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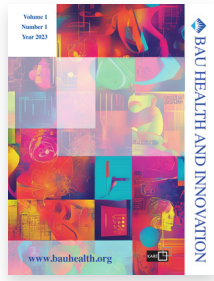

Original Article

Evaluation of Posture, Joint Movement, and Proprioception in Individuals with and without Chronic Neck Pain

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Abstract

Objectives: This study aimed to evaluate posture, cervical joint movement, and cervical proprioception in participants with chronic neck pain (CNP) and compare them with healthy individuals.

Methods: Forty individuals with CNP who were academicians at Istanbul Gelisim University's Vocational School of Health Services and 40 asymptomatic individuals were included the research. Pain intensity was evaluated with a Visual Analog Scale, cervical range of motion (ROM) with a digital goniometer, proprioception sense with target angle test and head repositioning test, posture with New York Posture Analysis Method (NYPAM), muscle shortness with standard tape measure, and neck disability status with neck disability index.

Results: The pain intensity of the CNP group at night, during activity, and at rest was found to be higher than the asymptomatic group ($p<0.05$). It was observed that the cervical ROM values of the CNP group were lower than the control group in all directions ($p<0.05$). There was no difference between the two groups in terms of pectoralis minor muscle shortness ($p>0.05$). NYPAM score was lower in the CNP group than in the control group ($p<0.05$). It was observed that NDI questionnaire scores were higher in the CNP group than the control group ($p<0.05$). In all tests, the joint position sense (JPS) error values of the CNP group were found to be higher than control group ($p<0.05$). There was no significant relationship between pain intensity and JPS error amount in the CNP group ($p>0.05$).

Conclusion: Data show that it was observed that the cervical ROM decreased in the CNP group. It was determined that posture changes occurred in the CNP group. In addition, it was determined that there was a decrease in proprioception sense in the cervical region in the CNP group. However, no relationship was found between CNP and cervical proprioception sense. We think that pain is a complex sensation by nature, it may not be directly associated with neck proprioception, and clearer results can be obtained through research on specific neck pain groups.

Keywords: Chronic neck pain, posture, proprioception.

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It is known that neck pain is the most common musculoskeletal problem in society after low back pain and can recur frequently. It is also known to be affected by gender, age, history of neck pain, postural weakness, musculoskeletal problems, repetitive traumas, and social or psychosocial factors.[1,2] About 70% of people have complained of neck pain at least once in their entire lives, and the prevalence of symptoms that persist for a year varies between 1.7% and 11.5%. Neck pain is a problem that negatively affects a people's social life, causes a decrease in productivity, and results in an increase in treatment costs.[2,3]

With pain, muscular fatigue increases, fiber-type changes occur, and degenerative changes such as fat infiltration and atrophy in the neck muscles occur. Therefore, modulation of

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cervical afferent input may be negatively affected. In addition, psychosocial stress accompanied by pain stimulates the sympathetic nervous system and changes joint mechanics and muscle spindle sensitivity, which are important for proprioception.[4] As a result, it has been stated that people with neck pain have low head-neck position awareness and a decrease in neck joint position sense (JPS).[5,6]

The sense of proprioception is defined as the perception of position, movement, and position of the extremities and the body in three dimensions. Cervical JPS is negatively affected by muscle fatigue, trauma, degeneration in the cervical spine with age, decrease in muscle strength and neck range of motion (ROM), and changes in the tension-length relationship of muscles. Comprehensive evaluation of these factors is great importance for the success of the treatment to be applied.[7]

In people with neck pain, decreased neck position sense, postural disorders, and impaired muscular balance are interrelated. As a result of this relationship, the head turns forward and passes beyond the center line of the body. People who have neck pain often experience an anterior tilt of the head. Extension is observed in upper neck region and flexion is observed in lower neck region. This posture causes mechanical loading in the neck area and flattening of the cervical vertebrae is observed.[8]

As a result of the head tilting forward, the normal gravity line changes, and to compensate for this, an increase in thoracic kyphosis and rounded shoulders is observed. Anterior tilt of the head is usually seen together with shortening of the sternocleidomastoid muscle, levator scapula, extensor cervical muscles, and upper trapezius muscle.[9,10] The incidence of chronic neck pain (CNP) increases in people who work in professions that require the neck area to remain in the same position or be in an abnormal position for a while. The most efficient position in terms of neck muscles is the neutral position. Therefore, working for a long time in inappropriate positions causes premature fatigue of the neck muscles. The head forward posture, which causes the head to stand forward abnormally, causes excessive load on the muscles and joints, causing pain in the neck and back area.[11]

Since there is a decrease in neck position sense, it is reported that more typical errors are observed in head positioning in people with neck pain than healthy individuals.[12,13] A study in the literature states that there is a relationship between forward head posture and weakness in the deep neck flexor muscles.[14] Another important issue that can affect head posture, such as muscle imbalance, is thought to be a decrease in cervical proprioception. In studies evaluating head posture, it is stated that disorders in proprioception in the neck area are observed in people with traumatic or idiopathic neck region pain.[12,15]

This study aimed to evaluate posture, cervical proprioception, and cervical joint movement in people with CNP and compare them with healthy individuals.

Materials and Methods

Participants

Forty CNP and 40 asymptomatic individuals working as academicians at Bahçeşehir University were included in our study. Ethical approval was obtained from the Istanbul Gelişim University Ethics Committee (Decision No: 2023/8, Date: October 20, 2023) and consent forms were obtained all participants in the study. The physiotherapist who evaluates the suitability of individuals to participate in the study and the physiotherapist who performs the measurements are different people. Therefore, the physiotherapist performing the measurements does not know which group the participant belongs to. Therefore, the study was designed as a single-blind.

Criteria for inclusion in the working group; being between the ages of 18–65, visual analog scale (VAS) pain value was to be over 30 mm, and to have neck pain for at least 3 months. Inclusion criteria for asymptomatic group; the requirement was to be a healthy volunteer between the ages of 18–65 and without neck pain in the last year. Individuals who had undergone shoulder surgery or cervical spine, had shoulder region pain, neck pain due to different pathologies (fracture, tumor, ankylosing spondylitis, rheumatoid arthritis, etc.), cord compression, severe radiculopathy, and osteoporosis were not included the research. Sociodemographic information (age, height, weight, gender, etc.) was obtained from the individuals. All participants were evaluated for pain intensity, ROM, JPS, and posture. All assessments were made by the same person in the same order and at 5-min intervals to avoid fatigue.

Assessment Tools

Pain Intensity Assessment

The neck pain intensity of the individuals in the resting position, at night, and during activity was evaluated and recorded with VAS, whose validity and reliability coefficients are 0.79 and 0.97, respectively.[16]

Cervical ROM Evaluation

The neck ROM of the individuals was measured using a digital goniometer (Baseline® digital Absolute+Axis™

goniometer) for movements in all directions (flexion, lateral flexion, extension, and rotation) while sitting on a stable stool and in an upright position. Each measurement was repeated 3 times and averaged.[17]

JPS Error Evaluation

In our study, the participants' JPS error in the neck region was evaluated with the help of "target angle tests (TAT)" and "head repositioning tests (HRT)," which are frequently used in the literature and reported to be reliable and valid. In the tests, the participants' deviations from the target angle were detected using a digital goniometer (Baseline® digital Absolute + Axis™ goniometer). In the evaluation, the tests were performed in accordance with the literature, the participants were seated on a stable chair, their hips and knees were placed in a 90° flexion position, and their eyes were closed.[18,19]

For the HRT test, the participants' head was placed in the neutral position (reference) by the clinician and they were asked to learn this position. After the reference position was taught, the individuals were asked to flex their heads as much as possible and wait in this position for 5 s. Afterward, they were asked to move their heads back to the reference position, and the angular difference between the final position and the neutral position in the sagittal plane was noted in degrees.

TAT, another test used to evaluate JPS error, was performed in 20° extension and 30° flexion positions of the neck. After the participants' heads were taken from the neutral position by the clinician and moved to the target angle. Moreover, the participants were asked to learn this position (target). After the participants were taught the target position, their heads were placed in a neutral position by the clinician. Participants were then asked to move their heads to the target angle, and the difference between the final position and the target angle was noted in degrees. All tests were repeated 3 times at 20-s intervals and the score obtained from the measurements was averaged and recorded.

Posture Evaluation

"New York Posture Analysis Method (NYPAM)" was used to assess the postures of the participants and the posture changes that could occur in 13 different parts of the body were observed and scored. If the person's posture in the relevant section was correct, 5 points were given, if there was a moderate disorder, three points were given, and if there was a serious disorder, one point was given. The maximum score that can be obtained at the end of the test is 65 and the minimum score is 13. A lower score on NYPAM indicates that there are more postural disorders.[20,21]

Shortness Evaluation

M. Pectoralis minor shortness test was applied to all individuals while lying on their back, bilaterally, by measuring the distance between acromion and bed with a standard tape measure.[17]

Neck Disability Status Assessment

Neck disability status was evaluated with the "Neck Disability Index" (NDI). Aslan et al.[22] conducted a Turkish validity and reliability study of the questionnaire. This questionnaire consists of 10 sections including pain intensity, lifting, self-care, reading, concentration, headache, professional life, driving, sleeping, and leisure activities. There are a total of six answer options for each question with a score between 0 and 5. It was scored as 0 (no functional limitation and pain) and 5 (maximum limitation and most rigorous pain). Participants were asked to mark the option that best suited them, and the participants' deficiencies were identified by taking the scores of the marked options.[21,22]

Statistical Analysis

A power analysis was performed to determine the number of people to be included in our study. According to the results of the analysis, it was calculated that if at least 64 people were included in the study (at least 32 people for both groups), 80% power and 80% confidence would be achieved. Continuous variables were expressed as mean±standard deviation, median, and categorical variables were expressed as percentage and number. SPSS 24.0 package program (Armonk, NY: IBM Corp. 2016) was used to analyze the data acquired from the research. The Kolmogorov–Smirnov test was used to determine whether the variables fit a normal distribution. Independent samples t-test was used to compare independent group differences when parametric testing assumptions were met. Mann–Whitney U-test was used if parametric test assumptions were not met. Chi-square analysis was used to compare qualitative variables. Spearman Correlation analysis was used to examine the relationships between continuous variables. In comparing all analyses, $\alpha=0.05$ was chosen for 95% confidence, and $p<0.05$ was considered statistically significant.

Results

Our study included 40 individuals with CNP for the intervention group and 40 asymptomatic participants for the asymptomatic group. Demographic information of the participants is shown in Table 1. When the groups were compared in terms of age, BMI, body weight, and gender, it was observed that there was no difference ($p>0.05$).

Table 1. Sociodemographic characteristics of the participants

	CNP group Mean±SD	Control group Mean±SD	z	p
Age (years)	32.43±12.16	29.72±10.32	-1.097	0.270
Height (cm)	168.85±9.10	173.00±8.87	-3.022	0.016*
Body weight (kg)	69.12±12.72	74.95±16.62	-1.785	0.071
BMI (kg/m^2)	24.47±4.07	25.09±4.64	-0.510	0.679
Gender, n (%)				
Female	25 (62.5)	18 (45)	–	–
Male	15 (37.5)	22 (55)		

*: p≤0.05. CNP: Chronic neck pain; Mean: Arithmetic mean; SD: Standard deviation; z: Test value of Mann Whitney U Test; BMI: Body mass index.

Table 2. Comparison of pain intensity of groups and questionnaires

	CNP group Mean±SD	Control group Mean±SD	z	p
VAS (mm)				
Rest	27.450±20.41	0.00±0.00	-7.567	0.000*
Activity	59.30±20.13	0.00±0.00	-8.215	0.000*
Night	47.10±34.49	0.00±0.00	-7.563	0.000*
NYPAM	52.21±3.92	56.86±4.24	-4.212	0.001*
NDI	13.89±5.11	4.19±3.39	-6.835	0.001*

*: p≤0.05; CNP: Chronic neck pain; Mean: Arithmetic mean; SD: Standard deviation; z: Test value of Mann Whitney U test; VAS: Visual analogue scale; NYPAM: New York posture analysis method; NDI: Neck disability ındex.

Table 3. Neck ROM and muscle shortness

	CNP group Mean±SD	Control group Mean±SD	t/z	p
Neck flexion (°)	34.38±8.00	44.91±5.18	z=-5.159	0.000*
Neck extension (°)	36.63±10.21	45.17±5.66	z=-4.041	0.000*
Neck rotation (°)				
Right	42.41±10.68	49.85±5.88	z=-3.089	0.002*
Left	42.37±9.07	48.60±7.12	t=-3.421	0.001*
Neck lateral flexion (°)				
Right	30.79±7.59	43.22±6.75	t=-7.657	0.000*
Left	33.58±7.49	44.50±5.41	z=-5.846	0.000*
Pectoralis minor shortness (mm)				
Right	11.87±1.75	11.95±2.03	z=-0.174	0.859
Left	11.26±1.55	11.91±1.86	z=-1.712	0.087

*: p≤0.05. ROM: Range of motion; CNP: Chronic neck pain; Mean: Arithmetic mean; SD: Standard deviation; t: Test value of significance test of the difference between two means; z: Test value of Mann Whitney U test.

When the groups were compared in terms of pain intensities at night, during activity, and at rest, the pain intensities of the CNP group were found to be higher and statistically significant than the asymptomatic group for all conditions (p<0.05). It was observed that the NYPAM score was lower in the CNP group (p<0.05). About NDI questionnaire results, it was seen that NDI scores were higher in the CNP group (p<0.05) (Table 2).

When we compared the groups in terms of cervical ROM, we determined that the ROM values of the CNP group were more limited than the control group for every angle and this was statistically significant (p<0.05). No statistically significant difference between the groups in terms of the shortness of the pectoralis minor muscle on both sides (p>0.05) (Table 3).

About cervical proprioception, it was determined that the JPS error values of the CNP group were higher in all tests and this was a statistically significant difference (p<0.05) (Table 4).

There was no statistically significant relationship between pain intensity and JPS error amount in the CNP group (p>0.05) (Table 5).

Discussion

Within the scope of this study, pain, ROM, proprioception, and posture in individuals with CNP were examined. Our aim was to compare individuals with CNP and asymptomatic individuals and to reveal the changes that occurred.

Stenneberg et al.[23] stated in their study that one of the most reported disorders in individuals with CNP was decreased cervical ROM. Shahidi et al.[24] reported in their study that cervical ROM values of individuals with CNP were lower than asymptomatic individuals. Similar to this study, in our study, all ROM values of the CNP group were found significantly lower than asymptomatic individuals.

Table 4. Comparison of neck JPS error between groups

	CNP group Mean±SD	Control group Mean±SD	t/z	p
HRT	5.80±2.33	2.93±1.61	z=−5.681	0.000*
TAT (fleksiyon)	4.63±3.01	1.98±1.23	z=−5.612	0.000*
TAT (extension)	3.83±2.19	1.25±1.13	z=−5.567	0.000*

*: p≤0.05. JPS: Joint position sense; CNP: Chronic neck pain; Mean: Arithmetic mean; SD: Standard deviation; t: Test value of significance test of the difference between two means; z: Test value of Mann Whitney U test; HRT: Head repositioning test; TAT: Target angle test.

Table 5. Examining the relationship between VAS pain intensity and JPS error in the CNP group

	HRT	TAT flexion (30°)	TAT extension (20°)
VAS rest			
r	0.260	0.115	0.159
p	0.106	0.478	0.327
VAS activity			
r	0.229	0.070	0.137
p	0.155	0.667	0.400
VAS night			
r	-0.152	0.046	0.265
p	0.350	0.777	0.099

VAS: Visual analogue scale; JPS: Joint position sense; CNP: Chronic neck pain; HRT: Head repositioning test; TAT: Target angle test; r: Spearman correlation coefficient.

Many studies in the literature have linked postural disorders and neck pain. It has been stated that head forward posture is generally linked with spasm of the M. Trapezius superior and neck pain.[25] Winkel and Westgaard stated in their study that excessive load on the neck region is related to trunk and head position.[26] Duman, in his study evaluating forty individuals with neck pain and forty asymptomatic individuals, used visual posture analysis and a three-dimensional ultrasonic spine posture measurement device to examine the postures of the participants. It was stated that there was an increase in head anterior tilt, shoulder protraction, and thoracic kyphosis curvature in the patient group.[27] In our study, NYPAM was used to evaluate the postures of the participants. A low score of the individual in NYPAM indicates that there are more postural disorders. As a result of the evaluations, the score obtained in individuals with CNP was found to be lower than in asymptomatic individuals, and this result indicated that there were more postural disorders in the CNP group.

The pectoralis minor muscle has attachments on the scapula and the coracoid process of the anterior ribs and elevates the scapula and tilts it forward. The increase in scapular elevation may alter postural mechanics to facilitate adaptive shortening of other scapular lifters, such as the upper trapezius and levator scapular muscles, which are common sites of local trigger points in individuals with non-traumatic neck pain.[24] Shahidi et al.[24] stated that the length of the pectoralis minor muscle in individuals with neck pain was significantly shorter than in asymptomatic individuals. In our study, the pectoralis minor muscle length of the CNP group was found to be shorter than asymptomatic individuals, but the difference was not statistically significant.

One of the commonly used and easily applicable methods in the evaluation of proprioceptive sense in the clinic is the measurement of JPS error. During the test, the ability of individuals to repeat the positions taught before the test or to perceive the angle of joint movement is evaluated. The amount of mistakes individuals make in tests allows us to have an idea about the impairment of the individual's proprioception sense.[28,29]

Chen and Treleaven compared the JPS error rates of both groups in their study on twenty-five individuals with CNP and 26 asymptomatic individuals. As a result of their study, they reported that the JPS error rate was higher in the CNP group than in the asymptomatic group.[30] Taş compared the JPS of the participants in his study on 47 individuals with CNP and 47 asymptomatic individuals. The measurement method used is the same as our study and is TAT and HRT at 30° neck flexion and 20° neck extension. As a result of his study, he reported that the JPS error rate of the CNP group was higher than that of asymptomatic individuals in all tests.[31] As a result of our study, the amount of JPS errors in all tests in individuals with CNP was higher than in asymptomatic individuals. This result drew attention to the loss of neck proprioception sense in individuals with CNP.

Neck muscles have rich proprioceptors that contribute significantly to the sensorimotor system. Although there are studies showing a relationship between the sense of proprioception and pain,[32,33] there are also studies stating that there is no relationship.[31]

Lee et al.[32] found in their study that joint position errors increased as pain intensity increased. Researchers have stated that cervical JPS is vital in maintaining cervical joint stability in static and dynamic positions and that loss of proprioception is effective in the development of clinical pain. Reddy et al.[33] observed in their study that there is a relationship between neck pain and JPS. Taş found in his study that there was no relationship between neck JPS and neck pain.[31] In our study, no significant relationship was found between CNP and JPS error. In the studies in the literature, evaluations were made

at different levels in the evaluation of JPS.[32,33] Since we evaluated JPS error only in the sagittal plane in our study, we think that the method may have affected our results.

In studies, symptoms such as pain in the cervical region and limitation in ROM have been associated with neck disability value.[34,35] NDI is one of the oldest and most widely used questionnaires for neck pain. It has also been stated that the NDI has validity in comparison with other pain and disability scales. A high NDI score means that the individual's perceived disability due to neck pain is high.[21,36] A NDI questionnaire was administered to all individuals who participated in our study. The questionnaire score was higher in individuals with CNP. We think that this result is caused by the decrease in neck ROM and loss of proprioception in individuals with CNP.

Considering the data we obtained from our study, we think that a holistic approach should be made to the neck region when evaluating individuals with neck pain and that different points should be focused not only on pain. It should not be forgotten that postural disorders, loss of proprioception, and limitation in movements that may occur in the neck region may lead to pain and functional losses in the neck region.

The strengths of our study are that it was blinded and that all evaluations were made by the same physiotherapist. Individuals participating in our study could be grouped according to the severity of neck pain. Thus, it could be examined how much different pain levels affected the neck area and proprioception sense. In our study, only the shortness of the pectoralis minor muscle was evaluated and other muscles in the neck region were not evaluated. In addition, participants were not asked to image the neck area. Imaging methods could be used to detect conditions that could cause pain in the neck area. These can be considered among the limitations of our study.

Conclusion

In the result of our research, all cervical ROM values of individuals with CNP were found to be significantly lower than asymptomatic individuals. NYPAM scores in individuals with CNP were found to be higher than in asymptomatic individuals, and postural changes were determined in individuals with CNP. The amount of error in JPS tests of individuals with CNP was found to be significantly higher than that of asymptomatic individuals, and it was determined that there was a loss of proprioception in individuals with CNP. The NDI questionnaire score, which indicates perceived disability due to neck pain, was found to be significantly higher in individuals with CNP than in asymptomatic individuals. There is no significant relationship was found between pain and neck JPS error.

Disclosures

Ethics Committee Approval: The study was approved by the Istanbul Gelişim University Ethics Committee (no: 2023/8, date: 20/10/2023).

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