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Evaluation of Temporomandibular Joint Dysfunction in Patients with Chronic Neck Pain

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Abstract
Objective: The aim of this study was to compare the presence of temporomandibular joint dysfunction (TMD) in individuals with and without chronic neck pain (CNP).
Materials-Methods: The study included 41 subjects with neck pain and 41 subjects without neck pain. Temporomandibular Disorders were evaluated according to the Research Diagnostic Criteria (TMR). The amount of mouth opening was measured with a ruler (cm). Presence of voice in TMJ movements was evaluated. Pain intensity (Visual Analog Scale (VAS)) was evaluated on palpation of chewing muscles. Active joint motion of the cervical region was evaluated with a goniometer. Pain-related disability was assessed with the Neck Disability Indicator/NDI.
Results: The results of our study showed that the pain intensity of the temporomandibular joint (TMJ) was significantly higher than the control group. The severity of pain felt during rest, activity (active mouth opening) and chewing in the study group was significantly higher than the control group ($p<0.05$). Six-way ROM of the cervical region of all individuals and TMJ active joint movements results were found to be significantly lower in the study group than in the control group ($p<0.05$). Painful response and voice findings on muscle palpation were found to be significantly higher in the study group ($p<0.05$).
Conclusions: This study revealed that the signs and symptoms of TMD are seen at a higher rate in individuals with CNP than in healthy individuals. Therefore, we think that TMJ should be included in the routine evaluation program for people with CNP.
Keywords: Cervical, Chronic Neck Pain, Temporomandibular Joint Dysfunction, Physiotherapy

INTRODUCTION

Neck pain is an important health problem occurring in up to 20% of adults[1]. Chronic neck pain (CNP) is defined as persistent or severe neck pain lasting more than 3 months[2]. It was reported that approximately half of the patients recovered within one year of treatment, whereas approximately 10% of the patients reported that their pain became chronic[3].

Another musculoskeletal problem that is adjacent to the cervical region and negatively affects the quality of life is temporomandibular joint (TMJ) disorders[4]. Temporomandibular joint dysfunction (TMD) often occurs because of musculoskeletal disorders associated with the masticator muscles and jaw joint[5]. It was reported that the prevalence of TMD reaches 16% and the rate of severe TMD requiring treatment varies between 3.6% and 7%. It is seen 4-6 times more frequently in women than in men, especially in the premenopausal period[6].

Some recent studies have shown a significant association between cervical spine disorders and TMD[7-8]. Although it has been reported that symptoms of cervical region dysfunctions are seen in patients with TMD, the mechanism of the relationship between cervical region pathologies and TMD has not been elucidated. It has been considered that changes in one of the two regions may affect the other region, as the cervical spines are directly connected to the cranium and masticatory structures through muscle, joint, and neurovascular structures[9-10].

Results of a study showed that TMD, whether chronic or not, is associated with neck muscle tenderness and disability[10]. In another study, it was found that patients with myofascial pain in the masticatory muscles associated with CNP had more widespread pain and distal hyperalgesia compared to patients with CNP alone [11]. Bevilaqua-Grossi et al. reported that as the severity of TMD increased, symptoms related to the cervical spine diseases also increased, but it was not vice versa[9]. In contrast, Matheus et al. concluded that TMD was not associated with craniocervical dysfunction[4]. Despite studies showing the contrary, the results of few studies examining the relationship between TMD and neck pain have demonstrated this relationship. It is seen in the literature that the functional status, especially the pain parameter, is also examined. Increasing the number of studies on the subject will provide a multifaceted approach to patients in treatment and reduce unnecessary medical expenses and labor losses.

The primary aim of this study was to compare the presence of temporomandibular joint dysfunction (TMD) in people with and without chronic neck pain (CNP).

MATERIALS AND METHODS

Ethical considerations

Ethics committee approval of this study was obtained from the Non-Interventional Medicine Ethics Committee of Pamukkale University (no:2018-05). All individuals included in the study signed the voluntary consent form.

Participants

This study is a prospective, observational study. It is included individuals with (study group) and without chronic neck pain (control group). This study was conducted at Viranşehir State Hospital between March 2018 and June 2018. Forty-one volunteers who met the inclusion criteria, presented to the Physical Therapy Clinic, and were determined to have chronic neck pain problems by the specialist physician were included in the study.

In both the study and control groups, individuals aged 20-50 years were included. The study group included individuals who had a complaint of neck pain for at least 3 months, marked a value above 0 on the Visual Analogue Scale (0-10 cm), and scored at least 5 on the Neck Disability Index (NDI). Those who met the following criteria were excluded from the study: Those who reported musculoskeletal pain in any region other than the neck region; those who have undergone surgery due to any pathology in the cervical region, temporomandibular joint dysfunction (TMD), or an orthopedic problem; those with cervical and/or other musculoskeletal system problems that may affect the cervical region such as impingement and thoracic outlet, where specific pathological conditions such as malignant condition of the TMJ, fracture, systemic rheumatoid disease were shown; those undergoing facial paralysis; those actively receiving cervical and/or TMD-related therapy; those with a diagnosed psychiatric illness; and, those with communication difficulties.

Evaluation methods

TMJ clinical evaluation

The Temporomandibular Disorders/Investigational Diagnostic Criteria (TMD/IDC), widely used in epidemiological and randomized controlled clinical trials, were used for clinical evaluation. According to this classification, TMD is divided into three groups. Group I: Muscle Disorders - Myofascial Pain Syndrome (MPS) a) MPS without limitation in mouth opening b) MPS with limitation in mouth opening; Group II: Disc displacements a) Disc displacement with reduction b) Disc displacement without reduction - limitation in mouth opening c) Disc displacement without reduction - without limitation in mouth opening; and Group III: TMJ degenerations a) Arthralgia, b) Arthritis, c) Arthrosis. In our study, mouth opening measurements, presence of noise in TMJ movements, palpation parameters of chewing muscles and TMJ, which are among the physical examination findings included in TMD/IDC, were used as outcome measurements [12].

TMJ Movements: While individuals were sitting in an upright position on the chair with their arms close to the body, maximal depression, lateral deviation (right and left), and protrusion (maximum forward movement) movements of TMJ were measured. A 15-cm ruler was used in the evaluation [13]. For measurement reliability, the maximum opening movement and maximum forward movement values were corrected by the amount of overbite (a condition characterized by the upper teeth covering the lower teeth by more than a third) and overjet (a condition characterized by the upper teeth being positioned more than two millimeters ahead of the lower teeth), respectively [14]. All measurements were performed 3 times and the mean value was recorded.

Muscle palpation: Temporal muscle, masseter muscle, and lateral and medial pterygoid muscles were evaluated bilaterally in the palpation of chewing muscles, and the results were recorded as 'pain' or 'no pain'. Noise in TMJ functions: Noise was evaluated with the aid of a stethoscope at the beginning, middle, or end of the mouth opening and closing movement, and it was recorded as a 'click' or 'crepitation' [14].

Evaluation of pain severity

VAS was used to assess the severity of pain. VAS is an assessment scale with proven validity and reliability in assessing musculoskeletal pain [15]. Participants were asked to mark the intensity of pain they felt at rest and activity in the cervical region and at rest and during chewing in the jaw region on a 10-cm scale (0: no pain, 10: unbearable pain).

Cervical region active normal joint movement

Flexion, extension, lateral flexion (right and left), and rotation (right and left) movements of the cervical region were measured using a universal goniometer. Measurements were taken while the participants were sitting on a chair with the head and torso upright [16]. Before the measurements were taken, the physiotherapist who made the evaluation showed the movements as a model and allowed the participants to try each movement once. All measurements were performed 1 times and the mean value was recorded.

Neck disability assessment

The Neck Disability Index was used to determine eligibility for study criteria in both groups. It is used to determine the severity of disability in patients with neck pain. The questionnaire was developed by Vernon and Mior [17-18] and it was adapted to Turkish by Telci et al. [19]. The questionnaire consists of 10 sections (frequency of pain, personal care, carrying heavy objects, headache, concentration, work, driving, sleep, and recreation). Each section is scored from 0 (No obstacle) to 5 (Full handicap). A score of 0-4 from the questionnaire indicates no disability, while a score of 35 and above indicates complete disability [19].

Statistical analysis

The number of participants planned to be included in the research was decided by the G-Power program [20]. It was calculated that when at least 40 people (20 studies, 20 controls) were recruited, 90% power would be obtained with 95% confidence. The data were analyzed with the SPSS package program. Continuous variables are presented as mean ± standard deviation and categorical variables as numbers and percentages. When the parametric test assumptions were met, the Test of Significance of the Difference Between the Two Means was used to compare independent group differences. When parametric test assumptions were not met, the Mann-Whitney U test was used to compare independent group differences. In addition, the differences between the categorical variables were examined by the Chi-square analysis.

RESULTS

The mean ages of the individuals in the study and control groups were 33.6± 8.8 years and 29.73± 5.8 years, respectively. The two groups were similar in terms of age, height, weight, BMI, years of education, and gender (p>0.05). Majority of the participants were married (61%) and employed (74.39%) (Table 1).

Table 1. Sociodemographic data of the study and control groups

Variables	Study Group n=41 X(SD)	Control Group n=41 X(SD)	P
Age (year)	33.63 (8.8)	29.73 (5.8)	**0.091***
BMI (kg/m^2)	25.08 (4.04)	24.03 (4.12)	**0.695****
Education Duration (year)	2.78 (1.17)	3.39 (1.09)	**0.297****
Gender	**n (%)**		
Sex			
Female	24 (%58)	21 (%51)	**0.376*****
Male	17 (%42)	20 (%49)	
Marital Status			
Married	32 (%78)	18 (%43.9)	
Single	9 (%22)	23 (%56.1)	
Occupation			
Housewife	13 (%31.7)	8 (%19.51)	
Employed	28 (%68.3)	33 (%80.49)	
Retired	0 (%0)	0 (%0)	

*Mann-Whitney U test, **Student's-t test, ***Chi-square test

According to TMD/IDC, there was no individual without TMD in the study group. In 19 patients (46.3%), Group 1 (Muscle disorders) signs and symptoms were recorded. In 17 patients (41.5%), Group 2 (Disc disorders) signs and symptoms were recorded. In 5 patients (12.2%), Group 3 (Joint disorders) signs and symptoms were recorded. In the control group, these values were 22 (53.7%), 8 (19.5%) and 2 (4.9%), respectively. TMD was not detected in 9 patients (22.0%) in the control group. The difference between the study group and the control group was found to be significant in terms of the levels of dysfunction signs and symptoms (χ^2=13.745 p=0.003). While disc- and joint-related TMD was more common in the study group, myofascial TMD was more common in the control group (Table 2).

Table 2. Comparison of the evaluation results of the Individuals in the study and control groups according to the TMD/IDC classification

		Group I n=41 n(%)	**Group II n=41 n(%)**	**Total n=82 n(%)**	**χ^2**	**p**
TMD/IDC Classification	No TMD	0	9 (%22.0)	9 (%11.0)	13.745	**0.003***
	Group1 (Muscular)	19 (%46.3)	22 (%53.7)	41 (%50.0)		
	Group2 (Disc)	17 (41.5)	8 (%19.5)	25 (%30.5)		
	Group3 (Joint)	5 (12.2)	2 (%4.9)	7 (%8.5)		

*Pearson Chi-Square

The mean neck pain duration of the individuals in the study group was 44.48 ± 35.79 months. The mean neck pain according to VAS was 3.82 ± 1.96 cm at rest and 7.73 ± 1.59 cm in activity. Thirty-one people (75.6%) in the study group and 8 people (19.5%) in the control group stated that they had TMJ pain complaints. There was a statistically significant difference between the two groups in terms of the incidence of pain in TMJ (p=0.000). The pain intensity felt at rest and during activity (active mouth opening and closing) and chewing in the study group was significantly higher than that in the control group (p<0.05) (Table 3).

Table 3. Comparison of study and control groups in terms of pain levels in the TMJ

Variables	**Study Group n=41 X(%)**	**Control Group n=41 X(%)**	**P**
TMJ Pain			
Yes	31 (%75.6)	8 (%19.5)	**p <0.001***
No	10 (%24.4)	33 (%80.5)	
	X(SD)		
TMJ Pain at Rest (cm)	0.80 (1.49)	0.07 (0.47)	**0.004****
TMJ Activity Pain (cm)	2.95 (2.63)	0.53 (1.77)	**p <0.001****
TMJ Chewing Pain (cm)	3.61 (2.84)	0.68 (1.59)	**p <0.001****

*Pearson Chi-Square, **Independent Samples Test

Six directions of Active Range of Motion (AROM) (flexion/extension, right and left lateral flexion, right and left rotation) belonging to the cervical region of all individuals and the total values of these movements were recorded. All measurement results were significantly lower in the study group than in the control group (p<0.05). TMJ active joint movements (AJM) (maximum opening, maximum right lateral, maximum left lateral, maximum forward movement amounts) were recorded. It was determined that all measurement results were significantly higher in the control group than in the study group (p<0.05) (Table 4).

Table 4. Comparison of the active range of motion values of the study and control groups for the cervical region and TMJ

Variables	Study Group, n=41, X(SD)	Control Group, n=41, X(SD)	P
Cervical Region AROM Values (°)			
Flexions	36.83 (10.86)	45.08 (8.84)	**p <0.001***
Extension	26.22 (8.76)	33.70 (8.70)	**p <0.001***
Lateral Flexion			
Right	32.35 (7.51)	35.79 (7.31)	**0.039***
Left	33.00 (9.57)	37.89 (7.92)	**0.014***
Rotation			
Right	51.26 (10.08)	63.49 (8.85)	**p <0.001***
Left	51.30 (10.30)	62.41 (7.27)	**p <0.001***
TMJ Lower Jaw AJM Values (mm)			
Maximum opening movement	42.22 (8.93)	45.88 (7.38)	**0.047***
Maximum right lateral movement	6.82 (2.66)	9.48 (2.28)	**p <0.001***
Maximum left lateral movement	7.10 (3.26)	9.72 (2.46)	**0.001***
Maximum forward movement	4.99 (2.70)	6.69 (2.01)	**0.002***

*Independent Samples Test; Active Range of Motion (AROM); TMJ active joint movements (AJM)

Pain response (pain/no pain) in the masticatory muscles was evaluated bilaterally. The greatest pain response occurred in the left lateral pterygoid muscle in the study group. It was determined that the presence of pain in all masticatory muscles except the right masseter muscle was significantly higher in the study group than in the control group ($p<0.05$). Clicking was observed in 31 individuals (75.6%) in the study group and 18 individuals (43.9%) in the control group. TMJ clicking in the study group was 1.72 times that of the control group. While there was no difference between the two groups in crepitation finding ($p>0.05$), it was determined that clicking was significantly higher in the study group than in the control group ($p<0.05$) (Table 5).

Table 5. Comparison of the study and control groups in terms of pain with palpation and noise data

Presence of pain on palpation	Study Group, n=41, X (%)	Control Group, n=41, X (%)	P
Right masseter	14 (%34.15)	7 (%17)	0.064
Left masseter	17 (%41.46)	6 (%14.63)	**0.006***
Right temporal	14 (%34.15)	6 (%14.63)	**0.035***
Left temporal	16 (%39)	6 (%14.63)	**0.012***
Right lateral pterygoid	21 (%51.22)	7 (%17)	**0.001***
Right medial pterygoid	18 (%43.9)	4 (%9.75)	**p <0.001***
Left lateral pterygoid	23 (%56)	7 (%17)	**p <0.001***
Left medial pterygoid	20 (%48.78)	4 (%9.75)	**p <0.001***
TMJ	27 (%65.8)	8 (%19.5)	**p <0.001***
TMJ Sound Finding			
Click sound	31 (%75.6)	18 (%43.9)	**0.003***
Crepitation	6 (%14.63)	4 (%9.75)	0.369

*Pearson Chi-Square

DISCUSSION

It was found in the present study that TMD findings were found in all patients with chronic neck pain. The most important result obtained in this study was that the incidence of TMD-related problems was significantly higher in individuals with CNP than in individuals without CNP.

According to many epidemiological studies, at least one symptom of TMD (such as movement anomalies, joint noise, limitation, and tenderness on palpation) is seen in an average of 75% in the general population without specific complaints[19,21]. In our study, at least one symptom was observed in 78% of individuals in the control group. No symptoms were observed in only 9 individuals in the control group. Kraus reported in a study that the presence of neck pain was associated with TMD at a rate of 70% [22]. In our study, symptoms of TMD were detected in all patients with CNP, which is higher than that belonging to healthy individuals.

In our study, in the study group consisting of patients with chronic neck pain, the severity of TMJ pain (at rest and during activity and chewing) was significantly higher than that in the control group. Furthermore, regarding TMJ pain intensities in the study group, it was seen that the lowest mean pain intensity was found at rest and the highest pain intensity mean value was obtained during chewing. In TMJ pain assessment, the outcome that the TMJ pain level felt during active mouth opening and chewing was significantly higher in the CNP group compared to the control group was explained by Stiesch-Scholz via the anatomical and functional relationships between trigeminal and cervical innervated structures in the craniofacial and cervical region[23]. Lauriti et al. [2014] measured the activity of the masticatory muscles with electromyography and found that the activation of the masticatory muscles was significantly correlated with the severity of TMD, and that TMJ pain intensity was felt at a lower level at rest[24-25].

In this study, we determined that the normal joint movements of the TMJ and cervical region in the study group were significantly lower than those of the control group. Similar to our results, De Laat et al. [1998] found that cervical movements were more restricted in individuals with TMD than in those without TMD[26]. This result shows that both joint movements are related to each other. Micarelli et al. [2020] evaluated a total of 254 patients, including patients with TMD or cervical region pain and healthy individuals. As a result, they found that people with TMD had limited cervical normal range of motion[27]. It is supported by the literature that individuals with TMD have limited range of motion in the cervical region[27-30].

In our study, when we compared the range of motion of the mandible between the two groups, we found that there were reduced movements in the CNP group compared to the control group. This result is similar the results reported by Rodrigues et al. [2015], who showed that TMJ movement capacity in patients with CNP decreased more than TMJ movement capacity in healthy individuals [31]. In addition, we did not find any limitation in our study in the left shifting movements of the chin in patients with CNP and we think that the reason for the limitation we found in the right shift movement may be that the left lateral pterygoid muscle is the muscle that produces the most pain response. In this study, the fact that the lateral pterygoid, which provides the anterior movement of the mandible, was the muscle that produced the most pain response, may explain the most common limitation in the maximum forward movement in the CNP group. In addition, the lack of joint limitations in this way shows us that there may not be internal irregularity in the TMJ, and that the TMJ problem may be caused by muscular structures[27]. In our study, we found that 50% of the individuals evaluated had myofascial TMD, and this rate was 46.3% in the study group, and myofascial TMD was highest in the group with CNP.

Matheus et al. [2009] reported that the relationship between cervical problems and TMD is due to muscular structures rather than joint structures [4]. In our study, in the comparison of pain on palpation of the masticatory muscles between the two groups, painful response on palpation in individuals with CNP was significantly higher compared to that of the control group. The muscle with the highest frequency of pain response on palpation in the CNP group was the left lateral pterygoid muscle. Furthermore, we determined that the frequency of pain response with muscle palpation was significantly higher in the study group than in the control group. When we examined the groups in terms of TMJ palpation, 65.89% of the individuals with CNP had a painful joint response, and it was 19.5% in the control group. The pain response revealed by TMJ palpation was significantly higher in the study group consisting of patients with chronic neck pain compared to the control group.

Our results showed that the muscle palpation and pain response due to myogenic factors seen in the form of excessive, frequent, and long-lasting load on the TMJ articular cartilage in the CNP group was higher than those of the healthy individuals.

The first sign of TMD is joint noise. The presence of noise-clicking in TMJ is mostly related to internal irregularity, but there may also be clicking in myofascial pain due to TMD [21]. In their study of 251 patients with TMD, Dalkız et al. [2001] reported clicking in 75.6%, locking in 7.1%, limitation in mouth opening in 90.4%, dislocation in 54.9%, and varying degrees of occlusal irregularities, temporal pain, facial pain, headache, or joint pain in all individuals. In the present study, the rate of TMJ clicking from both joints or one joint was 75.6% in the CNP group and 43.9% in the control group. Our results showed that the presence of noise-clicking is a common symptom in TMD, in line with the literature, and revealed that these symptoms are seen at a higher rate in individuals with CNP than in healthy individuals[21].

The limited number of studies in the literature comparing the signs and symptoms of TMD in patients with chronic neck pain and healthy individuals is the strength of this study. However, the relatively low number of cases to examine the parameters associated with TMD, especially in the study group consisting of patients with chronic neck pain was one of the limitations. The study population consisting of young individuals was another limitation of the study.

CONCLUSION

Although the incidence of TMD is high in our society, it is seen that there is no consensus in the literature on whether there is a relationship between TMD and CNP, and the number of studies on this subject is insufficient. In conclusion, TMD incidence was found to be significantly higher in patients with CNP than in healthy individuals. For this reason, we think that TMJ should be included in the routine evaluation program in people with CNP complaints, so a more effective improvement can be achieved in terms of pain and disability parameters.

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Ethics statement

In this study, all the rules stated in “the Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed; and, we undertake that none of the actions specified under the title of "Actions Contrary to Scientific Research and Publication Ethics" of the aforementioned directive have been carried out.

Ethics committee approval of this study was obtained from Pamukkale University Non-Interventional Medicine Ethics Committee (no: 2018-05). All individuals included in the study signed the voluntary consent form.

Disclosure statement: The authors have no conflicts of interest to declare.

Author contributions: Conceptualization: [HCG, EAT]; Design: [HCG, EAT]; Writing: [HCG AA]; Investigation/Data collection: [HCG, AA]

Conflict of interest: There is no potential conflict of interest relevant to this article.

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