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Investigation of The Relationship Between The Pressure-Pain Threshold of Masticatory Muscles and Neck Muscles in Women With Temporomandibular Disorders

Temporomandibular Eklem Disfonksiyonu Olan Kadınlarda Çiğneme Kasları ile Boyun Kaslarının Basınç-Ağrı Eşiği Arasındaki İlişkinin İncelenmesi

Duygu SAHİN ALTAC[1], Ebru KAYA MUTLU[2], Olcay SAKAR[3], Hanifegul TASKİRAN[4]

[1]M.Sc., Halic University, Faculty of Health Science, Division of Physiotherapy and Rehabilitation, Istanbul, 0000-0002-2914-7976
[2]Proff. Dr, Bandirma Onyedi Eylul University, Faculty of Health Science, Division of Physiotherapy and Rehabilitation, Bandirma, 0000-0002-8595-5513
[3]Proff. Dr, Istanbul University, Faculty of Dentistry, Department of Prosthodontics, Istanbul, 0000-0003-1513- 4186
[4]Proff. Dr, Istanbul Aydin University, Faculty of Health Science, Division of Physiotherapy and Rehabilitation, Istanbul, 0000-0002-9428-5347

ABSTRACT

Purpose: Although there are studies showing the relationship between the temporomandibular joint and the neck, more studies are needed to reveal the relationship between muscle sensitivity in these two regions in women with temporomandibular joint dysfunction (TMD). The aim of our study is to investigate the relationship between the pain pressure threshold (PPT) of masticatory and the neck muscles in women with temporomandibular disorders (TMD).

Methods: Twenty women diagnosed with myofascial TMD who were followed up at Istanbul University, Faculty of Dentistry, Department of Prosthodontics, between August 2019- November 2019, were included and data analysis of the cases was performed retrospectively. PPT values of the anterior temporal and masseter muscles as masticatory muscles, and the upper trapezius and sternocleidomastoid (SCM) muscles as neck muscles, evaluated with an algometer, were included in the study. Pearson correlation coefficient was used to provide statistical analysis of the data.

Results: There were a statistically significant and positive correlation between the right anterior temporalis muscle with the right upper trapezius muscle (p=0.012; r:0.551) and the left upper trapezius muscle (p=0.015; r:0.553); right masseter muscle with the left trapezius muscle (p=0.005; r:0.599) and left SCM muscle (p=0.041; r:0.461); left masseter muscle and left trapezius muscle (p=0.002; r:0.645).

Conclusion: The positive relationship between the PPT of the masticatory and neck muscles in women with TMD in our study highlights the necessity of considering the other region in the clinical examination of both regions and in the treatment programs created for their disorders.

Keywords: Masticatory muscles, Neck muscles, Temporomandibular joint disorders, Women

ÖZET

Amaç: Temporomandibular eklem ile boyun arasındaki ilişkiyi gösteren mevcut çalışmalar olmasına karşın, temporomandibular eklem disfonksiyonu (TMD) olan kadınlarda bu iki bölgenin kas hassasiyeti arasındaki ilişkinin ortaya koyulması için daha fazla çalışmaya ihtiyaç duyulmaktadır. Çalışmamızın amacı TMD olan kadınlarda çiğneme ve boyun kaslarının basınç ağrı eşiği (BAE) arasındaki ilişkinin belirlenmesidir.

Yöntem: Çalışmamıza, Ağustos 2019- Kasım 2019 tarihleri arasında İstanbul Üniversitesi-Diş Hekimliği Fakültesi-Protetik Diş Tedavisi Ana Bilim Dalı'nda miyofasiyal TMD tanısı almış ve takibi gerçekleştirilen 20 kadın dahil edilerek, olguların veri analizleri retrospektif olarak gerçekleştirilmiştir. Çiğneme kasları olarak anterior temporal ve masseter kaslarının, boyun kasları olarak ise üst trapez ve sternokleidomastoid (SKM) kaslarının algometre ile değerlendirilmesi gerçekleştirilen BAE değerleri çalışmaya dahil edilmiştir. İstatistiksel olarak, verilerin ilişkilendirilmesi amacıyla Pearson korelasyon katsayısı kullanılmıştır.

Bulgular: Olguların sağ anterior temporalis kası ile sağ üst trapez kası (p=0,012; r:0,551) ve sol üst trapez kası (p=0,015; r:0,553) arasında; sağ masseter kası ile sol trapez kası (p=0,005; r:0,599) ve sol SKM kası (p=0,041; r:0,461) kası arasında; sol masseter kası ile sol trapez kası (p=0,002; r:0,645) arasında istatistiksel olarak anlamlı ve pozitif bir korelasyon bulunmuştur.

Sonuç: Çalışmamızda TMD'li kadınlarda çiğneme ve boyun kaslarının BAE'si arasında bulunan pozitif ilişki, klinikte her iki bölgenin muayenesinde ve bozukluklarında oluşturulan tedavi programlarında diğer bölgenin de göz önünde bulundurulması gerekliliğini vurgulamaktadır.

Anahtar kelimeler: Çiğneme kasları, Boyun kasları, Temporomandibular eklem bozuklukları, Kadın

Sorumlu yazar/Corresponding author:
Duygu SAHİN ALTAC, Halic University, Faculty of Health Science, Division of Physiotherapy and Rehabilitation, Istanbul, Turkey, fztduygusahin@gmail.com

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INTRODUCTION

Temporomandibular joint dysfunction (TMD) is described as a complex clinical disorder in which the temporomandibular joint (TMJ) and masticatory muscles with structures related to these regions are affected (1). Studies report that the prevalence of TMD is 10-15% in adults. Although the signs and symptoms of TMD vary clinically from person to person, they generally include pain and muscle tenderness in the masticatory muscles, TMJ, head, neck and shoulders; disturbing TMJ sounds occurring as clicking and crepitating; locking in the TMJ; ear complaints, especially tinnitus and chronic pain behavior is classified as psychosocial problems such as anxiety and depression (2).

TMJ and cervical spine are complex systems that are in a functional relationship and sensory-motor interaction through the trigeminocervical complex, which provides nociceptive information transfer (3). Nociception, which develops from the joints and muscles innervated by the upper cervical spinal nerves, also plays a role in overlapping disorders of other regions fed by the trigeminal nerve. Similarly, masticatory muscles motor activity and neck muscles activity, which are responsible for mandibular movement during speaking, chewing or opening the mouth, are also affected by each other for the same reason (4). So, due to this neuroanatomical, biomechanical and miofascial relationship between the TMJ and the cervical region, these regions are known in the literature as a functional chain where any disorder or pain in one region can affect the others (3). Matheus et al. (2009) investigated the relationship between TMJ and cervical joints by examining the position of the skull relative to the cervical spine in individuals with and without disc displacement and found that there was no relationship between the position of the joints relative to each other and TMD. For this reason, they reported that the relationship between these two regions originates from muscles, not the joints (5). Da Costa et al. (2015) found a negative correlation between TMD and cervical region in terms of disability and pressure pain threshold (PPT) (6). Parallel to this study, Silveria et al. (2015) in their study investigating the relationship between mandibular dysfunction, neck disability and muscle tenderness in TMD and healthy individuals, reported that high sensitivity in the upper trapezius and temporalis muscles was highly associated with mandibula and neck dysfunction (7).

Research indicates that the frequency of TMD in women is twice as high as in men, and the frequency of TMD symptoms is four times higher (1). Theories about why TMD is more common in women than men: it has been associated with hormonal, anatomical, behavioral and genetic differences (8-10). Cigarán-Méndez et al. (2019) in their study aiming to identify gender difference in the presence of trigger points in the shoulder, servical region and head muscles,

they reported that the PPT of the muscles of these regions were lower in women with headache than in men (11). In our literature review taking this information into consideration, we did not find any study that eliminated the gender difference and included only women in whom TMD is more common, and examined the relationship between masticatory muscles and neck muscles in terms of PPT.

The aim of our study is to contribute to the gap in the literature by investigating the relationship between PPT of masticatory (anterior temporalis and masseter) and neck muscles (upper trapezius and SCM) in women with TMD and to provide new perspectives on TMD-related clinical evaluation and treatment practices. We therefore hypothesized that there will be a positive correlation between the PPT of anterior temporalis and masseter with upper trapezius and SCM in women with TMD.

METHODS

Study Design

A retrospective cross-sectional trial was designed. This manuscript was approved by the Halic University Institutional Review Board (2023/234) and complied with Declaration of Helsinki. In this study, the patient files of 20 women diagnosed with myofascial TMD by a dentist who recruited from Istanbul University-Department of Prosthodontics from July 2019-December 2019.

Participants

This study was carried out by retrospective analysis of the characteristics features and PPT values of masticatory and neck muscles of 20 women who met the inclusion criteria. The inclusion criteria was as follow being diagnosed with myofascial TMD by a dentist according to Diagnostic Criteria for Temporomandibular Disorders. The exclusion criteria were as follows: (i) having had TMJ or cervical surgery within the last three months; (ii) presence of rheumatic disease involving TMJ; (iii) having TMJ instability or fracture; (iv) having a perception/coordination problems; and (v) presence of chronic pain such as trigeminal neuralgia.

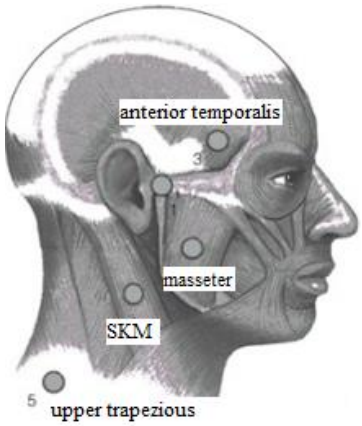
Assessments

Data obtained from the women’s files including age, weight, height, affected side and PPT information obtained from the women's files were included in the study.

An algometer device (FDIX Digital Force Gage; Wagner Instruments) was used to perform PPT measurements of the masticatory and neck muscles. Using the reference points reported by Ortner (2003) **(Figure 1),** the algometer was pressed on the anterior temporalis, masseter,

upper trapezious and SCM muscles in 1 kg/cm^2 increments until the women felt pain. The measurements was repeated three times and the average pressure applied to the muscles was recorded (10).

Figure 1. Reference points for PPT measurements of masticatory and neck muscles (10).



Statistical Analysis

Statistical analysis was performed via SPSS Version 24.0. Variables were indicated as mean and standard deviation (mean±SD). Because our data has a normal distribution, "Pearson correlation coefficient" was used to correlate PPT values and significance level was set at $p<0.05$. The magnitude of each effect was measured as a "little correlation (r: 0.00-0.25)", "low correlation (r: 0.26-0.49)", "moderate correlation (r: 0.50-0.69)", "high correlation (r: 0.70-0.89)" and "very high correlation (r: 0.90-1.00)" (12).

Power analysis was performed by post-hoc analysis with the "G-Power software", since the study was conducted retrospectively. Based on 0,61 coefficient of determination of between PPT of masseter and trapezious muscles with a sample size 20, the power of this study was calculated as 0.99 with an effect size of 0.78 (6).

RESULTS

Characteristics of participants are shown in **Table 1**.

Table 1. Characteristics of participants

Age, year, mean (SD)	32.15 (12.39)
Height, centimeter, mean (SD)	162.1 (5.45)
Weight, kilogram, mean (SD)	63.2 (13.19)
Affected size (%)	
Rigth	40 %
Left	35 %
Both	25 %

SD, standart deviation; %, percentage

Positive and significant correlation were found between PPT values of right anterior temporalis with right upper trapezious (p=0.012; r:0.551) and left upper trapezious (p=0.015; r:0.533); between PPT values of righ masseter with left upper trapezious (p=0.005; r:0.599) and left SCM (p=0.041; r:461); between PPT values of left masseter with left upper trapezious (p=0.002; r:0.645). However, there was no significant correlation between right anterior temporalis with other muscles (p>0.05). The magnitude of the effect was low to moderate for all comparison (r: 0.461-0.645) **(Table 2)**.

Table 2. Correlation between PPT of masticatory and neck muscles

Side		**Right**		**Left**	
	Muscle	**Upper trapezius**	**SCM**	**Upper trapezius**	**SCM**
Right	**Anterior temporalis**	**r: 0.551** **p: 0.012***	r: 0.010 p: 0.966	**r: 0.533** **p: 0.015***	r: 0.052 p: 0.827
	Masseter	r: 0.323 p: 0.164	r: 0.441 p:0.052	**r: 0.599** **p: 0.005***	**r: 0.461** **p: 0.041***
Left	**Anterior temporalis**	r: 0.348 p: 0.133	r: 0.212 p: 0.370	r: 0.309 p: 0.184	r: 0.160 p:0.499
	Masseter	r: 0.433 p: 0.057	r: 0.421 p: 0.065	**r: 0.645** **p: 0.002***	r: 0.413 p: 0.070

SCM, sternocleidomastoideus
r: Pearson correlation coefficient
*p<0.05

DISCUSSION

This retrospective cross-sectional study aimed to contribute to the gap in the literature by investigating the relationship between PPT of masticatory (anterior temporalis and masseter) and neck muscles (upper trapezius and SCM) in women with TMD and to provide new perspectives on TMD-related clinical evaluation and treatment practices. The results demonstrated that there was a statistically significant correlation between masticatory and neck muscles at low and moderate levels in women.

In his study, Darnell (1983) suggested for the first time that the activity of the masticatory muscles was related to trunk muscles (13). In support of this study, another studies in the literature indicate that the mandibular muscles are connected to the neck and trunk muscles (14,15). Sforza et al. (2011) mentioned in their study that the neck muscles most associated with the craniomandibular system are the trapezius and SCM (16). Considering these studies, we decided to include trapezius and SCM as neck muscles in our study in which we

aimed to determine the relationship between masticatory and neck muscles in women with TMD.

Silveria et al. (2015) investigated the relationship between mandible and neck disability and the PPT of the masticatory muscles and neck muscles measured with an algometer in patients with TMD and healthy controls. They reported that high levels of TMD are due to high sensitivity in the temporalis and upper trapezious muscles (7). In parallel with this study, in our study, a positive moderate level of relationship was found between the PPT that is, muscle sensitivity, of right temporalis muscle between both the right and left trapezius muscles.

Lee et al. (2021), investigated whether there was any relationship between masticatory and neck muscles in terms of muscle thickness and function in individuals with and without TMD, and reported that there was a significant and positive correlation between the thickness of the SCM and masseter muscles, that is, the increase in muscle tone, in individuals with TMD (17). Similarly, in our study, a positive low level of relationship was found between the right masseter and the left SCM muscles. In addition, in our study, a moderate relationship was found between the right and left masseter muscles and the left trapezius muscle.

Alam et al (2023). examined the relationship between PPT of masticatory muscles and neck muscles in individuals with neck disability and reported that there was a moderate and high level of relationship between the masseter, anterior temporalis, upper trapezius and SCM muscles (18). In our study, in which we included women with TMD, unlike this study, the muscles were evaluated separately, right and left, and although there was a general relationship between PPT of masticatory and neck muscles, no relationship was found between some parameters. We think that this is due to differences in the TMD involvement side and the fact that they were not initially evaluated in terms of neck disability. We think that this is due to differences in the side of TMD involvement and the fact that the participants were not evaluated in terms of TMD duration or severity, and existing neck disability at the beginning.

The most powerful aspect of our study is that it will fill the gap in the literature on this subject by examining the controversial relationship between masticatory and neck muscles only in the female gender, where TMD is more common. This study has some limitations. One of our limitations is that our study was planned retrospectively. In addition, our other limitations are that the affected sides of the patients are not in similar proportions and our sample number is small. In addition, adding a control group consisting of healthy individuals to our study could have provided a more reliable representation of the relationship between regions. All these limitations affect the generalization of the results we found. For this reason, there is a need further studies in which the relationship between masticatory muscles and neck muscles is

investigated with a larger sample group, compared with healthy controls and women with neck disabilities, and the relationships between TMJ and other regions are investigated, taking into account myofascial pathways.

In conclusion, the positive relationship between the PPT of the masticatory and neck muscles in women with TMD in our study emphasizes the necessity of evaluating the neck muscles in terms of muscle sensitivity or trigger point during the clinical examination of individuals with TMD and applying physiotherapy interventions such as exercise, manual therapy or electrotherapy agents covering the neck area in the treatment of TMD.

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Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: Halic University Institutional Review Board (2023/234)

Author contribution: Sahin Altac D: collected the data, analysed the data and wrote the manuscript; Kaya Mutlu E: design the study, analysed the data and wrote the manuscript; Sakar O: design the study, provide facilities and equipments, wrote the manuscript; Taskiran H: design the study, provide facilities and equipments, wrote the manuscript.

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