

Investigation of factors related to scapula position in young women with neck pain: A control group study

Scapula Position in Young Women with Neck Pain

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Abstract

Aim: The primary aim of this study was to examine the relationships between scapular position and pain, muscle shortness, shoulder and neck stabilization, and disability in women with neck pain. We additionally aim to compare scapular position, muscle shortness, shoulder and neck stabilization, and disability in women with and without neck pain.

Material and Methods: The study included 42 women with a mean age of 21.53±2.33 years. For evaluation of scapula position, the protractor method and the Lennie test were used. In the neck pain group, the scapula position was measured by protractor method and right and left muscle shortness was tested for both dominant and non-dominant sides. In addition, a visual analog scale (VAS), the International Physical Activity Questionnaire (IPAQ), pectoralis minor muscle shortness, closed kinetic chain shoulder stabilization, neck flexor muscle endurance test, and the Neck Disability Index were used for evaluation.

Results: According to VAS scores, on a scale of 1-10, the pain level of the group with neck pain was recorded as 4.81±1.15. On the non-dominant side, a statistically negative and low-level significant correlation was found with the right-side shortness test ($p<0.001$, $p<0.04$). When the groups were compared, no significant difference was found between the studied parameters ($p>0.05$).

Discussion: As a result of this study, it was seen that scapular position as measured by protractor method was associated with muscle shortness. In addition, neck pain increases disability. The protractor method may be a viable measurement method for evaluation of scapula position.

Keywords

Neck Pain, Scapula Position, Muscle Strength, Women, Protractor Method

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Introduction

Neck pain is a recurrent disorder characterized by periods of remission and exacerbation. Studies have shown that approximately 54% of adults experience neck pain in a 6-month period [1]. It is known that the surrounding structures are also affected by neck pain. These structures include sections such as the shoulder girdle and the scapula. The position of the scapula and the alignment of the neck vertebrae are indicators of changes in joint position and muscle length [2]. It is known that the vertebral edge of the standard position of the scapula is parallel to the spine, positioned approximately 7.5 cm from the midline of the rib cage and located between the 2nd and 7th thoracic vertebrae [2, 3]. Abnormal scapular position is also known to be associated with neck pain [4]. In addition, changes in the activation of the muscles surrounding the shoulder girdle and scapula and changes in the anatomical position of these structures are also observed with neck pain [3]. Studies have shown that restoration of normal scapular kinematics has positive effects on the cervical vertebrae, such as increased range of motion and pain reduction [5-7]. Clinical measurement of the scapular position enables us to examine the effects of disease states on scapular position [8].

There are a limited number of studies in the literature examining scapular position in people with neck pain, but these studies report that scapular position is associated with pain [9-12]. In addition, it has been suggested in the literature that women should be examined in terms of scapular asymmetry and neck pain because they have relatively weak muscles and are more prone to abnormal body alignment [10]. In one study, the position of the scapula and the cervical range of motion were examined in individuals without neck pain [6]. Increasing the number of these studies will provide more objective data with the determination of the changes that can be seen in the scapula in people with neck pain.

The normal scapular position is affected by the dominant side, and the scapula is positioned lower on the side of the dominant hand [3]. In the literature, methods such as radiography, Moire topography, infrared/visual spectrum motion analysis systems, electromagnetic tracking systems, electromechanical digitizers and palpation meters, goniometers, inclinometers, sliding calipers, string measurement, and measuring tapes have been used to measure the position of the scapula [8]. Another common method is the Lennie test. It has been stated that it is important to measure the position of the scapula in the vertical plane in order to measure and evaluate shoulder height asymmetry [8]. O'Shea et al. [13] emphasized that another important aspect of measuring scapular position is measuring the vertical distance between scapular and spinal landmarks. Therefore, they developed the protractor method, which measures the vertical position of the scapula. It was stated that studies to be carried out with this method would reveal the relationship between musculoskeletal pain and the vertical position of the scapula [8]. In the literature, no study has examined the factors affecting the scapula position as measured by the Lennie test and protractor method in individuals with neck pain. The primary aim of the present study was therefore to examine the relationships between scapular position and pain, muscle shortness, shoulder and neck stabilization, and disability in women with neck pain.

We also aimed to compare scapular position, muscle shortness, shoulder and neck stabilization, and disability in women with and without neck pain.

Material and Methods

Participants

This study was conducted with female students with and without neck pain studying in the Department of Physiotherapy and Rehabilitation of a university. All volunteering female students with and without neck pain were planned to be included in the study; therefore, this universe was accepted as the sample group. In the first part of the study, 59 people were included. Seventeen people who did not correctly mark the body diagram were excluded. Blinding was applied, paying attention to the fact that the researchers who would evaluate the data did not know whether the participants were experiencing neck pain or not. Approval was obtained from the ethics committee of the relevant medical faculty for the study (ethics approval number: 2018-10). Individuals who volunteered for the study and signed the voluntary consent form were included.

Since it was planned to include sedentary people in the study, the International Physical Activity Questionnaire (IPAQ) was applied to participants before evaluations were performed. Students determined to be inactive according to the IPAQ were included in the study. Participants with pain in any part of the body other than the neck were excluded from the study if their pain intensity was higher than 3.5 on a scale of 1-10 using a visual analog scale (VAS).

Inclusion criteria were as follows: Members of the determined sample group confirming voluntary consent to participate in the study; neck pain VAS score of 3.5 or above; inactivity according to the IPAQ score.

Exclusion criteria were as follows: Neck pain VAS score below 3.5 in the patient group; pain in any part of the body other than the neck with a VAS score of 3.5 or above; pain in the shoulder area due to conditions such as degeneration, impingement, or thoracic outlet syndrome due to any trauma; history of any surgical operations due to any musculoskeletal problems; any health problems that would prevent individuals from performing the tests; unwillingness to volunteer for the study; inability to complete any of the applied tests; the discovery of any of these exclusion criteria during the course of the application.

Procedures

The evaluation protocols to be applied to the individuals by the researchers were explained and the study was begun. Our assessment consisted of four different parts. In the first part, the demographic information of the participants such as age, height, weight, and the presence of neck pain were recorded. In the second part, participants were asked to mark the areas with pain on a body diagram, and a VAS was used for pain severity assessment. In the third part, tests related to the neck and scapula were applied. In the final part, the Neck Disability Index questionnaire was used to evaluate the effects of neck pain on daily life. Evaluations were made by two physiotherapists.

Assessments

International Physical Activity Questionnaire (IPAQ): This questionnaire was developed by Craig et al. [14]. The Turkish validity and reliability study of this test was conducted by

Saglam et al. [15]. In the evaluation of all activities, the criterion is that each activity is done for at least 10 minutes at a time. Standard MET values, whereby METs represent multiples of the resting metabolic rate, have been established for these activities. Scores are obtained as “MET minutes/week” by multiplying the minutes, days, and MET values. Physical activity levels are classified as physically inactive at 3000 MET minutes/week [14].

Evaluation of scapula position: The protractor method and Lennie test were used for scapula evaluation. In the Lennie test, the distance between two points was measured with the help of a special ruler by marking C7 and the top of the medial edge of the scapula while the person was sitting in a neutral position; this value was recorded in centimeters. The C7 method was applied while using a protractor [8]. With this method, the distance between this point and the suture below C7 to the upper point of the medial edge of the scapula was measured and recorded in centimeters.

Evaluation of pectoralis minor muscle shortness: For this evaluation, subjects lay supine with knees in flexion, arms alongside the trunk, and elbows in extension. In this position, the distance between the acromion and the bed was measured and recorded in centimeters. Increases in length indicate the shortness of the minor pectoral muscle [16].

Closed kinetic chain shoulder stabilization test: This test was used for evaluation of shoulder stabilization. Two observers monitored the participants according to the protocol for the administration of the test. While one observer kept time, the other observer counted the repetitions of the participant's movements, performed on the knees with a modified push-up position. Participants were positioned with a straight back and 91.4 cm of spacing between the hands. Paying attention to the parallelism of the hands, participants lifted one hand for 15 seconds, touching it to the other hand, and then returned to the starting position. The same process was then repeated for the other side. The maximum number of repetitions per 15 seconds was recorded. Rest periods of 45 seconds were given and the test was repeated three times [17].

Neck flexor muscle endurance test: For measurements of the endurance of the cervical muscles, individuals were asked to lie on a bed in supine position with hands next to the body and legs in a 45° hooked position. They were then asked to perform head retraction with their jaws slightly back. While performing this test, the participant placed her thumb and index finger under the most swollen part of the occiput. The participant was then asked to raise the upper part of her head so that the fingers were slightly removed from the occiput. The test was considered finished when the participant stated that she felt too much pain to continue, she reached the end of her endurance, she lost the chin retraction position, she flexed her head until contact between the head and the researcher's fingers was completely lost, or superficial flexor muscles such as the sternocleidomastoid and anterior scalene muscles contracted. This time was recorded in seconds [18].

Neck Disability Index: This index consists of 10 items including pain intensity, personal care, lifting, reading, headache, concentration, working, driving, sleeping, and recreation. Individuals participating in this study were asked to score

themselves between 0 (no disability) and 5 (complete disability) for each category. Total scores range from 0 (no disability) to 50 (complete disability) [19].

Statistical analysis

Data were analyzed with the SPSS 22 package program. Continuous variables were given as mean±standard deviation and categorical variables as numbers and percentages. When parametric test assumptions were met, the independent samples t-test was used to compare differences between independent groups. If parametric test assumptions were not met, the Mann-Whitney U test was used to compare independent groups' differences. In addition, the relationships between continuous variables were analyzed using Spearman or Pearson correlation analysis, and differences between categorical variables were analyzed using chi-square analysis. Correlation coefficients are interpreted as follows: 0.00-0.19, very weak; 0.20-0.39, weak; 0.40-0.59, moderate; 0.60-0.79, strong; 0.80-1.0, very strong. Significance was accepted at $p < 0.05$.

Results

This study included 42 women with a mean age of 21.53 ± 2.33 years. The demographic data of these women are shown in Table 1. The pain level of the group with neck pain according to VAS scores was recorded as 4.81 ± 1.15 cm.

In the group with neck pain, the scapula position was measured by the protractor method and both right and left shortness tests on the dominant side ($p < 0.000$, $p < 0.03$, Table 2), and a statistically negative and low-to-moderate significant correlation was found between the right and left shortness tests on the non-dominant side ($p < 0.02$, $p < 0.04$, Table 2). When the two groups were compared, no significant difference was found between the evaluated parameters ($p > 0.05$, Table 3).

Table 1. Demographic values

| | Patient group X±SD | Control group X±SD | p |
|--------|--------------------|--------------------|------|
| Age | 21.70±2.25 | 21.36±2.47 | 0.66 |
| Height | 163.90±4.84 | 164.80±6.47 | 0.61 |
| Weight | 55.80±14.78 | 59.23±7.54 | 0.34 |

X: mean, SD: standard deviation, $p < 0.05$.

Table 2. Relationship between scapular position and muscle shortness test, neck flexor muscle endurance, shoulder stabilization test, and disability

| | Protractor method | | Lennie test | |
|--|-------------------|--------------------|----------------|--------------------|
| | Dominant r (p)* | Non-dominant r (p) | Dominant r (p) | Non-dominant r (p) |
| Muscle shortness test | | | | |
| Right | -0.517 (0.00)* | -0.452 (0.02)* | 0.185 (0.24) | 0.036 (0.82) |
| Left | -0.410 (0.03)* | -0.307 (0.04)* | 0.167 (0.29) | 0.267 (0.09) |
| Neck flexor muscle endurance test | | | | |
| | 0.224 (0.15) | -0.023 (0.88) | -0.281 (0.07) | -0.86 (0.58) |
| Shoulder stabilization test | | | | |
| | -0.097 (0.54) | -0.097 (0.54) | -0.078 (0.62) | 0.074 (0.64) |
| Neck Disability Index | | | | |
| Mean | 0.161 (0.30) | 0.054 (0.73) | 0.047 (0.76) | -0.125 (0.43) |
| Categories | 0.159 (0.31) | 0.058 (0.71) | 0.085 (0.59) | -0.197 (0.21) |
| VAS | 0.188 (0.23) | 0.172 (0.27) | -0.094 (0.55) | -0.154 (0.33) |

*Spearman correlation analyses, $p < 0.05$, VAS: visual analog scale.

Table 3. Comparison of scapula position, muscle shortness test, neck flexor muscle endurance, shoulder stabilization test, and disability between groups

| | Patient group (neck pain) X±SD | Control group (no pain) X±SD | t | p |
|-----------------------------------|--------------------------------------|------------------------------------|-------|-------|
| Protractor method | | | | |
| Dominant | 6.14±1.43 | 5.70±1.08 | 1.12 | 0.27 |
| Non-dominant | 5.36±1.16 | 5.10±1.15 | 0.73 | 0.46 |
| Lennie test | | | | |
| Dominant | 7.22±1.48 | 7.50±1.12 | -0.67 | 0.50 |
| Non-dominant | 6.53±1.37 | 7.52±4.11 | -1.05 | 0.29 |
| Muscle shortness test | | | | |
| Right | 5.93±1.81 | 6.45±1.14 | -1.11 | 0.27 |
| Left | 5.87±1.87 | 6.34±1.20 | -0.93 | 0.35 |
| Neck flexor muscle endurance test | | | | |
| | 29.11±15.37 | 33.76±19.85 | -0.66 | 0.50 |
| Shoulder stabilization test | | | | |
| | 17.72±3.31 | 18.59±3.90 | -0.77 | 0.44 |
| Neck Disability Index | | | | |
| Mean | 0.85±0.37 | 0.30±0.29 | -4.24 | 0.00* |
| Categories | 2.08±0.31 | 1.28±0.46 | -4.40 | 0.00* |

*Mann-Whitney U test, X: mean, SD: standard deviation, p<0.05.

Discussion

The results of this study revealed a relationship between scapular position and shortness tests in women with neck pain. When women with and without neck pain were compared, no difference was found for any parameters.

The pectoralis minor is adaptively shortened in the kinematic changes of scapular position [16]. As a result of the present study, a relationship was found between scapula position measured by protractor method on the dominant and non-dominant sides and the shortness test of the pectoralis minor muscle. No difference was found between the results of the Lennie test and the measured scapular position for any parameter. This result may show that the protractor method is an effective evaluation tool.

Studies show that the neck flexor muscles are weak in women with neck pain. In addition, decreased cervical endurance is associated with neck pain [20-22]. Cervical flexor and extensor muscle groups also control the position of the scapula [20]. In this study, however, no relationship was found between scapular position and neck flexor endurance.

In the literature, there is no study examining the relationship between scapular position and shoulder stabilization in individuals with neck pain. In the present study, no relationship was found between scapular position and shoulder stabilization. This result may be due to the low number of individuals with neck pain, the inclusion of only one gender, and the young age of the participants.

In another study conducted with female students, no relationship was found between scapular position and the level of neck disability [10]. In the present study, as well, no correlation was found between scapular position and the level of neck disability. This may be due to the low level of disability in the group with neck pain in the present study. Higher levels of disability may change the scapular position.

In studies investigating the relationship between scapular position and pain, no relationship was found in drivers, but

scapular position was associated with pain among computer professionals with neck pain [11, 12]. In the present study, there was no relationship between neck pain and scapular position as measured by protractor and by Lennie test. In those previous studies, it was thought that individuals may have neck pain due to work-related abnormal posture, with a resultant relationship between pain and scapula position. In the present study, participants were non-working students with neck pain. Students may not yet suffer from neck pain because they are not working.

In Dahiya and Ravindra's study conducted with computer professionals, the scapular position of individuals with neck pain was found to be significantly different compared to the scapular position of those without neck pain. That result was thought to be due to individuals with neck pain working with abnormal postures for long periods [12]. In the present study, when women with and without neck pain were compared, no difference was found in terms of scapular position. The individuals included in this study consisted of only students, however. Therefore, similar results were found in both groups as participants had not developed abnormal postures related to their professions.

In the present study, no difference was found between the groups in terms of muscle shortness. In addition, pectoralis minor muscle shortening was more common in the group without neck pain. Shortness of the pectoralis minor muscle may be associated with chest and arm pain [21]. Therefore, there may be no difference between the groups in terms of muscle shortness.

Some studies found a difference in neck flexor endurance when comparing individuals with and without neck pain and concluded that individuals with neck pain had insufficient capacity in terms of endurance [22, 23]. In another study, no difference was found between groups in terms of endurance [24]. These studies reported that the forward position of the head may be related to the weakness of the deep flexor cervical musculature. In the study of Aimi et al. [24], in which the head position was almost the same as that observed in both groups in the study conducted by Oliveira and Silva [22], it was suggested that the head position is different in people with neck pain, so that may affect the results. In the present study, although the mean endurance was better in the control group without neck pain, no significant difference was found between the two groups in terms of endurance. No measurements were conducted regarding head position.

Individuals with work-related neck pain particularly try to modify the scapular position to reduce pain, and this is also associated with shoulder stabilization [25]. Although the control group of the present study had better shoulder stabilization, no significant difference was found between the two groups in terms of shoulder stabilization. This may be due to the fact that the group with neck pain consisted of students who are not yet professionally employed and therefore do not have severe work-related pain.

One limitation of this study was that the sample size was smaller than expected. Another limitation was that we could not measure head position. Further studies can be done by measuring different parameters (head position, etc.) related to

scapular position with younger groups including both genders and greater numbers of participants with neck pain.

Conclusion

This study was one of the first studies to use the protractor method to evaluate scapular position. As a result, it was seen that the scapular position as measured by the protractor method was associated with muscle shortness. In addition, neck pain increased disability scores. Accordingly, it may be said that the protractor method is a viable measurement method. However, more studies are needed in which both genders are included and more patients are compared with different age groups.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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