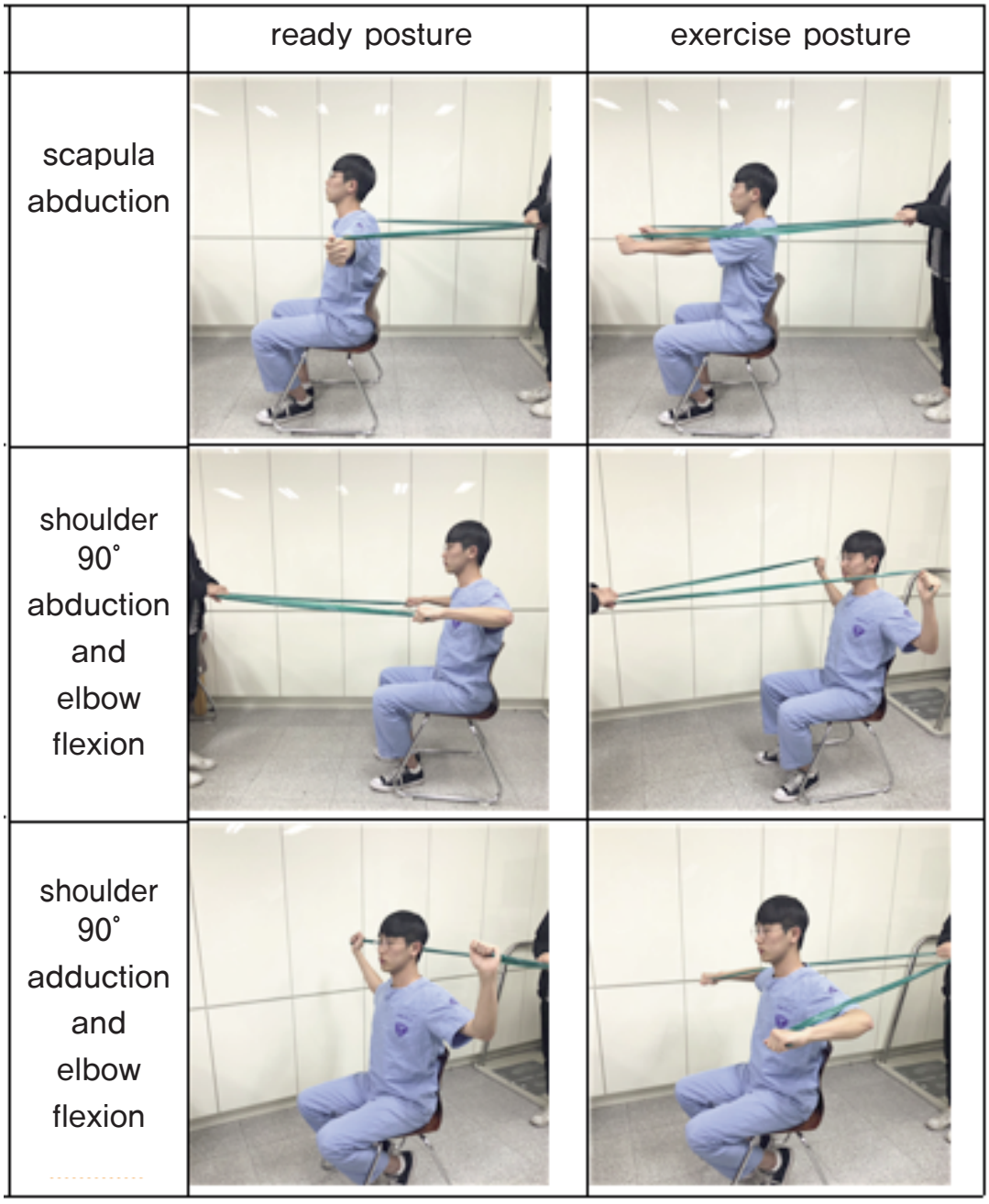



**Figure 2.** Dynamic exercise of the shoulder.

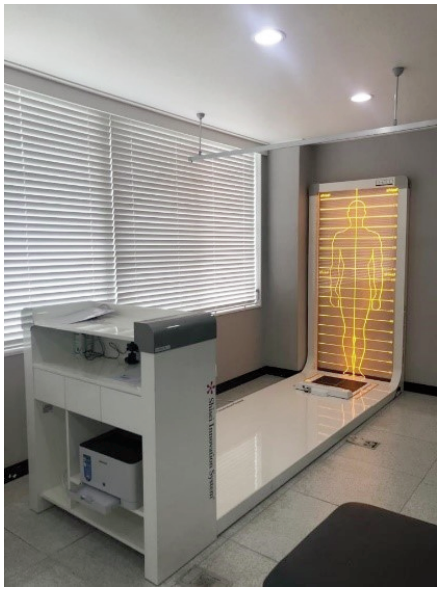


**Figure 3.** Shisei innovation system.

All subjects are to stand in the anatomical position at the designated points in the PA200. Markers were attached to the target's 7th cervical through the frequency promotion for angle measurement, and the target was photographed standing position through the camera away from the target. Marked on the screen taken at the 7th cervical and the tragus of ear, the horizontal line that forms an angle of 90° to the vertical line behind the target is drawn past the 7th cervical. The angle at which the horizontal line is formed with the line connecting the 7th cervical to the movement of the ear is defined as the CVA. A target with a forward head posture indicates that CVA is at a smaller angle, resulting in an increased flexion of the lower neck.

### Analysis

All data were subjected to normality test, statistical analysis was performed using SPSS 18.0 for Window. Statistical significance was α=.05. To compare the average difference before and after the CVA of the subjects in each group, the paired t-test were performed, and the one-way ANOVA was performed to compare the difference before and after the intergroup. In the event of significant statistical differences, the Bonferroni method was performed as a post-hoc test.

## RESULTS

The study was conducted on 24 adults who were experiencing a forward head posture. The subjects were assigned eight persons each in the groups, and there was no significant difference in the general characteristics of the subjects ($P$>.05) (Table 1).

### Comparison of the results of CVA between pre- and post-intervention in three group

The CVA was significantly different from the paired t-test results of Group Ⅰ ($P$<.05), but in Group Ⅱ, Ⅲ the values increased but did not show any significant difference ($P$>.05) (Table 2).

**Table 1.** General characteristic of the subject.

(M±SD)

| General characteristic | Group Ⅰ | Group Ⅱ | Group Ⅲ | *P* |
|---|---|---|---|---|
| Height (cm) | 64.00 ± 8.42 | 60.25 ± 4.13 | 56.13 ± 6.62 | .114 |
| Weight (kg) | 168.13 ± 8.99 | 168.75 ± 10.01 | 164.12 ± 7.16 | .082 |
| CVA (°) | 45.00 ± 5.45 | 47.13 ± 8.51 | 43.88 ± 5.54 | .532 |

M±SD: mean ± standard deviation
CVA: Craniovertebral angle

**Table 2.** Comparison of changes in CVA outcome within three group.

(unit: °)

| Sortation | Pre | Post | t | *P* |
|---|---|---|---|---|
| Group Ⅰ | 45.00 ± 5.45 | 49.75 ± 5.37 | −3.937 | .006* |
| Group Ⅱ | 47.13 ± 8.51 | 47.75 ± 8.68 | −.473 | .651 |
| Group Ⅲ | 43.88 ± 5.54 | 45.00 ± 5.81 | −1.760 | .122 |

*$P$<.05

**Table 3.** Comparison of changes in CVA outcome between three group. (unit: °)

| Sortation | pre-post | F | *P* | Bonferroni |
|---|---|---|---|---|
| Group I | 4.75 ± 1.21 | | | |
| Group II | .62 ± 1.32 | 4.210 | .029* | Group I > II=III |
| Group III | 1.13 ± .64 | | | |

*$P < .05$

The one-way ANOVA for comparison among the three groups of CVA showed a significant difference ($P<.05$). The post-hoc analysis results showed a significant difference between Group Ⅰ and Group Ⅱ, Group Ⅲ ($P<.05$), but Group Ⅱ and Group Ⅲ showed no significant difference ($P>.05$) (Table 3).

## DISCUSSION

In this study, we applied neck and shoulder dynamic exercises, a typical modern treatment for common musculoskeletal disorders, to patients with forward head posture to discover their effects. Later, the CVA was measured and analyzed in order to discover the kinetic effects of the forward head position. As a result, Group Ⅰ showed a significant difference, but there was no significant difference in Group Ⅱ or Group Ⅲ. There were some increases in in Group Ⅱ or Group Ⅲ, but they were not significant.

Harman et al found an increase in CVA when the Kendall exercise was applied to patients with forward head posture for 10 weeks. Kim et al[26] found that the combined sling exercise on the neck and shoulders affected the muscle activity of the forward head posture and the alignment of the cervical. There was a significant difference in both the CVA and the head rotation angle before and after intervention, and there was a significant muscle activity difference in both the serratus anterior and lower trapezius muscles. In addition, when the results of each week were compared with McKenzie's exercise and traditional physical therapy to combat forward head posture, the McKenzie's exercise was more effective than traditional physical therapy.[27] In this study, dynamic stability exercises of the neck and shoulder also increased the CVA, as in the previous study. This is thought to be due to the alignment of the atlanto-occipital and lower cervical joint and the retraining of the muscles.

Kang[28] reported that shoulder stabilization and thoracic extension exercises led to significant differences in the CVA and the neck impairment index in adults with forward head posture. Lee[29] reported that after dynamic movement exercises of the shoulder using a Thera-band, there were significant differences in the CVA and the head rotation angle. Cho[30] stated that when comparing the muscle tension in the neck, back, and shoulders found in ordinary people and in patients with forward head posture, the muscle activity of the neck and back muscles was lower and fatigue was greater in those with forward head posture, especially for the sternocleidomastoid muscle. In this study, the complex dynamic exercises of the neck and shoulders used differed from those used in the preceding study. This is thought to have a slight effect on the efficacy of the exercises because direct intervention on the muscles of the neck, rather than those in the back and shoulders, can have greater effects on forward head posture, and a complex exercise program can cause muscle fatigue in the subject.

The limitation of this study is that it may be difficult to generalize due to the small number of subjects. In addition, the type of variable examined to measure forward head posture after intervention may be too small to accurately determine the effects of the intervention on forward head posture. In addition, the strength of the Thera-band selected for each participant was not properly tailored to measurements of each participant's level of strength.

The complex exercise program applied in this study to the neck and shoulders affected the CVA of the forward head posture, but the neck exercise groups showed significant. Although Janda's[11] theory shows that the forward head posture weakens the flexor muscle of the neck and the extensor muscle of the thoracic vertebrae, the neck exercise program applied in this study consisted of a direct exercise program for the bending muscles of the neck. This is thought to be an effective treatment if a stabilization exercise program for the atlanto-occipital joints is applied along with stretching for the thoracic vertebrae to align the neck and shoulders and correct forward head posture.

## CONCLUSION

This study was conducted for six weeks to find out how it affected neck, shoulders, and complex dynamic exercise using Thera-band affects the CVA with forward head posture. The results were compared and analyzed by measuring them through PA200 in order to compare the pre- and post- exercise of CVA.

There was a significant difference between the pre and post difference between each group in the neck exercise group. A one-way ANOVA to compare the difference by group showed significant difference in the three group, there was no significant difference between shoulder exercise group and the complex exercise group.

Based on the results of this study, it is believed that the dynamic exercise program using the Thera-band has had a positive effect on neck alignment of patients with forward head posture, and that it can be recommended as a home exercise program using the Thera-band after treatment of the manual therapy in hospital.

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