

Effects of strengthening and stretching exercises on the forward head posture

The purpose of this study was to investigate the effects of strengthening and stretching exercises on forward head angle and static · dynamic balance ability. 21 adults with the forward head posture were participated in this study. Subjects were randomly assigned to strengthening exercise group I(n=11) and stretching exercise group II (n=10) respectively. Each group were underwent six intervention over the period of 2 weeks, each session lasting 30 minutes. During a preliminary examination, forward head angle and static · dynamic balance were measured, and a post examination was conducted that involved same procedure as preliminary examination. There were significant differences in forward head angle after exercise in both groups. In the strengthening group, center of gravity total sway distances was significantly changed under all conditions. In the stretching group, center of gravity total sway distances was significantly changed when subjects had their eyes open while standing on an foam surface. There were significant changes in center of gravity sway velocities in the strengthening group under all conditions, and the same was true in the stretching group only when the subjects had their eyes open while standing on an foam surface. In the comparison between groups, eyes closed while standing on a firm surface was significantly different. There was a significant difference in dynamic balance of the stretching group when the subjects tilted their bodies forward, and there was a statistically significant difference between groups under the same condition. The results of this study suggest that forward head posture can be corrected through therapeutic exercise, and muscle strengthening exercise more effective in improving static balance of forward head posture more than stretching exercise.

Key words: *Forward Head Posture; Strengthening Exercise; Stretching Exercise; Balance*

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INTRODUCTION

The excessive use of smartphones and video display terminals in the modern society has given rise to various problems(1,2). One of these includes emergence of forward head posture, which is recognized that excessively extension between atlantooccipital joint and upper cervical, and increased flexion between lower cervical and upper thoracic(3). Such changes in articular structure may lead to a buildup of too much pres-

sure on disks around the neck(4). Moreover, if this abnormal posture is maintained, it leads to repeated damages on muscle fibers(5). Therefore, forward head posture leads to weakening of neck flexor and shoulder retractor, shortening of neck extensor, and pectoral group(6).

These musculoskeletal functional abnormalities cause postural changes(7), and alter distribution of weight bearing, which decreases balance control (8). In addition, they may increase risk of falling and musculoskeletal injury(7). Therefore, a variety

of therapies including strengthening exercise, stretching exercise, manual exercise, taping, and electrical stimulation therapy, has been explored for correction of forward head posture(9). Among these, strengthening exercise and stretching exercise have been highly recommended(8). However, many studies have focused on the effects of therapeutic exercises on pain reduction rather than balance improvement, and research on the correlation between correction of forward head posture and balance ability is still lacking. Therefore, this study aims to investigate changes in forward head angle during strengthening and stretching exercises, as well as changes in balance ability, in subjects with forward head posture.

METHODS

Subjects

A total of 21 healthy subjects in their 20's with forward head posture were selected in this study. Subjects who had no existing neck pain, had a history of undergoing surgical procedures on the vertebra, and had neurological damage, neck fracture, arthritis or vascular diseases were excluded. All participants received verbal and written information about the study and signed a consent form. This study was approved by Cheongju University's Research and Ethics Committee. The selected subjects were randomly assigned to either strengthening group I (n=11), or stretching group II(n=10)(table 1).

Table 1. General characteristics of the subjects

	Group I	Group II
Gender(M/F)	1/10	2/8
Age(years)	20.6±1.0	20.6±0.7
Height(cm)	163.0±7.3	161.4±7.3
Weight(kg)	55.5±10.2	53.8±6.0
BMI(kg/m ²)	22.6±2.6	20.6±2.1

Values are expressed as the Mean±SD.

GroupI: strengthening exercise, GroupII: stretching exercise

Procedure

During a preliminary examination, forward head angle and static·dynamic balance were measured. Two-week after intervention, The same as in the

preliminary examination procedure was conducted in the post-test. The intervention was conducted by a physical therapist, during Three times a week a total two weeks, each time lasting thirty minutes(10). In the strengthening group, the subjects performed their first exercise, in which they stretched their arms while lying down on top of gym balls, and drew elbows in toward to side(8). For the second exercise, they retracted and protracted scapular in the flank position(8). For the third exercise, the subjects spreaded arms while holding elastic bands and keeping elbows placed on the sides of bodies(10). Each session involved 3 sets, one set involving 10 reps, and the number of reps was increased by 5 reps every week(10). In the stretching group II, for the first exercise, the subjects lay on top of gym balls, spread their arms out, and pushed elbows toward the ground(10). For the second exercise, the subjects faced the wall, and tilted bodies toward it while arms were placed against the wall, thereby stretching their pectoral muscles(10). For the third exercise, they drew chins toward their chests in the supine position (8). For each session, the positions were maintained for 15 seconds and performed for 3 sets, and the time for maintaining the positions was increased by 5 seconds every week(10). forward head posture subjects were selected if the crossing angle between the horizontal line of the spinous process of the 7th cervical and the line that connects the spinous process to the tragus was between 50.98° and 69.78°(11). The camera was placed 2m away from the subject, and its height was adjusted at an eye level(10). The diagnostic mode of I Balance S(CyberMedic Co., Iksan, Korea) was used for the assessment of static balance(12). The diagnostic mode of Spine Balance 3D(CyberMedic Co., Iksan, Korea) was used to assess dynamic balance(13).

Data Analysis

SPSS(version 22.) program was used for statistical analysis of the collected data. An independent t-test was used to examine general characteristics of the subjects. A Kolmogorov-Smirnov test was used to normality test. An independent t-test was used to investigate changes in each group before and after exercise. A paired t-test was used for the comparison of the groups. The level of significance was set at p<0.05.

RESULTS

There was a significant difference in the forward head angle after exercise in both the strengthening group and stretching group ($p < 0.05$) (Table 2).

Table 2. Comparing of forward Head Angle in the each group

	Pre	Post
Group I	52.5±4.2	58.8±5.4**
Group II	52.6±3.9	56.1±6.4*

Values are expressed as mean±SD.
Significant difference between Pre-Post (*: $p < 0.05$, **: $p < 0.01$).

Center of gravity total sway distances and center of gravity sway velocities were measured for static balance. In the strengthening group, there was a significant difference in center of gravity total sway distances under all conditions, whereas in

the stretching group, a significant difference was observed when the subjects had their eyes open while standing on an foam surface. There were significant difference in center of gravity sway velocities in the strengthening group under all conditions, whereas for the stretching group, the same was true when the subjects had their eyes open while standing on an foam surface. The comparison of the groups showed statistically significant differences when the subjects had their eyes closed while standing on a firm surface (Table 3,4).

No significant difference was observed in dynamic balance of the strengthening group. A significant difference was observed in the stretching group when the subjects tilted their bodies forward. The comparison of the groups also showed a statistically significant difference between the two groups when the subjects tilted bodies forward ($p < 0.05$) (Table 5).

Table 3. Comparing of Center of gravity total sway distances in the each group

		Pre	Post
Group I	Firm – eyes open	409.9±98.3	302.6±40.4**
	Firm – eyes closed	376.7±102.5	301.9±36.5*
	Foam – eyes open	486.3±167.8	328.0±51.5*
	Foam – eyes closed	771.2±283.9	485.7±89.7**
Group II	Firm – eyes open	382.4±115.2	328.6±79.3
	Firm – eyes closed	342.5±82.4	340.1±72.8
	Foam – eyes open	443.7±125.5	352.5±72.3**
	Foam – eyes closed	663.7±207.7	564.4±162.8

Significant difference between Pre-Post test (*: $p < 0.05$, **: $p < 0.01$).

Table 4. Comparing of center of gravity sway velocities in the each group

		Pre	Post
Group I	Firm – eyes open	0.06±0.0	0.04±0.0**
	Firm – eyes closed	0.21±0.0	0.16±0.0**
	Foam – eyes open	0.26±0.9	0.18±0.0*
	Foam – eyes closed	0.43±0.2	0.30±0.1**
Group II	Firm – eyes open	0.06±0.0	0.05±0.0
	Firm – eyes closed	0.18±0.1	0.18±0.0 †
	Foam – eyes open	0.23±0.1	0.19±0.0*
	Foam – eyes closed	0.38±0.1	0.31±0.1

Significant difference between Pre-Post test (*: $p < 0.05$, **: $p < 0.01$).
Significant difference between groups (†: $p < 0.05$)

Table 5. Comparing of Dynamic balance in the each group

		Condition	Pre	Post
Group I		Left	7.36±4.0	5.78±1.0
		Back oblique left	8.85±3.6	7.70±1.2
		Back	5.72±1.8	5.39±0.9
		Back oblique right	8.67±3.0	7.69±3.0
		Right	6.78±3.0	5.79±1.2
		Front oblique right	8.5±1.5	7.86±0.9
		Forward	6.77±1.2	6.05±1.1
		Front oblique left	8.26±2.4	7.85±1.5
Group II		Left	7.95±3.7	7.80±3.1
		Back oblique left	11.03±4.7	9.73±3.9
		Back	8.41±4.1	7.56±2.6
		Back oblique right	9.34±4.3	8.48±2.5
		Right	8.13±6.4	7.16±3.7
		Front oblique right	8.00±1.9	8.83±2.3
		Forward	6.65±1.5	8.61±3.3* †
		Front oblique left	9.86±2.7	11.05±3.2

Significant difference between Pre-Post test (*: $p < 0.05$).

Significant difference between groups(†: $p < 0.05$)

DISCUSSION

This study investigated changes in forward head angle, and static·dynamic balance in subjects with forward head posture, who were assigned to either the strengthening group or the stretching group. After looking at changes in forward head angle after two weeks of strengthening and stretching exercises, it was found that forward head angle was significantly increased after intervention, but there was no significant difference between two groups. In a prospective study, a significant difference in forward head angle was observed after 6 weeks of muscle strengthening and stretching exercises(10). The result was consistent in this study. Therefore, it is deemed that strengthening and stretching exercises influence forward head angle in people with forward head posture. In this study, static balance was measured through applying visual changes closing and opening eyes, and changing surface on which a subject stands solid surface or sponge. Hyong investigated changes in ankle angle and static balance at different cranial vertical angle(14). The study demonstrated that plantar flexor muscle angle

increases as the cranial vertical angle increases; however, there was no significant change in static balance. On the contrary, a significant change was observed in static balance as forward head angle increased in strengthening group in this study. While changes in ankle angle and static balance were measured at different forward head angles without therapeutic exercise in the prospective research along with forward head angle, seems to have affected the subjects' static balance through therapeutic exercise with forward head posture in this study. Prospective studies by Lee(12) and Abdelrhman(15) demonstrated that there was no significant difference of dynamic balance between normal people and those with forward head posture. In this study, despite of changing forward head angle after strengthening and stretching exercises, no significant difference was observed in dynamic balance. It appears that the changes in forward head angle after the therapeutic exercises did not greatly affect dynamic balance because forward head posture did not influence dynamic balance in our study, just as was observed in the prospective studies. This study is limited in that it had a small sample size, and a short intervention

period, making generalization of the results less feasible. The result of this study showed that forward head posture can be corrected through therapeutic exercises, and strengthening exercise affects static·dynamic balance of forward head posture to a greater extent than stretching exercise. Therefore, research on changes in forward head angle and static·dynamic balance after therapeutic exercise as well as on the persistency of these changes, using a larger sample population and longer intervention period, would be necessary in the future.

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