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Research Paper: Effects of 4 Week Postural Corrective Exercise on Correcting Forward Head Posture

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ABSTRACT

Introduction: This study aimed to assess the effects of 4-week postural corrective exercise program on forward head posture in college-aged females.

Materials and Methods: This is a randomized controlled study. Twenty-one female students with craniovertebral angle measured less than or equal to 50 degrees were selected and randomly assigned to intervention (n=12) or control (n=9) group. Intervention group performed forward head posture corrective exercises in the form of stretching and strengthening exercises. The craniovertebral angle, active neck flexion range of motion and strength of lower and middle trapezius were measured before and after 4 weeks exercise program.

Results: After four weeks, significant increases were observed in the intervention group regarding the means of craniovertebral angle (P=0.0001), active neck flexion range of motion (P=0.04) and lower trapezius strength (P=0.03), while the mean strength of middle trapezius had not changed significantly (P>0.05).

Conclusion: Four week intervention protocol successfully improved postural alignment related to forward head posture. Thus, corrective exercise program for 4 weeks is effective to decrease forward head posture.

1. Introduction

Forward Head Posture (FHP) is anterior positioning of the head relative to the line of gravity in the sagittal plane [1], which results from habitual postures adopted over time [2]. It is frequently observed in individuals working with a computer for prolonged periods [3]. FHP has been considered as a "bad" posture [4]. According to Sahrman [5, 6], the least strain is imposed on the musculoskeletal system in an ideal posture. Normal stresses to the muscles and joints can decrease acute and chronic musculoskeletal pain and discomfort.

The imposed loads on the muscles and joints of the cervical spine due to this postural misalignment of the head on the trunk may result in various musculoskeletal disorders [7]. FHP has been linked to complaints

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of pain in neck and shoulder region [8-11], fatigue and restricted movement of neck [12, 13], reduced proprioception [14] and temporomandibular joint dysfunction [15, 16]. FHP is also found in asymptomatic people [17-19]. In addition, this posture is associated with weakness of deep cervical short flexors and mid-thoracic scapular retractors (such as middle and lower trapezius) as well as shortness of the opposing cervical extensors and pectoralis muscles [1, 17, 18, 20].

For correcting FHP, strengthening and stretching exercises can be used. This exercise which can address the imbalances of the underlying soft tissues, consists of stretching the cervical and pectoral muscles and strengthening the deep cervical flexor and shoulder retractor muscles. This management approach has been advocated to improve postural alignment [18, 21, 22]. Previous studies have supported improvement of FHP after such an intervention protocol [23]. However, these studies have considered a long duration (8-32 weeks) of corrective exercises [2, 23-27]. The present study chose a 4-week intervention program, to investigate if using shorter duration of intervention is effective to have similar changes. To the best of our knowledge, no study has yet considered the effects of four weeks exercise training on multiple aspects of FHP.

The present study aimed to evaluate the effects of a 4-week exercise program on musculoskeletal parameters, including Craniovertebral (CV) angle, the strength of lower and middle trapezius muscles, and active neck flexion Range of Motion (ROM) associated with FHP. We hypothesized that four weeks exercise training is adequate for improving above measurements in the FHP patients.

2. Materials and Methods

The current study used a randomized, controlled trial design. Thirty female students with FHP (20 to 28 years old) recruited conveniently from School of Rehabilitation of TUMS and were evaluated with photogrammetry. They were screened before inclusion by measuring the CV angle. If the angle was less than 50 degrees, the participant would be included [28]. The participants who had previous shoulder surgery, scoliosis, cervical or thoracic fracture, and chronic or acute diseases such as metabolic, neural or heart disease were excluded. The participants, who missed the intervention exercises more than one session, were excluded.

Considering these criteria, a total of 21 participants were included and randomly allocated into intervention (n=12) and control group (n=9). Randomization was performed by a person who blindly picked up numbers from sealed envelopes containing numbers. All participants were recruited from August 2015 to October 2016. They were briefed about the procedures and signed an inform consent form approved by the Ethics Committee of our Institutional Review Board.

Postural alignment assessment

The most common way to objectively assess the FHP is measuring the CV angle [1, 29-32]. This angle is considered to be a valid and reliable evaluation tool [33]. It is measured in the sagittal plane formed by intersection of an imagery horizontal line drawn through the spinous process of the C7 and a line drawn from the tragus of the ear to the C7 (Figure 1); Yib et al. (2008) reported an average value of 55.02±2.86 degrees for this angle [28]. The more anterior position of the head, the smaller value of the angle [34].

For measuring the angle, the reflective markers were placed on the tragus of the ear and spinous process of the C7. The participant was asked to stand and maintain her usual upright posture with her arms resting at the sides, and looking straight ahead. The photos were captured by a digital camera (Samsung Galaxy S4) from the dominant side of the upper extremities. The camera was positioned on a tripod 50 cm away from the participant. The axis of the lens of the camera was placed orthogonal to the sagittal plane of the participant at the level of the shoulder. The photos were taken repeatedly so that the participant was not exactly aware of the actual time of photography. The CV angle was calculated by image J; 1.48 (Rasband, USA). If this angle was less than 50 degrees, the subject would be included in the study [28].

Strength assessment

The isometric strength of the lower and middle trapezius muscles of the dominant side was measured by a dynamometer (Multi Analyzer, MIE Medical Research LTD, England). Isometric strength tests performed in the standard position as described by Kendall [18]. The participant was given instructions regarding the testing procedure. Before the main test, participants got familiarized with the test by performing one submaximal and one maximal isometric contraction. After 2 minutes rest, the participant performed three maximum isometric contractions for each muscle.

They maintained each maximum contraction for 5 seconds. Thirty seconds rest was allowed between successive contractions of each muscle. Also, one minute rest was

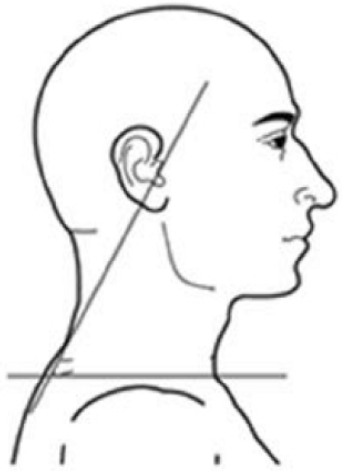

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Figure 1. Craniovertebral angle (the angle between horizontal and the tragus to C7 line)

considered between the tests of each muscle. The maximum value of the recorded forces during three trials was considered as the measure of strength for each muscle.

Range of motion assessment

The active neck flexion ROM was measured by using a goniometer (Lafayette Gollehon Extendable Goniometer, Model 01135, USA). Goniometry was done by the technique described by Norkin and White [35]. In this method, the participant sits on a chair in a usual manner while his or her feet are on the ground. Before the test, she was given instructions about the test and asked to perform an active neck flexion. Three trials were performed and the average was considered for analyses. All measures, including posture alignment, strength and ROM were assessed for both groups before and four weeks after intervention.

Intervention protocol

The participants in the intervention group received a postural corrective exercise program consisting of two strengthening (deep cervical flexor and shoulder retractor muscles) and two stretching (pectoral and sternocleidomastoid muscles) exercises (Table 1). These exercises were selected based on the assumption that performing therapeutic exercise is effective in the correction of the neck and shoulder postures [24, 26, 36, 37]. The participants were given a list of exercises and descriptions (with illustration) for each exercise. They were asked to perform three sets daily, 12 repetitions in each set as strengthening exercises, and two stretching exercises each held for 30 seconds.

A 30-second rest was considered between successive exercises. The intervention protocol lasted for four weeks and was repeated four times per week. Every session of the intervention program took 20 minutes on average. Participants in both groups were asked to avoid any other intervention that could interfere with the results. The participants in the intervention group were called at the end of each week to check for performing the exercises, supervision and guidance. Participants in the control group did not receive any intervention for posture correction; however, they were instructed to car-

Table 1. Strengthening and stretching exercises used during four weeks training program

Exercise	Description
1. Chin tuck	The participant is asked to chin tuck in the supine position with the head in contact with the floor, keep the head straight and hold it for 6 seconds and relax, then repeat the exercise. This exercise improves the function of deep flexor muscles of the upper cervical region.
2. Strengthening shoulder retractors	This exercise is done in the standing position by using a thera-band pulling the shoulders back. The participant is instructed to retract and pinch scapula together without elevation or extension in the shoulders and hold this position for 6 seconds and then relax.
3. Stretching of sternocleidomastoid muscle	The participant is positioned in optimal posture and asked to place left arm behind the body and depress the shoulder, tuck chin and slowly draw her right ear to the right shoulder, also is asked to rotate her neck upward toward the ceiling until a slight stretch is felt on the left side; she should hold this position for 30 seconds then relax and repeat it for the opposite side.
4. Pectoralis stretch	The participant is asked to stand, hold a piece of wood and place it behind her neck while her scapula is pinched and her elbow is in 90 degrees flexion until a slight stretch is felt in front of the chest. She should hold this position for 30 seconds and then relax.

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ry on their regular activities and were called at the end of each week to check their activities.

Statistical analysis

All statistical analyses were performed by SPSS v.22 (SPSS Inc, Chicago, IL, USA). For each variable, the mean and standard deviation were calculated. Significant level was set at 0.05. The Kolmogorov-Smirnov test showed the normality of data distribution. Paired sample t tests were used to compare the means of CV angle, muscle strength and active neck flexion ROM before and four weeks after the intervention in each group. Independent sample t tests were used for comparing means of demographic values and other variables between two groups.

3. Results

In the present study, 12 students in the experimental group and 9 students in the control group were assessed. Demographic data of both groups are presented in Table 2. The results of the independent sample t tests showed no significant difference between two groups before the intervention for the mean of age, weight, height or CV angle, as well as strength and neck flex ROM.

The results are summarized in Table 3. Accordingly, in the intervention group, paired t test analysis revealed significant differences between pretest to posttest for means of CV angle (P=0.0001), ROM (P=0.04) and lower trapezius strength (P=0.03). However, there was not any significant change in the mean of middle trapezius strength (P>0.05). In the control group, the results of analysis revealed no significant change after four weeks for the mean of CV angle (P=0.16), ROM (P=0.34), lower trapezius strength (P=0.72) and middle trapezius strength (P=0.5). However independent sample t test showed significant change in the means of CV angle, strength and ROM between intervention and control groups at posttest. The intervention group presented with an increase in the means of CV angle (P=0.0001), lower trapezius strength (P=0.01), middle trapezius strength (P=0.007)

Table 2. Mean±SD for demographic data, CV angle, as well as strength and flex neck ROM of participants at the beginning of study

	Intervention Group (n=12)	Control Group (n=9)	P-value
Age (year),mean±SD	23.58±2.6	23.22±1.9	0.73
Weight (Kg), mean±SD	61.6±7.73	60.22±5.4	0.65
Height (cm), mean±SD	165.4±6.99	163.6±5.71	0.53
CV angle (deg), mean±S	46.21±2.93	44.42±2.98	0.18
Lower trapezius (N), mean±SD	17.5±3.35	15.22±8.56	0.30
Middle trapezius (N), mean±SD	17.75±9.48	14.33±3.12	0.07
ROM (deg)	37.25±7.07	38.11±5.48	0.18

Abbreviations: SD: Standard Deviation; CV: Craniovertebral; ROM: Range of Motion

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Table 3. Means±SD of study variables in control and intervention group, pretest and posttest

	Control Group (n=9)			Intervention Group (n=12)		
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value
CV angle (deg)	44.42±2.98	45.04±2.33	0.16	46.21±2.93	51.12±2.72	0.0001*
ROM (deg)	38.11±5.48	37.88±5.25	0.34	37.25±7.07	43.16±2.4	0.04*
Lower trapezius (N)	15.22±8.56	15.11±8.44	0.72	17.5±3.35	28.83±7.14	0.03*
Middle trapezius (N)	14.33±3.12	14.66±2.59	0.5	17.75±9.48	24.08±9.71	0.07

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* P<0.05 is significant.

Abbreviations: SD: Standard Deviation; CV: Craniovertebral; ROM: Range of Motion

and ROM (P=0.006) following exercise program compared with control group.

4. Discussion

The present study investigated whether or not a four-week exercise protocol with shorter duration (comparing with previous exercise programs) can significantly improve FHP. Findings indicated that the intervention program significantly increased CV angle, neck active flexion ROM and lower trapezius muscle strength. However, there was no significant change in middle trapezius muscle strength after training. The results revealed an increase in CV angle for both groups although it was not statistically significant in the control group. This trend may be due to postural awareness. Postural awareness of the control group was developed because all participants were acknowledged about FHP. This awareness may have affected the control system, so that postural awareness may influence the habitual postures. Therefore, the control system should be considered in postural re-education programs [2].

FHP is associated with weakness in the deep cervical short flexors and mid-thoracic scapular retractors, and shortness of the cervical extensors and pectoralis muscles [17, 18, 20]. FHP can be corrected by restoring the normal muscle balance between agonist and antagonist muscles [23] .In the present study, an intervention protocol as a form of two strengthening (deep cervical flexors and shoulder retractors) and two stretching (pectoral muscles and sternocleidomastoid) exercises was designed. The intervention program was performed four times per week for four weeks. In the present study, a shorter treatment period (compared to previous studies) was found to be effective in correction of the FHP. For example, Harman et al. (2005) showed that a 10-week exercise program consisted of two strengthening (deep cervical flexors and shoulder retractors) and two stretching (cervical extensors and pectoral muscles) exercises can improve postural alignment related to FHP.

They measured cervical ROM and reported that exercise program can result in significant improvement of cervical ROM. One of the exercises that targeted the movement is chin tuck [2]. In the current study, we achieved similar therapeutic effect; as our results indicated that exercise program can improve cervical ROM. Diab et al. (2012) in two studies reported that a 10-week stretching and strengthening exercises was successful at correcting the FHP [25, 26]. Ruivo et al. (2015) demonstrated that targeted exercise program with strengthening and stretching exercises during a 32-week period was beneficial in decreasing FHP in adolescents [23].

Lynch et al. (2012) reported improvement in FHP during eight weeks stretching and strengthening program. They also reported an increase in the strength of shoulder girdle muscles in both groups (control and intervention groups), but no differences were observed in the strength measures of the intervention group compared with the control group after training. The results of their study may be due to exercise program that was not challenging enough for highly trained swimmers [24]. In contrast, Wang and Colleagues (1999) reported an increase in the strength of periscapular muscles after eight weeks exercise intervention. They incorporated a resistance tubing for strengthening program [38].

Resistance tubing was used in the current study and the results showed an increase in the strength of the lower trapezius after four weeks exercise program in the intervention group. As mentioned, no significant change was observed in the strength of the middle trapezius in the intervention group after four weeks. This was a borderline measure, so if the sample size was bigger it may show a difference between the two groups. However, this study has some limitations which can be corrected in future studies. In the present study, only college-aged females were assessed, so the results cannot be generalized to other age and sex groups. Also, the long-term effects of the exercise was not determined.

Our findings indicate that a 4-week exercise intervention (performed four times per week) improved postural parameters, including CV angle, active neck flexion ROM and lower trapezius muscle strength in the females with FHP. Therefore, a 4-week stretching and strengthening exercises seems enough for correcting FHP and improving neck ROM and muscle strength.

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Conflict of Interest

The authors declared no conflicts of interest.

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