

# Evaluation of Diagnostic Efficiency of Ultrasonography in Temporomandibular Joint Disorders: A Pilot Study

## Temporomandibular Eklem Bozukluklarında Ultrasonografinin Diagnostik Etkinliğinin Değerlendirilmesi: Bir Pilot Çalışma

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### Abstract

**Objective:** Temporomandibular Joint diseases (TMD) and disorders refer to a complex of conditions, manifested by pain in jaw area and associated muscles and limitations in the ability to make the normal movements of speech, facial expression, eating, chewing, and swallowing. Ultrasonography (US) is a non-invasive, cost-effective, easy-to-use imaging method using sound waves, without ionizing radiation and as a diagnostic procedure it has been shown to be accurate for the diagnosis of TMD. The purpose of this pilot study is to evaluate the diagnostic efficacy of ultrasonography imaging in temporomandibular joint disorders.

**Material and Method:** The retrospective ultrasonography images of 20 patients (female, male) who had been referred to Marmara University, Faculty of Dentistry, Oral Diagnosis and Radiology Clinic with a complaint related to Temporomandibular joint (TMJ) were evaluated in terms of condylar surface irregularities, joint space reduction and joint effusion.

**Results:** A total of 20 patients (% 70 female, %30 male, mean age: 33,75) and 40 TMJ were evaluated and in % 15 erosive – degenerative changes, in % 82,5 condylar surface flattening and in % 27,5 increased joint capsule width was observed.

**Conclusion:** Ultrasonography is a non-invasive technique suitable for visualization of TMJ and evaluation of TMD in routine clinical practice.

**Keywords:** Temporomandibular Joint Disorders, Ultrasound, Radiology

### Öz

**Amaç:** Temporomandibular eklem hastalıkları (TMD) ve rahatsızlıkları, çene bölgesinde ve ilgili kaslarda ağrı ile ortaya çıkan ve normal konuşma, yüz ifadesi, yeme, çiğneme ve yutma hareketlerini kısıtlayabilen durumları ifade eder. Ultrasonografi (US), invazif olmayan, düşük maliyetli, kullanımı kolay ve iyonlaştırıcı radyasyon olmaksızın ses dalgalarının kullanıldığı, bununla birlikte; diagnostik prosedür olarak TMD teşhisi için doğruluğu kanıtlanmış bir görüntüleme yöntemidir. Bu pilot çalışmanın amacı, temporomandibular eklem hastalıklarında ultrasonografik görüntülemenin tanısal etkinliğinin değerlendirmektir.

**Gereç ve Yöntem:** Temporomandibular eklem (TME) ile ilgili şikayetleri bulunan, Marmara Üniversitesi Diş Hekimliği Fakültesi Oral Diağnoz ve Radyoloji Kliniğine başvuran 20 hastanın (kadın, erkek) retrospektif ultrasonografi görüntüleri kondiler yüzey düzensizlikleri, eklem boşluğunda daralma ve efüzyon açısından değerlendirilmiştir.

**Bulgular:** Toplam 20 hasta (% 70 kadın, % 30 erkek, yaş ortalaması :33,75) ve 40 TME değerlendirilmiş ve % 15 eroziv – dejeneratif değişiklik, % 82,5 kondiler yüzeyde düzleşme ve % 27 oranlarında artan eklem kapsülü genişliği gözlenmiştir.

**Sonuç:** Ultrasonografi, TME' nin görüntülenmesi ve rutin klinik uygulamada TMD'nin değerlendirilebilmesi için uygun ve invaziv olmayan bir tekniktir.

**Anahtar Kelimeler:** Temporomandibular Eklem Bozuklukları, Ultrason, Radyoloji

### Introduction

The chewing system in individuals is the unit responsible for the speech, chewing and swallowing of the body. This system consists of joints, ligaments, bones, teeth and supporting tissues and muscles. Furthermore, the coordination of these structural components is provided by neurological control systems (1).

Temporomandibular joint (TMJ) is composed of mandibular condyle, temporal bone, articular disc, ligaments

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and various muscles. It is a ginglymodiartrodial joint with a sliding axis, which is located below the temporal bone between the mandibular fossa and the mandibular condyle, in front of the external auditory canal (1-4). In this system, a biconcave-shaped dense fibrous connective tissue arises in the articulating disc (1, 4,5) in order to ensure the conformity of the articular surfaces between the mandibular mandible of the condyle head and the mandibular fossa at the temporal bone. Metabolic needs of the tissues are provided through synovial fluid containing mucopolysaccharide which makes the joint surfaces lubricious in the joint system. Since articular surfaces and discs do not contain blood vessels, the metabolic needs of the tissues are provided by synovial fluid that surrounds the joint surface and at the same time lubricates the joint surfaces (3,4,6,7).

Temporomandibular joint dysfunctions (TMD) are manifested by limitations of normal jaw movements, speech, facial expressions, eating, drinking and swallowing functions and pain in the jaws which affect chewing muscles (8-12). According to the World Health Organization (WHO) report, temporomandibular dysfunction is one of the most common diseases in the mouth and jaw region (13). According to the Diagnostic Criteria for Temporomandibular Joint Disorders (CDC / TMD) scale, the most important symptoms of Temporomandibular dysfunction (TMD) are noise (click, creep) and reduction (14-16).

Among the TMJ dysfunctions, the deviations are the most frequently seen (17-19). Patients with TMJ disorders often complain of tenderness, pain, difficulty in opening the mouth, and tenderness in the TMJ region and these complaints are the reasons for referral to patients' clinics. In the diagnosis of TMD, history and clinical examination results should be correlated with radiological findings (4).

Different imaging modalities are used in examining the anatomical structures of TMJ complex. Prevention of exposing the patient to unnecessary radiation dose is important in selecting the imaging method (4,11,20-22). Computerized tomography (CT), magnetic resonance imaging (MRI) and arthrography are the most commonly used methods of imaging TMJ, and MRI is accepted as the gold standard in the literature (23-26). However, despite its advantage in imaging, features such as an expensive imaging technique, the inability to use in cardiopulmonary patients and heart pacemakers limit the use of MRI (27).

Ultrasonography (US) is a noninvasive, low cost, easy to use imaging method which transmits high-frequency sound waves to the tissue through a probe (transducer). In this

technique, sound waves reflected from textures of varying intensities are subsequently displayed on a screen (11, 28-31). In US, a much higher (2-10 MHz) frequency of sound waves are used (11,28,32,33). Ultrasonography can be used to diagnose disc displacements, effusion, intra-articular defects in TMJ (32,33). In ultrasonographic images of the TMJ, the hyperechoic areas are the white areas representing the margins of the bone and joint capsule, the hypoechoic areas are the black areas representing the bone tissue, empty space, and water, and the isoechoic or grey areas represent the connective tissue and muscular tissue (34,35). When TMJ is displayed, information about joint space, joint disc position, joint fluid and ligament adhesions can be obtained using a linear probe with a frequency of 7.5-12 MHz (28).

Imaging of TMJ and articular disc was first performed by Nebeith and Speculand (36) in 1991 using a 3.5 MHz probe. Stefanoff et al. (37) have shown successful results in asymptomatic patients using a 5 MHz probe. Based on the TMD studies in literature between 1991 and 2006, Melis et al. (20) reported that US has a sensitivity of 13-100% in disc displacement, 70.6-83.9% in effusion, and 70-94% in condylar erosion. These studies portrayed the diagnostic reliability of ultrasonography in the diagnosis of TMJ disorders. Therefore, the aim of this study is to evaluate the diagnostic efficacy of ultrasonography imaging in temporomandibular joint dysfunctions.

## Materials and Method

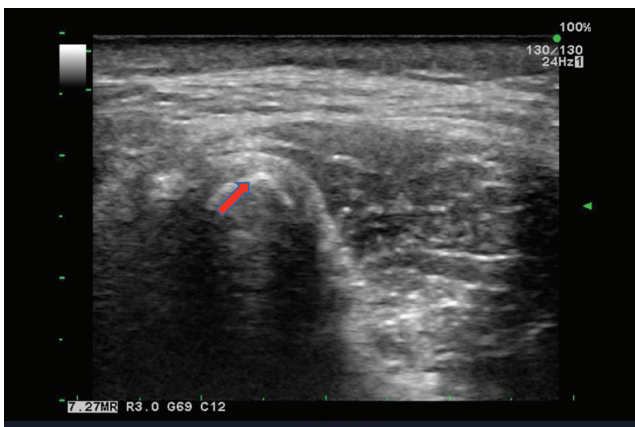
The study evaluated 20 patients and 40 joints with a mean age of 33.7 years who are over 15 years of age, with complaints of TMD and records of USG images. 20 patients over 15 years old from the archive in Oral and Maxillofacial Radiology Department, who had complaints of TME, who did not use any medication for bone diseases and who don't have any developmental anomalies were included in the study. Confirmation for the study was acquired from the Department of Non-invasive Clinical Research Ethics Committee, Marmara University Faculty of Medicine (Protocol No: 092016501). The written informed consent was acquired from each subject to inform about the study's object and procedure. This study was carried out to the recommendations of the Helsinki declaration.

Examinations were performed by using an Aloka Prosound  $\alpha 6$  equipped with a 8 MHz-wide bandwidth linear active matrix transducer ranging from 1 to 15 MHz. Transcutaneous B mode images of the right and left TMJs

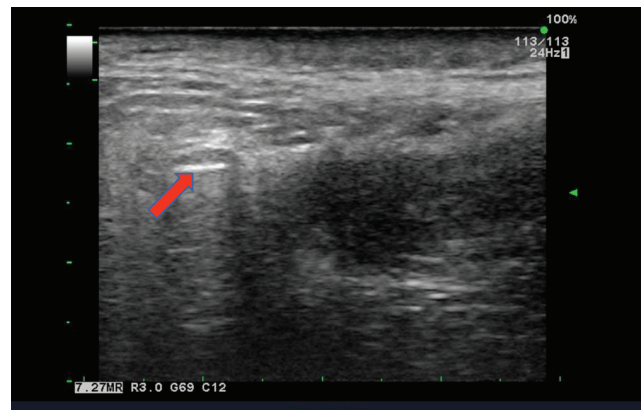
were obtained with the patient in the supine position. The patient was asked to open and close their mouth and, on palpation of the pre-auricular region, an arbitrary position of the head of the condyle and TMJ was obtained (Figure 1). Once this position was achieved, a linear transducer was placed in a transverse direction in close contact with the skin. The transducer was then tilted obliquely until an optimal visualization of the head of the condyle was visible on the screen. The TMJ was assessed for the following parameters: destructive changes including condylar erosions, synovial width alterations and effusions (Figure 2-4).



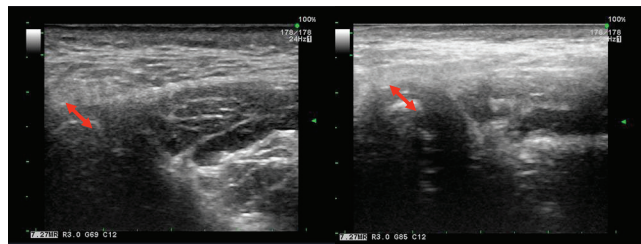
**Figure 1.** After obtaining position of the joint by palpation of the pre-auricular region, the transducer is placed in close contact with the skin with the mouth closed.



**Figure 2.** Joint surface irregularity. The surface of the condylar head appears hyperechoic and an irregularity can be appreciated on the margin.



**Figure 3.** Flattening of the condylar surface



**Figure 4.** Increase in width of the approximating surfaces. This could be an indication of synovial width alterations.

## Results

Ultrasonography was performed on all 40 TMJs. The examinations revealed that in % 15 erosive – degenerative changes, in % 82,5 condylar surface flattening and in % 27,5 increased joint capsule width was observed. The results of the ultrasonography examinations of the TMJs are summarized in Table 1.

**Table 1.** Distribution of Temporomandibular Joint Disorders

		Right	Left
		n (%)	n (%)
condylar surface irregularities increase in joint space width	<i>erosive – degenerative changes</i>	4 (20%)	2 (10%)
	<i>condylar surface flattening</i>	14 (70%)	19 (95%)
		4 (20%)	13 (65%)

## Discussion

Temporomandibular joint (TMJ); consists of the mandibular condyle which is separated from the mandibular fossa by an articular disc, ligaments, and muscles (3). TMJ disorders are



recognized as one of the most common causes of orofacial pain and TMDs affect around 8–12 % of the population (27,34, 38). In clinical practice, CT and MRI can help in the confirmatory diagnosis of hard-tissue and soft-tissue alterations in the TMJ, respectively, an effective screening modality is still lacking. Pathologies affecting the head and neck region, which includes the salivary glands, lymphatics, thyroid, nerves, and vascular structures, are accessible to ultrasound imaging and have been routinely imaged using ultrasonography (27, 39). However, reports on its use in the detection of TMDs in routine clinical practice are limited (5,14,16,25,27). Magnetic resonance imaging (MRI) has been reported as the most precise method for visualizing the disc-condyle relationship (16). The accuracy of MRI is about 95% when sagittal and coronal scans are evaluated (14). With the advantages of being noninvasive and less expensive than other methods, US has been used as a new method for diagnosing TMJ disc displacement (14, 27,31).

The aim of this study was to evaluate the diagnostic efficacy of ultrasonography imaging in temporomandibular joint disorders. Emshoff et al.(40), conducted a study on 29 patients who were aged between 19 to 62 years. Accuracy was found to be 91% in closed mouth position and it was 93% in open mouth position. Another study was conducted by Emshoff et al. (41), on 208 patients who were aged 13 to 78 years. The sensitivity, specificity and diagnostic accuracy were 80-68% both in closed mouth-open mouth, 87-93% (closed mouth-open mouth) and 82-82% (closed mouth – open mouth), which were lesser than those which were reported in a previous study. In the present study a total of 20 patients (% 70 female, %30 male, mean age: 33,75) and 40 TMJ were evaluated in closed mouth position and in % 15 erosive – degenerative changes, in % 82,5 condylar surface flattening and in % 27,5 increased joint capsule width was observed.

Byahatti et al. (42), conducted a study on 100 patients with a 12 MHz transducer using dynamic ultrasonography. Sensitivity in closed mouth position was found to be 80%, while in the open mouth position, it was found to be 76%. Except for study of Byahatti et al. (42), in all the other studies, US diagnosis was compared to MRI diagnosis, as it has been so far described as the gold standard and the most reliable method in diagnosis of TMJ disorders (11, 14,20,40,41).

Bonafe et al. (43) found the estimated sensitivity to be 22.5% in closed mouth position, which was lower than that was seen in previous studies. The specificity in closed mouth

position was 96.6%. In 2001, Jank et al. (44) introduced the use of a high resolution transducer of 12 MHz to visualize the TMJ structures more accurate. The authors reported the disc as a hypoechoic structure in the glenoid fossa surrounded by a hyperechoic rim. Their results, comparing ultrasonography with diagnoses based on MRI, achieved a sensitivity, specificity and accuracy at closed-mouth position of 78%, and a sensitivity, specificity and accuracy of 61%, 88% and 77%, respectively, at maximum-mouth opening position.

When MRI was taken as the gold standard, TMJ disorders in a majority of studies ranged from 41%-90% in disc displacement (11,14,20,27,40,41). In case of TMJ effusion and condylar effusion, sensitivities ranged from 20-80% and 83% respectively (11,27,40-42). In the available literature, it was found that ultrasonography was an acceptable diagnostic tool for detection of disc displacement, condylar erosion and articular effusion.

## Conclusion

The present study has several limitations because of the small sample size and lack of High Resonance Ultrasonography (HR-US) usage and MRI correlations with the ultrasonographic findings. Since our study sample is small we could not evaluate the sensitivity and specificity in our study. Moreover, it can be concluded that, US with the added benefit of reduced cost, remains another effective, noninvasive technique, to define the disk, its position, and the presence of TMJ internal derangements. Future studies with larger sample sizes and MRI correlations need to be conducted.

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