Original Article

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Evaluation of Cervical Dysfunctions in Temporomandibular Disorders

Temporomandibular Bozukluklarda Servikal Disfonksiyonların Değerlendirilmesi

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ABSTRACT

Objective: *Our purpose in this study is to investigate upper cervical segmental dysfunctions in female patients with chronic temporomandibular disorders (TMDs) with and without neck pain and to compare them with those of healthy subjects.*
Method: *Patients admitted to our hospital with jaw pain were evaluated, and a total of 152 patients and healthy subjects who met the inclusion criteria for the study were divided into 3 groups: TMD with neck pain (n = 94), TMD without neck pain (n = 28) and control (n = 30). Patients with myofascial pain (category I) or disc displacements (category II) were diagnosed based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) guidelines. Upper cervical segmental dysfunctions were identified using functional and pain provocation tests in patients with TMD and healthy subjects.*
Results: *When patients with TMD were classified, there was a significant difference between TMD with neck pain (category I, 62.8%; category II, 37.2%) and TMD without neck pain (category I, 28.6%; category II, 71.4%) groups (p = 0.002). A statistically significant dysfunction [difference] was found in all upper cervical segments in favor of the TMD with neck pain group compared to the group with TMD without neck pain and healthy control group (p < 0.05). In the neck pain group with TMD , occiput-C1, C1-C2, and C2-C3 segment dysfunctions were detected in 51.1%, 81.9% and 53.2% of the patients, respectively.*
Conclusion: *Upper cervical segmental dysfunction rate was higher in TMD group with neck pain than those without and healthy control group.*

Keywords: *neck pain, myofascial pain syndromes, temporomandibular joint disorders*

ÖZ

Amaç: *Bizim çalışmamızda amacımız, boyun ağrısı olan ve olmayan kronik TMB'li kadın hastalarda üst servikal segmental disfonksiyonları araştırmak ve sağlıklı gönüllüler ile karşılaştırmaktır.*
Yöntem: *Çene ağrısı ile hastanemize başvuran hastalar değerlendirildi ve çalışmaya dahil edilme kriterlerine uyan toplam 152 hasta ve sağlıklı gönüllüler olmak üzere 3 gruba ayrıldı: TMB ile birlikte boyun ağrısı olan (n=94), TMB ile birlikte boyun ağrısı olmayan (n=28) ve kontrol (n=30). Miyofasyal ağrı (kategori I) veya disk deplasmanları (kategori II) olan TMB hastalarının tanısı Temporomandibular Bozukluklar için Araştırma Tanı Kriterleri (TMB/ATK) kılavuzuna göre konuldu. TMB hastaları ve sağlıklı gönüllülerde fonksiyonel ve ağrı provokasyon testleri ile üst servikal segmental disfonksiyonlar saptandı.*
Bulgular: *TMB hastaları sınıflandırıldığında, TMB ile birlikte boyun ağrısı olan (kategori I, 62,8%; kategori II, %37,2) ve TMB ile birlikte boyun ağrısı olmayan (kategori I, %28,6; kategori II, %71,4) gruplar arasında anlamlı farklılık saptandı (p=0,002). TMB ile birlikte boyun ağrısı olmayan grup ve sağlıklı kontrol grubuna göre TMB ile birlikte boyun ağrısı olan grup lehine tüm üst servikal segmentlerde istatistiksel olarak anlamlı disfonksiyon varlığı bulundu (p <0.05). TMB ile birlikte boyun ağrısı olan grupta %51,1 Oksiput-C1, %81,9 C1-C2 ve %53,2 C2-C3 segment disfonksiyonu tespit edildi.*
Sonuç: *TMB ile birlikte boyun ağrısı olan grupta üst servikal segmental disfonksiyon oranı, TMB ile birlikte boyun ağrısı olmayan ve sağlıklı kontrol grubuna göre daha yüksek saptandı.*

Anahtar kelimeler: *boyun ağrısı, miyofasyal ağrı sendromu, temporomandibular eklem bozuklukları*

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INTRODUCTION

Temporomandibular disorders (TMDs) are painful conditions and dysfunctions in the masticatory muscles, temporomandibular joint (TMJ) and related structures [1]. The detection rate of at least one symptom of TMD in population is estimated to be range between18–33%, however the incidence of TMD requiring treatment is estimated to be approximately 5% in the community [1]. TMD is more common in women aged 20–40 years and 4 times more common in women than men [2]. The etiology of TMD is not known for certain, but it is considered to be multifactorial. Local factors such as minor or major traumas of TMJ, chewing muscles and associated ligaments and tendons, parafunctional activities (tooth tightening, lip biting) and surgical treatments lead to the activation of nociceptive neurons in the trigeminal ganglion and spinal trigeminal nucleus, resulting in pain associated with TMD [3,4]. In addition, most central factors such as sensitization of second-order neurons in the spinal trigeminal nucleus and supraspinal level and impairment of descending pain inhibitory system play an important role in the chronicization of pain [3,5].

In recent years, studies have focused on the neuroanatomic–physiological relationships of the masticatory system and the cervical spine. Studies have shown that neck muscle activity is increased during jaw activities, such as opening the mouth and chewing in the presence of coordinated cervical and trigeminal motor patterns in healthy individuals [6,7]. It has also been shown that in painful cases, cervical movements are restricted due to masseter pain or decreased motor functions of the jaw due to cervical pain [8,9]. It has been suggested that the mutual effect between the jaw and cervical regions occurs with the convergence of the upper cervical afferent nerves (C1, C2 and C3) and the medullary dorsal horn of the upper cervical spinal cord of trigeminal inputs, called the trigeminocervical complex (TCC) [4,10]. Due to the convergence of TCC, there will also be mutual pathological relations between the structures of the jaw and cervical regions, i.e. the problem in one region may affect the other region [11]. It is known that the irritant injection into the paraspinal tissues provides activation in both jaw and neck muscles [12]. In addition, many studies have shown that painful conditions occur in the neck with the stimulation of the structures innervated by trigeminal nerve [13,14]. This, in turn, is considered to be an important process underlying TMD and concomitant cervical dysfunctions.

Focusing on the relationship between TMD and cervical dysfunctions can provide a better understanding of the symptoms and signs of TMD. Therefore, TMD should not be examined as an isolated symptom. Instead, it should be evaluated together with the dysfunctions of the upper cervical spine. Therefore, this study investigated upper cervical segmental dysfunctions in female patients with and without neck pain and compared them with those of healthy subjects.

MATERIALS AND METHODS

Patients who presented to the jaw outpatient clinic of the Physical Medicine and Rehabilitation and received the dignosis of TMD following clinical examination based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) guideline [15] and healthy subjects were included in the study. A total of 152 patients and control subjects who were included in this cross-sectional study were divided into 3 groups: TMD with neck pain (n = 94), TMD without neck pain (n = 28) and control (n = 30). All evaluations were made by the same physician. The patients were informed about the purpose of the study in writing and orally, and they signed the “Informed Consent Form” after the approval was obtained. Ethics Committee approved the study protocol in accordance with the Principles of Helsinki Declaration.

The inclusion criteria of the study were as follows: presence of single or bilateral painful TMD for at least 6 months; having category I (myofascial pain) and/or category II (disc displacements) TMD based on RDC/TMD criteria and being female aged between 18 -50 years. In addition, patients with TMD who had upper cervical dysfunction based on functional and pain provocation tests were included in the study [16].

Patients with category III (arthralgia, osteoarthritis and osteoarthrosis) dysfunctions based on RDC/TMD criteria, those with primary cervical spine disor-

ders such as disc herniation or spondylosis, cases with a history of cervical surgery, TMJ surgery or those with rheumatic diseases that could affect the cervical region, such as rheumatoid arthritis or ankylosing spondylitis, were excluded from the study.

Clinical Examination

The diagnosis of TMD was based on RDC/TMD guidelines, followed by a detailed subjective and objective clinical evaluation by a physician. RDC/TMD guidelines include routine assessments consisting of a diagnosis and treatment plan for patients admitted with jaw pain. The healthy control group included subjects without chronic pain, clinical pathology or past surgeries related to the chewing system or cervical spine. Patients with TMD and healthy subjects who were eligible for the study were informed about the objectives of the study and planned cervical evaluation. Upper cervical dysfunction was diagnosed with functional and pain provocation tests [16,17]. In addition, patients with TMD were asked to describe the average intensity of jaw pain that they felt in the last week, and to score their average pain levels between 0 and 10 based on a visual analog scale (VAS).

Statistical Analysis

A post- hoc power analysis (G*Power version 3.1.9.4, Franz Faul) was performed to estimate our sample size that would detect the dysfunctions with enough statistical power (80%). A post- hoc power analysis revealed that the effect sizes to be 0.266, 0.329 and 0.341, respectively with a statistical power of 84.4%, 96.1% and 97.2%, respectively for occiput-C1, C1-2 and C2-C3 dysfunctions.

The Statistical Package for the Social Sciences (SPSS) (Version 22.0, IBM Corp., Armonk, NY, USA) was used in the analysis. The descriptive statistics of the data were expressed in mean values and standard deviation (SD) for continuous variables and numbers and percentages for categorical variables. The Shapiro–Wilk test was used to analyze the normal distribution of quantitative variables. For differences in demographic features and clinical characteristics of dysfunctions between groups, Kruskal–Wallis or Mann–Whitney U–test was performed for continuous variables and chi-square test for categorical data. The effect size of the chi-square test was determined by Phi Cramer's value. Effect size standards were 0.10 = small, 0.30 = medium and 0.50 = large. In the study, the level of significance was determined as $p < 0.05$.

RESULTS

Demographic and clinical characteristics of the patients are summarized in Table 1. Sample size consisted of 152 patients (TMD with neck pain, n = 94; TMD without neck pain, n = 28; Control, n = 30) (Figure 1). There was

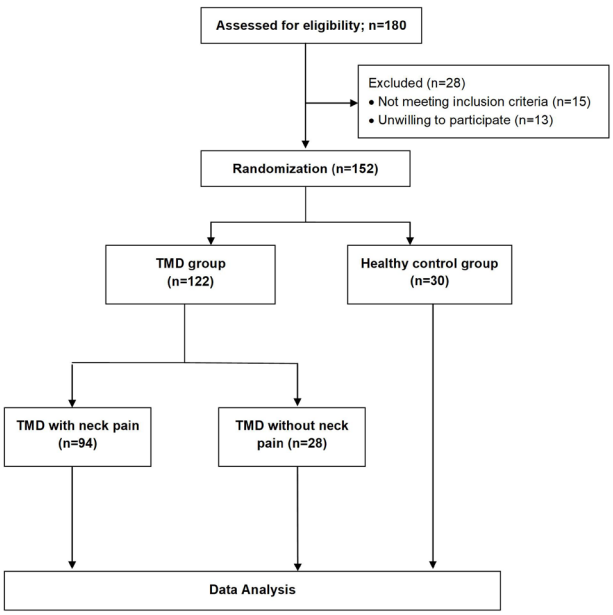

Figure 1. Flow diagram.

no significant difference between the three groups in the evaluation of age and body mass index (BMI) of the patients ($p > 0.05$). In the intergroup comparisons of TMD with and without neck pain any difference in symptom duration and VAS was not detected ($p = 0.173$; $p = 0.098$, respectively) (Table 1). When patients with TMD were grouped based on RDC/TMD criteria , category I patients (62.8%) in those with TMD with neck pain and category II patients (71.4%) in those without neck pain were proportionally higher, and there was a significant intergroup difference ($p = 0.002$) (Table 1).

When patients were distributed based on the level of upper cervical segmental dysfunction, occiput-C1 (n = 48, 51.1%), C1-C2 (n = 77, 81.9%) and C2-C3 (n = 50, 53.2%) segment dysfunctions were detected in TMD with neck pain group; occiput-C1 (n = 7, 25.0%), C1-C2 (n = 16, 57.1%) and C2-C3 (n = 6, 21.4%) segment dys-

Table 1. Demographic and clinical features.

Characteristics	TMD with neck pain (n = 94)	TMD without neck pain (n = 28)	Control (n = 30)	
	Mean ± SD or n (%)			p values*
Age (years)	33.5±8.2	30.7±8.0	32.5±6.5	0.092
BMI (kg/m²)	22.4±2.6	21.7±1.9	22.6±1.4	0.201
Duration of symptoms 6 months-1 year 1-2 years >2 years	29 (30.9) 30 (31.9) 35 (37.2)	14 (50.0) 6 (21.4) 8 (28.6)		0.173
VAS-jaw pain (0-10)	4.3±1.6	3.9±2.4		0.098
RDC/TMD Category I Category II	59 (62.8) 35 (37.2)	8 (28.6) 20 (71.4)		0.002*

Means (SD) is given for continuous s; and n (%)for categorical data.
SD, Standard Deviation; BMI, body mass index, VAS, visual analog scale; TMD, temporomandibular disorder; RDC/TMD, research diagnostic criteria for temporomandibular disorders
p values for continuous variables were calculated using Kruskal-Wallis or Mann-Whitney U test
p values for categorical data were calculated using chi-square test
*p <0.05.

functions in TMD without neck pain group, and occiput-C1 (n = 7, 23.3%), C1-C2 (n = 14, 46.7%) and C2-C3 (n = 5, 16.7%) segment dysfunctions in the control group in indicated percentages of participants. Significant differences were found in favor of the TMD with neck pain group in terms of segmental dysfunctions of occiput-C1 (effect size = 0.266, p = 0.005) (Figure 2a), C1-C2 (effect size = 0.329, p < 0.001) (Figure 2b) and C2-C3 (effect size = 0.341, p < 0.001) (Figure 2c) compared with TMD without neck pain group and the healthy control group (Table 2).

Table 2. Distribution of patients according to the levels of upper cervical segmental dysfunction and comparison between groups

Upper Cervical Segmental Disfunction	TMD with neck pain (n = 94)	TMD without neck pain (n = 28)	Control (n = 30)	Intergroup group comparisons	
	n (%)	n (%)	n (%)	p values*	Effect size
C0-C1 (Occiput/ Atlas)	48 (51,1)	7 (25,0)	7 (23,3)	0.005*	0.266
C1-C2 (Atlas/Axis)	77 (81,9)	16 (57,1)	14 (46,7)	<0.001*	0.329
C2-C3	50 (53,2)	6 (21,4)	5 (16,7)	<0.001*	0.341

n (%) is given for categorical data.
TMD, temporomandibular disorder.
p values were calculated using chi-square test for intergroup comparisons *p < 0.05.

DISCUSSION

In this study, segmental evaluation and comparison of upper cervical dysfunctions were performed in patients with and without neck pain and asymptomatic healthy subjects. Based on the results of our study, the rate of all upper cervical dysfunctions, especially C1-C2 dysfunction, was higher in patients with TMD with neck pain compared to those without and asymptomatic control patients. In addition, the proportion of patients with myofascial pain was significantly higher in TMD with neck pain group and patients with disc displacements were significantly more numerous in TMD without neck pain group.

Investigating the relationship between TMD and cervical disorders has drawn attention due to anatomi-

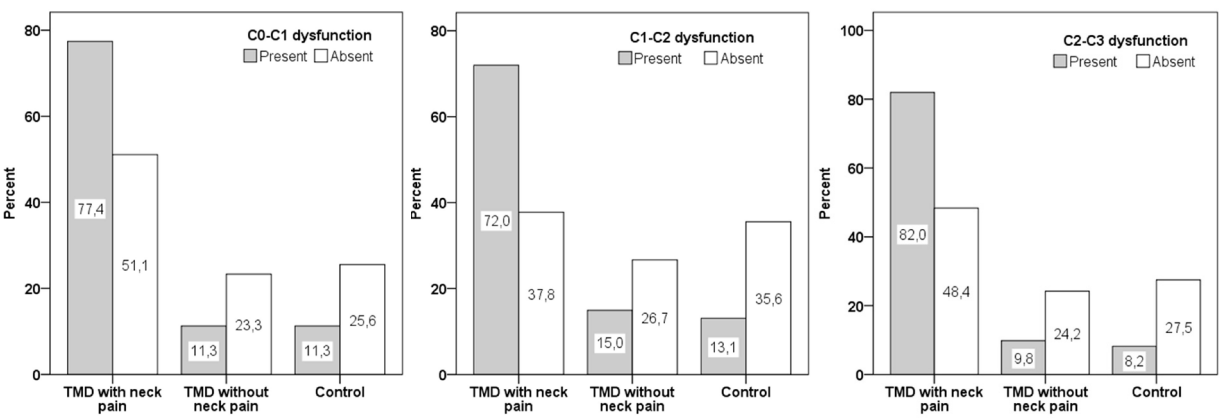

Figure 2. Upper cervical segmental dysfunction rates in 3 groups (%). a) CO-C1 dysfunction b) C1-C2 dysfunction c) C2-C3 dysfunction.

cal proximity, neuronal interconnections and convergence inputs between the cervical and trigeminal regions. Clinical studies have shown that headaches, neck pain and cervical spinal dysfunctions are well-known comorbidities of TMD. It has been respective percentages of patients with TMD have at least one (83%) or two (59%) comorbid pain conditions [18,19]. Giannakopoulos et al. have showed the effects of TMD and pain on neck motor patterns that could ultimately affect neck movement [20]. Several studies have found that pain and dysfunctions in the cervical region, sensitive points in cervical region muscles and low pressure pain thresholds (PPT) are very common in patients with TMD [21,22]. Again, there is also a positive correlation between severity , and disability of TMD and cervical disability [23].

The prevalence of neck pain in patients with TMD is very high, ranging from 54% to 88% [24,25]. Weber et al. assessed the frequency of symptoms and signs of cervical spine dysfunctions in patients with and without TMD in their study; and painful cervical dysfunctions were detected in 88.24% of patients with TMD, and in 51.35% of patients without TMD [24]. Similarly, in our study, upper cervical dysfunctions accompanied by neck pain were detected in 94 (77%) of 122 patients with TMD. In our study, upper cervical dysfunctions were examined at segmental level in patients with TMD and asymptomatic control group, and the rate of dysfunction in all upper cervical segments was statistically significantly higher in TMD group accompanied by neck pain compared to other groups. This significant difference may indicate that diffuse dysfunctions, rather than a single segment dysfunction, lead to neck pain accompanying TMD. In flexion-rotation test by Grondin et al., patients with TMD had restricted upper cervical range of motion (ROM) compared to asymptomatic controls [26]. However it has not been identified whether the patients in this study have cervical spine disorders associated with TMD. On the contrary, Piekartz et al. investigated cervical symptoms in patients with mild or moderate-severe TMD and healthy subjects in their study and reported lower PPT for the upper trapezius and obliquus capitis inferior muscles without any limitation of ROM in the upper cervical spine [22]. This is due to the sensitization of neurons in intensive TCC, which does not lead to development of upper cervical dysfunctions in the cervical region, or the lack of central sensitization, because the above-mentioned study involved patients with acute and subacute TMD. Although the evaluation of the upper cervical ROM was not performed in our study, C1-2 dysfunction might restrict ROM of upper cervical segment , since segment C1-2 in human beings is responsible for a very large majority of the upper cervical ROM [27]. Although all patients with TMD in our study had upper cervical dysfunction, 57.1% of patients with TMD without neck pain had C1-C2 dysfunction, and this rate was 81.9% among patients with TMD accompanied by neck pain. These findings support the above-mentioned study by Grondin et al., which indicates that restriction of cervical ROM is significantly greater in patients with TMD accompanied by neck pain [26].

In the study by Almoznino et al., which investigated cervical muscle tenderness in 192 patients with TMD and 99 healthy subjects, total cervical muscle tenderness involving trapezius, sternocleidomastoid and suboccipital muscles was significantly higher in TMD patients of myogenic origin, whereas no significant difference was found in TMD patients of articular origin [28]. Similarly, Stiesch-Scholz et al. found that tenderness of the neck muscles was significantly more frequently detected in patients with TMD with muscle tenderness compared to those without and that patients with TMD with TMJ internal irregularities were more often associated with painless cervical dysfunctions [29]. In addition, Lobbezoo-Scholte et al. found that neck pain was significantly more common in patients with TMD with myogenic compensation rather than articular components [30]. In our study, consistent with the literature, there was a significant categorical difference between TMD groups based on RDC/TMD. There were higher number of category I patients with myofascial origin in TMD group with neck pain, and a higher number of category II patients with joint origin in the TMD group without neck pain. In their study, Greenbaum et al. compared patients with myogenic TMD and healthy subjects and found that the flexion-rotation test was positive (less than 32°) in 90% of patients with TMD [31]. The reason for the higher rate of patients with C1-C2 dysfunction (81.9%) in the TMD with neck pain group in our study can be explained by the fact that all TMD patients in the previous study were of chronic myogenic origin. Patients with chronic TMD of myogenic origin are

prone to central sensitization and may have a significant fear of movement that may increase disability and reduce neck ROM [32]. In their study, Hong et al. found a higher number of trigger points in the cervical and jaw muscles in patients with TMD accompanied by neck pain compared to patients with TMD alone, which can be explained by the TCC and central sensitivity of the nociceptive pathways at the supraspinal level [33]. Again, Munoz-Garcia et al. determined that patients with chronic neck pain as well as pain in chewing muscles had more often widespread pain and distal hyperalgesia compared to those with only chronic neck pain [34].

Strengths and Limitations

Evaluation of TMD and concomitant cervical comorbidities is the strength of this study. Our study is important as it examines upper cervical dysfunctions at the segmental level. Furthermore, the inclusion of asymptomatic healthy subjects in the study has revealed the role of upper cervical dysfunction in TMD.

Our study has some limitations. First, the inclusion of only female patients into the study makes it difficult to generalize its results. Second, since all of our patients have chronic TMD, the lack of psychological and social status assessment may have affected the results. Third, when evaluating upper cervical dysfunction, a validated and objective measurement could have been performed for hypomobility.

CONCLUSION

In this study, the rate of upper cervical segmental dysfunctions was higher in TMD group of patients with neck pain compared to those without neck pain and asymptomatic control group. In addition, in the comparison of patients with TMD, the rate of myofascial pain was higher in patients with TMD with neck pain, and the rate of disc displacements was significantly higher in patients with TMD without neck pain. These results show the importance of evaluating cervical disorders during risk assessment and treatment planning for TMD. Therefore, for proper management of TMD and concomitant cervical spine disorders, an integrated approach may be required including both masticatory and cervical systems.

Ethics Committee Approval: The study was approved by the Ethical Committee (Bakırköy Sadi Konuk Research and Training Hospital no: 2020–357).
Conflict of interests: Authors have no conflict of interest.
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Informed Consent: Informed consent was obtained from all individual participants included in the study.

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