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Evaluation of the Effect of Mask Use on Temporomandibular Joint Dysfunction During the Covid-19 Pandemic: A Cross-Sectional Study

Covid-19 Pandemisi Sürecinde Maske Kullanımının Temporomandibular Eklem Disfonksiyonu Üzerine Etkisinin Değerlendirilmesi: Kesitsel Bir Çalışma

Gülçin KILCI[1], Gönül DİNÇ[2], Saadet ÇINARSOY CİĞERİM[2], Semih TANRIVERDİ[3]

[1]*Aydın Ağız ve Diş Sağlığı Merkezi, Türkiye*
[2]*Van Yüzüncü Yıl Üniversitesi, Diş Hekimliği Fakültesi, Ortodonti AD, Türkiye*
[3]*Aydın Adnan Menderes Üniversitesi, Diş Hekimliği Fakültesi, Ağız, Diş ve Çene Radyolojisi AD, Türkiye*

ÖZET: Bu çalışmanın amacı Covid-19 pandemisi sürecinde maske kullanımının temporomandibular eklem disfonksiyonu üzerine etkisinin değerlendirilmesidir. Çalışma 2020-2022 yılları arasında radyoloji ve ortodonti kliniğine başvuran diğer tedavileri için panoramik filmi çekilen 500 yetişkin hasta üzerinde yapıldı. Hastaların kullandıkları maskenin türü ve kullanım süresi ile maske kullanırken nefes almakta zorlanma, farkında olmadan ağzı açık tutma, diş sıkma, alt çeneyi öne getirme, eklem ve kulak ağrısı gibi durumlarının varlığı hazırlanan anketler yardımıyla sorgulandı. Klinik ve radyografik temporomandibular eklem muayenesi yapıldı. N95 vb. maskeleri kullanan katılımcılarda maske takılıyken dişlerini sıkanların, çene ekleminde ve kulaklarında ağrı hissedenlerinin oranları; bu maskeyi takmayanlara göre anlamlı düzeyde daha yüksek bulundu ($p<0.05$). Günlük ortalama maske kullanım süresi 5-8 saat olan katılımcılarda maske takarken nefes zorluğu çekenlerin oranı diğerlerine göre anlamlı düzeyde daha yüksekti ($p<0.05$). Maske takarken nadiren de olsa dişlerini sıkan ve farkında olmadan alt çenesini öne getirenlerin eklem muayenesinde veya radyografik muayenesinde patolojik bir bulguya rastlananların oranı, ilgili sorunları hiç yaşamayanlara göre anlamlı düzeyde daha yüksek bulundu ($p<0.05$). Maske takarken dişlerini sıkan, farkında olamadan alt çenesini öne getiren, çene ekleminde ağrı hisseden katılımcılarda ve uzun süre maske kullananlarda eklem muayenesinde veya radyografik incelemede patolojik bir bulguya rastlanma oranı yüksek bulundu. Bu konuda daha ileri çalışmalara ihtiyaç olduğu görüldü.

Anahtar Kelimeler: COVID-19, maske, temporomandibular eklem

ABSTRACT: The aim of this study is to evaluate the effect of mask use on temporomandibular joint dysfunction during the Covid-19 pandemic. The study was conducted on 500 adult patients who applied to the radiology and orthodontics clinic between 2020-2022 and had panoramic films taken for their other treatments. The type of mask used by the patients and the duration of use, as well as the presence of conditions such as difficulty breathing while using the mask, keeping the mouth open without realizing it, clenching the teeth, bringing the lower jaw forward, joint pain and earache, were questioned with the help of prepared questionnaires. Clinical and radiographic temporomandibular joint examination was performed. Among the participants who wore N95 and similar masks, the rates of those who clenched their teeth while wearing the mask and felt pain in the jaw joint and ears were significantly higher than those who did not wear this mask ($p<0.05$). The rate of those who had difficulty breathing while wearing a mask was significantly higher in participants whose average daily mask use time was 5-8 hours compared to others ($p<0.05$). Participants who clenched their teeth while wearing a mask, unconsciously brought their lower jaw forward, felt pain in the jaw joint, and those who wore masks for a long time were more likely to have a pathological finding in joint examination or radiographic examination. Further studies are needed in this regard.

Keywords: COVID-19, mask, temporomandibular joint.

Sorumlu Yazar: Uzm. Dt. Gülçin Kılcı, e mail: dentstgulcin@gmail.com

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INTRODUCTION

The SARS-CoV-2 virus is the causative agent of the globally widespread COVID-19 disease. SARS-CoV-2 is a highly contagious virus that can cause disease through close contact with infected people or through droplets from coughing, sneezing and breathing. COVID-19 manifests in individuals as acute respiratory illness and pneumonia. The disease is asymptomatic in some cases (1). To prevent the spread of the virus, it is necessary to pay attention to hygiene rules and widen social distancing. Countries take preventive measures, such as wearing masks, to combat the widespread coronavirus disease (2019) (COVID-19). Today, medical masks are widely used to protect against infection (2, 3).

The temporomandibular joint (TMJ) is of great importance in the realization of mastication, speech and swallowing functions (1). The morphologic structure of the TMJ varies between individuals in society. Situated between the mandibular fossa and the mandibular condyle, this diarthrodial joint can be found in front of the external auditory canal (2). The articular disc, which is one of the structural elements of the TMJ, consists of three parts with different thicknesses: anterior, central and posterior. There are no blood vessels and nerves in its structure. The articular disc divides the joint cavity into two parts as upper and lower. While translation movement takes place in the upper joint space, the lower joint space plays a role in rotation movement (3). Both joint cavities are filled with fluid. The function of this fluid called synovial fluid is to lubricate the inner surface of the joint and to prevent deformation of the joint structures by creating minimum friction force during movements (4).

Pain around the TMJ originates from the masticatory muscles, head and neck musculoskeletal structures associated with the joint area (5). Disorders related to the TMJ region are more commonly observed in individuals between the ages of 20 and 50 (6). With aging, the incidence of changes in the bony structures of the joint, articular disc displacement and difficulty in masticatory function increases (7). Along with biological and environmental factors, social, behavioural and cognitive determinants are involved in the aetiology of TMJ disorders (6). In addition, studies have reported that malocclusion, parafunctional habits, stress and trauma may also be factors in the formation of TMJ disorders (8, 9). In the presence of TMJ-related pathologies, patients most commonly present to healthcare institutions with headache, earache, tinnitus, dizziness, limited or asymmetric jaw movement and joint sounds (10).

Temporomandibular joint complaints increase in patients with parafunctional movements of the jaw. Our main hypothesis is to investigate how the widespread mask-wearing during COVID-19 and the increase the length of time an individual wears masks cause a change in parafunctional movements. The aim of this study is to investigate the effects of prolonged mask use on the complaints seen in the temporomandibular joint region in adults.

MATERIAL AND METHODS

Following the planning of the study, for making this investigation purely ethical, the Clinical Research Ethics Committee has given

Sorumlu Yazar: Uzm. Dt. Gülçin Kılcı, e mail: dentstgulcin@gmail.com

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consent for ethics committee approval. (Decision no: 2020/07-24). It has been ensured the compliancy of the principles of the Declaration of Helsinki, and obtaining consent from each individual included in the study. This study was carried out on 500 adult patients who applied to the radiology and orthodontic clinics of Aydın Adnan Menderes University Faculty of Dentistry and Van Yüzüncü Yıl University Faculty of Dentistry hospitals between 2020 and 2022 for various reasons and had panoramic films taken for other treatments. Individuals aged 18 years and older without any history of previous surgery in the maxillofacial region has been participated in the study. Patients whose panoramic radiographs had artifacts that made it difficult to evaluate the temporomandibular region and who had scans with poor image quality were excluded from the study.

The medical history information of the patients, the type of mask they used and duration of use, the presence of conditions such as difficulty in breathing while using the mask, keeping the mouth open without realizing it, clenching the teeth, bringing the lower jaw forward, joint and ear pain were questioned with the help of prepared questionnaires. Clinical and radiographic temporomandibular joint examination was performed. Patients were asked to answer the first 15 questions. The medical anamnesis section in the questionnaire form was filled by the relevant physician according to the information obtained from the patients. The last two questions of the questionnaires were completed by the physician according to the data obtained from the joint examination and examination of the panoramic radiographs of the patients. Patients who presented with symptoms of TMD between 2020 and 2022 were prospectively evaluated. So as to identify patients with TMD resulting solely by repetitive jaw movements associated with the mask usage, a questionnaire has been designed by evaluating various categories such as demographic data (age and gender), average duration of daily mask use, mask type and panoramic radiographic images.

RESULTS

The study included 500 adults, 62.2% (n=311) of whom were female, with the mean of age 35.51±15.67 years (median: 29 years, IQR: 22-46, range: 18-82). It was determined that 21.7% (n=107) of the participants were constantly taking medication, 7.2% (n=36) had any cardiovascular disease and 22.8% had Covid-19. Among the participants who had Covid-19, 35.4% (n=40) stated that the disease was mild and 31.0% (n=35) stated that it was moderate (Table 1). It was determined that 74.2% (n=371) of the participants used a three-layer surgical mask, 12.6% (n=63) used two masks on top of each other, and 94.0% (n=470) usually used the mask covering the nose. It was determined that 10.4% (n=52) of the participants felt that their jaw had become distorted since they started wearing masks, while 27.0% (n=135) felt that their ears had become prominent (Table 2). No pathologic findings were found in 64.4% (n=322) of the participants on joint examination and 73.4% on radiographic examination (Table 3). Among the participants using N95 and similar masks, the ratio of those who clenched their teeth while wearing the mask to those who felt pain in the jaw joint and ears was significantly higher than those who did not wear this mask ($p < 0.05$, Table 4). The proportion of participants who had breathing difficulties while wearing a mask was significantly higher in participants with an average daily mask wearing time of 5-8 hours compared to the others ($p < 0.05$). A statistically significant difference has been found between those with a mean daily mask wearing time of 0-4 hours and those with a mean daily mask wearing time of 5-8 hours in terms of keeping the mouth open while wearing a mask, clenching the teeth, dry mouth, feeling pain in the jaw joint and pain in the ears ($p < 0.05$).

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Table 1. Distribution of mask use by association with participants' clinical histories

Clinical history (n=500)	**n (%)**	**Mask use (n=500)**	**n (%)**
constantly taking medication	107 (21.7)	Mask type*	
cardiovascular disease	36 (7.2)	N95 etc.	58 (11.6)
diabetes	33 (6.6)	Three-layer surgical mask	371 (74.2)
bleeding problem	10 (2.0)	Washable cloth mask	29 (5.8)
infectious disease	3 (0.6)	Two masks on top of each other	63 (12.6)
allergy	28 (5.6)	Daily mask usage time	
respiratory disease	24 (4.8)	0-4 hours	282 (56.4)
parafunctional habits	27 (5.4)	5-8 hours	161 (32.2)
Covid-19 history	114 (22.8)	9-12 hours	39 (7.8)
Covid-19 severity (n=13)		more than 12 hours	18 (3.6)
asymptomatic	21 (18.6)	Position of the mask	
Mild	40 (35.4)	covering the nose	470 (94.0)
Moderate	35 (31.0)	under the nostrils	25 (5.0)
Severe	17 (15.0)	under the lip	2 (0.4)
		chin tip	3 (0.6)
		Frequency of paying attention to the use of masks	
		None	19 (3.8)
		Rarely	47 (9.4)
		Sometimes	49 (9.8)
		often	385 (77.0)

*The sum of the rates may exceed 100% due to the use of more than one type of mask.

Table 2. Distribution of the problems experienced by the participants while wearing a mask

While wearing a mask	**None n (%)***	**Rarely n (%)**	**Sometimes n (%)**	**Often n (%)**
Difficulty breathing	123 (24.6)	151 (30.2)	151 (30.2)	75 (15.0)
Keeping your mouth open	233 (46.6)	146 (29.2)	90 (18.0)	31 (6.2)
Bruxism	303 (60.6)	80 (16.0)	81 (16.2)	36 (7.2)
Bringing the lower jaw forward unintentionally	364 (72.8)	59 (11.8)	57 (11.4)	20 (4.0)
Dry mouth	180 (36.0)	153 (30.6)	111 (22.2)	56 (11.2)
Pain in the jaw joint	342 (68.4)	87 (17.4)	48 (9.6)	23 (4.6)
Earache	206 (41.2)	91 (18.2)	95 (19.0)	108 (21.6)

*Line percentage is given.

Table 3. Distribution of participants according to joint examination and radiographic examination results

Joint examination result*	**n (%)**
There is no pathological finding.	322 (64.4)
The presence of sound was detected in the joint when opening and closing the mouth.	74 (14.8)
The patient has difficulty opening the mouth or the mouth opening is limited.	18 (3.6)
The patient has hypertrophy or increased tone in the muscles.	106 (21.2)
Radiographic examination result*	**n (%)**
No pathological finding was observed.	367 (73.4)
Unilateral or bilateral degenerative changes (such as flattening/erosion) were observed in the condyle head.	55 (11.0)
Changes (increase or decrease) in unilateral or bilateral joint space were observed.	77 (15.4)
Changes in the location of the unilateral or bilateral condyle head were observed.	9 (1.8)

*More than one pathology was observed in some patients.

Sorumlu Yazar: Uzm. Dt. Gülçin Kılcı, e mail: dentstgulcin@gmail.com

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Table 4. Evaluation of the problems experienced by the participants while wearing masks according to the type of mask they use, the duration of using the mask and the care they show to use the mask.

	Difficulty breathing		**Bruxism**		**Pain in the jaw joint**	
	None	**Rarely/ Sometimes/ Often**	**None**	**Rarely/ Sometimes/ Often**	**None**	**Rarely/ Sometimes/ Often**
	n (%)*	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
N95 etc.						
no	114 (25.8)	328 (74.2)	276 (62.4)	166 (37.6)	314 (71.0)	128 (29.0)
yes	9 (15.5)	49 (84.5)	27 (46.6)	31 (53.4)	28 (48.3)	30 (51.7)
p-value	0.088		**0.020**		**<0.001**	
Three-layer surgical mask						
no	29 (22.5)	100 (77.5)	71 (55.0)	58 (45.0)	82 (63.6)	47 (36.4)
yes	94 (25.3)	277 (74.7)	232 (62.5)	139 (37.5)	260 (70.1)	111 (29.9)
p-value	0.516		0.133		0.170	
Washable cloth mask						
no	115 (24.4)	356 (75.6)	279 (59.2)	192 (40.8)	320 (67.9)	151 (32.1)
yes	8 (27.6)	21 (72.4)	24 (82.8)	5 (17.2)	22 (75.9)	7 (24.1)
p-value	0.700		**0.020**		0.373	
Two masks on top of each other						
yes	108 (24.7)	329 (75.3)	273 (62.5)	164 (37.5)	301 (68.9)	136 (31.1)
no	15 (23.8)	48 (76.2)	30 (47.6)	33 (52.4)	41 (65.1)	22 (34.9)
p-value	0.876		**0.024**		0.544	
Daily mask usage time						
0-4 hours	76 (27.0)	206 (73.0)	193 (68.4)	89 (31.6)[2]	215 (76.2)	67 (23.8)[5]
5-8 hours	24 (14.9)	**137 (85.1)**	74 (46.0)	87 (54.0)[2]	84 (52.2)	77 (47.8)[5]
9-12 hours	14 (35.9)	25 (64.1)	22 (56.4)	17 (43.6)	29 (74.4)	10 (25.6)
more than 12 hours	9 (50.0)	9 (50.0)	14 (77.8)	4 (22.2)	14 (77.8)	4 (22.2)
p-value	**<0.001**		**<0.001**		**<0.001**	
Frequency of paying attention to the use of masks						
None	3 (15.8)	16 (84.2)	12 (63.2)	7 (36.8)	10 (52.6)	9 (47.4)
Rarely	9 (19.1)	38 (80.9)	35 (74.5)	12 (25.5)	36 (76.6)	11 (23.4)
Sometimes	7 (14.3)	42 (85.7)	25 (51.0)	24 (49.0)	34 (69.4)	15 (30.6)
often	104 (27.0)	281 (73.0)	231 (60.0)	154 (40.0)	262 (68.1)	123 (31.9)
p-value	0.151		0.123		0.297	

*Line percentage is given.

The dark colored ratios are significantly different from the other ratios in the related column ($p<0.05$).
[1-8]There is a statistically significant difference between the ratios shown with the same number ($p<0.05$)

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Table 5. Evaluation of the examination results according to the type of mask used by the participants, the duration of using the mask and the care they show to use the mask.

	Pathological finding on joint examination		**Pathological finding on radiographic examination**	
	Yes	**No**	**Yes**	**No**
	n (%)*	**n (%)**	**n (%)**	**n (%)**
N95 etc.				
no	153 (34.6)	289 (65.4)	116 (26.2)	326 (73.8)
yes	25 (43.1)	33 (56.9)	17 (29.3)	41 (70.7)
p-value		0.204		0.619
three-layer surgical mask				
no	46 (35.7)	83 (64.3)	39 (30.2)	90 (69.8)
yes	132 (35.6)	239 (64.4)	94 (25.3)	277 (74.7)
p-value		0.987		0.278
Washable cloth mask				
no	170 (36.1)	301 (63.9)	123 (26.1)	348 (73.9)
yes	8 (27.6)	21 (72.4)	10 (34.5)	19 (65.5)
p-value		0.353		0.322
Two masks on top of each other				
yes	153 (35.0)	284 (65.0)	113 (25.9)	324 (74.1)
no	25 (39.7)	38 (60.3)	20 (31.7)	43 (68.3)
p-value		0.469		0.323
Daily mask usage time				
0-4 hours	91 (32.3)	191 (67.7)	72 (25.5)	210 (74.5)
5-8 hours	68 (42.2)	93 (57.8)	44 (27.3)	117 (72.7)
9-12 hours	13 (33.3)	26 (66.7)	12 (30.8)	27 (69.2)
more than 12 hours	6 (33.3)	12 (66.7)	5 (27.8)	13 (72.2)
p-value		0.205		0.880
Frequency of paying attention to the use of masks				
None	2 (10.5)	17 (89.5)	2 (10.5)	17 (89.5)
Rarely	11 (23.4)	36 (76.6)	8 (17.0)	39 (83.0)
Sometimes	17 (34.7)	32 (65.3)	9 (18.4)	40 (81.6)
often	148 (38.4)	237 (61.6)	114 (29.6)	271 (70.4)
p-value		**0.022**[§]		**0.042**[§]

*Line percentage is given.

[§] When the categories in the rows were compared in pairs, no significant difference was observed between the rates.

Sorumlu Yazar: Uzm. Dt. Gülçin Kılcı, e mail: dentstgulcin@gmail.com

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Table 6. Evaluation of the examination results of the participants according to the problems they experienced while wearing a mask

	Pathological finding on joint examination		**Pathological finding on radiographic examination**	
	Yes	**No**	**Yes**	**No**
	n (%)*	**n (%)**	**n (%)**	**n (%)**
Difficulty breathing				
None	37 (30.1)	86 (69.9)	36 (29.3)	87 (70.7)
Sometimes/Rarely/Often	141 (37.4)	236 (62.6)	97 (25.7)	280 (74.3)
p-value	0.114		0.441	
Keeping your mouth open				
None	77 (33.0)	156 (67.0)	58 (24.9)	175 (75.1)
Sometimes/Rarely/Often	101 (37.8)	166 (62.2)	75 (28.1)	192 (71.9)
p-value	0.265		0.420	
Bruxism				
None	85 (28.1)	218 (71.9)	66 (21.8)	237 (78.2)
Sometimes/Rarely/Often	93 (47.2)	104 (52.8)	67 (34.0)	130 (66.0)
p-value	**<0.001**		**0.002**	
Bringing the lower jaw forward unintentionally				
None	111 (30.5)	253 (69.5)	84 (23.1)	280 (76.9)
Sometimes/Rarely/Often	67 (49.3)	69 (50.7)	49 (36.0)	87 (64.0)
p-value	**<0.001**		**0.004**	
Dry mouth				
None	55 (30.6)	125 (69.4)	45 (25.0)	135 (75.0)
Sometimes/Rarely/Often	123 (38.4)	197 (61.6)	88 (27.5)	232 (72.5)
p-value	0.077		0.544	
Pain in the jaw joint				
None	95 (27.8)	247 (72.2)	72 (21.1)	270 (78.9)
Sometimes/Rarely/Often	83 (52.5)	75 (47.5)	61 (38.6)	97 (61.4)
p-value	**<0.001**		**<0.001**	
Earache				
None	61 (29.6)	145 (70.4)	47 (22.8)	159 (77.2)
Sometimes/Rarely/Often	117 (39.8)	177 (60.2)	86 (29.3)	208 (70.7)
p-value	**0.019**		0.109	
Jaw disorder				
No	147 (32.8)	301 (67.2)	110 (24.6)	338 (75.4)
Yes	31 (59.6)	21 (40.4)	23 (44.2)	29 (55.8)
p-value	**<0.001**		**0.002**	
İncrease in ear curl				
No	123 (33.7)	242 (66.3)	90 (24.7)	275 (75.3)
Yes	55 (40.7)	80 (59.3)	43 (31.9)	92 (68.1)
p-value	0.144		0.106	

*Line percentage is given.

Sorumlu Yazar: Uzm. Dt. Gülçin Kılcı, e mail: dentstgulcin@gmail.com

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It was determined that the results of joint examination or radiographic examination did not differ according to the type of mask used, average daily duration of mask wearing, and the care participants showed while using the mask ($p > 0.05$, Table 5). The proportion of participants who clenched their teeth while wearing a mask, albeit rarely, brought their lower jaw forward without realizing it, and felt pain in the jaw joint was significantly higher in participants who had a pathological finding in joint examination or radiographic examination compared to those who never experienced related problems ($p < 0.05$, Table 6). Similarly, the proportion of participants who had pathologic findings in the relevant examinations was significantly higher in participants who thought that they had jaw joint disorders since they started wearing masks compared to other participants.

DISCUSSION

Being one of the body's joints, The Temporomandibular Joint (TMJ) plays an inevitable role in the functions of mastication, swallowing and speech (11, 12). In addition, if a number of clinical problems affect the masticatory muscles and/or TMJ, it means the patient is suffering from Temporomandibular disorder. TMJ disorders have been shown to be the main cause of non-dental pain in the head and neck region (11, 13). In TMJ disorders, patients often present to the clinic with complaints such as tenderness, pain, noise and difficulty in opening the mouth. In the diagnosis of TMJ disorders, anamnesis and clinical examination results should be evaluated together with radiologic findings, and especially for the evaluation of radiologic findings, the anatomy of the TMJ should be well known.

Not with standing the poorly characterization of the aetiology and etiopathogenesis of TMDs, it is widely acknowledged that the main cause of TMD might be multifactorial, meaning this might include biomechanical, neuromuscular, bio-psychosocial and biological reasons as well as occlusal factors, parafunctional habits, trauma, stress, and heredity (14,15). If the patient is suffering from sleeping disorders or stress like physical, emotional or occlusal, these factors may exacerbate this disorder by exceeding the adaptive capacity of the stomatognathic system (16). Impacting approximately 5-12% of the population (even quadrupling the incidence among women). Furthermore, various symptoms of TMD, such as pain, decreased jaw movement and TMJ noises, are observed in the lives of many patients (more than half of the world's population) (17). Prolonged mask use during the COVID-19 pandemic has been reported to trigger or facilitate many health problems. Pushing jaws forward and downward repeatedly is a common treat of those who use mask in order to adjust the position of the mask properly on the face, which may lead to temporomandibular joint disorder (TMD). Therefore, this study aims to examine how effective repetitive jaw movements, opening and closing of the jaw, back and forth and left and right movements of the jaw during mask use are on TMD. It was thought that in a period of increased fear, anxiety and stress, such as the Covid-19 Pandemic, individuals may have an increase in joint problems, and the addition of the use of a mask may increase this possibility. This study was planned to investigate whether the mask has any effect on the joint.

Various evaluation methods can be used in TMJ imaging. Some panoramic radiography devices have special TMJ imaging programs. These radiographs, in which both joints can be observed on a single image with the mouth open and closed position, are called open-closed TMJ radiographs or lateral panoramic radiographs. Imaging method has to be determined basing upon some of certain criteria that can be chosen via analysing radiation dose, contribution to diagnosis and treatment plan, easy applicability and cost

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together in the diagnosis of TMJ disorders, planning how the treatment process will be carried out, and patient follow-up (15,17,18). For the reasons mentioned in this study, TMJ evaluation was performed on panoramic radiographs. Radiological images of patients whose panoramic x-rays were taken and who applied to the faculty for treatment were examined.

Pain, functional and psychosocial disorders associated with temporomandibular disorders affect the quality of life more negatively than other oral conditions (19). Although TMD is a very common public health problem, there are relatively few studies on this issue in Turkiye. The majority of existing studies focus on the treatment of TMD. In order to overcome TMD problems and achieve permanent success in treatments, the etiology, etiopathogenesis and risk factors of the disorder should be known very well (20). TMD is reported to mainly affect young adults or middle-aged people. Increased TMD in the young population is associated with psychological problems such as high mental pressure, anxiety, depression, insomnia and fatigue. Studies on TMJ patients have shown a higher prevalence in women in varying proportions. In the study by Ferrando et al. (21) the female-to-male ratio in TMJ patients was found to be 6:1. In this study, the relationship between age and gender and TMJ problems was not examined, but the general effect of mask use and its effect on joint problems were investigated, regardless of age and gender.

Jaw motion is a combination of forward and downward force vectors, and tension in the articular ligaments is essential for the sake of the stabilization of the TMJ (22). It enables TMJ's functional consistency. Besides, TMJ is shielded by the sphenomandibular ligament in case of excessive translational motions. Standard-size in masks may not fit in every patient's face owing to having wide variety of facial features, which creates a need for manoeuvre – like repetition in jaw movements rather than use hands for this due to hygiene concerns – in order to adjust a mask. In this case, the mask wearer pushes the limits of mandibular protrusion and rotation (23). Similarly, TMJ joint problems and pain due to prolonged mask use were also found, and it was determined that vertical and forward jaw movements were made during mask use.

The most common radiologic finding of TMD is internal irregularity resulting from the abnormal relationship between the TMJ disc and the condyle (24). In a study, abnormal morphologic features of the disc were examined in four groups: disc displacement in the mouth-closed position, disc displacement with/without reduction in the mouth-open position and osteoarthritic changes (24). In the early stages, the disc maintains its normal shape despite the stress, so this study was performed on patients who had been wearing a mask for at least 1.5 years. In this study, TMJ findings as a result of joint examination* were evaluated as follows: no pathologic findings, the presence of sound in the joint during mouth opening and closing, the patient has difficulty opening the mouth or mouth opening is limited, the patient has hypertrophy or increased muscle tone; radiographic examination showed no pathological findings, degenerative changes (such as flattening/erosion) were observed in the unilateral or bilateral condyle head, changes in the unilateral or bilateral joint space (decrease (Figure 1) or increase (Figure 2)) were observed, changes in the location of the unilateral or bilateral condyle head were observed.

Surprisingly, Maruyama et al. (25) reported that osteoarthritis was significantly higher in patients without an underlying risk factor, despite having TMD complaints in the last year. This may be attributed to prolonged mask use.

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Figure 1. Decreased joint space on panoramic radiography

Figure 2. Increased joint space on panoramic radiography

Bruxism is defined as repetitive jaw muscle activity characterized by clenching or grinding (26). Parafunctional habits such as bruxism have also been associated with an increased risk of developing TMD Temporomandibular joint disorders (27). When the habit of clenching or grinding is repeated, it may lead to tooth damage, TMD symptoms, headache, toothache and periodontal problems (28). It has been reported that increased anxiety and depression levels may increase the incidence of bruxism in patients (29). Some studies have found a positive relationship between parafunctional habits and TMD, while others have not (30). Michelotti et al. (31) reported a relationship between TMD and parafunctional habits. Çarikci et al. (32) stated that long-term mask use during the COVID-19 pandemic period may increase symptoms such as temporomandibular pain, head-neck, face, throat, ear and jaw pain, and teeth clenching by showing an effect similar to bruxism.

In their study examining the effect of mask use on TMD, Zuhour et al. (24) reported that correcting the position of a face mask with repetitive jaw movements and long-term mask use may increase TMD formation. They reported the importance of choosing the appropriate mask size according to the TMD risk and face shape of individuals wearing face masks. Çarikci et al. (32) investigated the effects of long-term mask use on temporomandibular pain, headache and fatigue during the COVID-19 pandemic period and examined head, neck, face, throat, ear and jaw pain, cheek tension, teeth clenching, acne, mask scarring, palpitations, voice and sleep disorders in 909 people. It has been reported that prolonged mask use causes many symptoms such as headache, jaw pain, fatigue, and that increased mask wearing time might trigger all these symptoms. Çarikci et al. (32) recommend relaxing breaks and exercises for the neck, jaw and facial muscles and the use of appropriate masks to minimize negative symptoms. Similarly, in this study, participants with an average daily mask wearing time of 5-8 hours were more likely to experience breathing difficulties, open mouth, clenched teeth, dry mouth, pain in the jaw joint and sore ears while wearing a mask. Participants who clenched their teeth, unconsciously brought their lower jaw forward, and felt pain in the jaw joint while wearing a mask were more likely to have a pathological finding in joint examination or radiographic examination. Among the participants who wore N95 and similar masks, the rates of those who clenched their teeth while wearing the mask and felt pain in the jaw joint and ears were higher than those who did not wear this mask. Similarly, the proportion of participants who had pathologic findings in the relevant examinations was significantly higher in participants who thought that they had jaw joint disorders since they started wearing masks compared to other participants.

Limitations of the study

Lacking of the variety in standard size in masks is one of the drawbacks of this study. This limitation happens

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notwithstanding the production of masks considering coverage, stretchy and durability. In addition, patients using N95 and similar masks, three-layer surgical mask, washable cloth mask, two masks on top of each other have been evaluated in the study.

The other limitation in this paper is short period of observation to conduct this investigation about which how repeated jaw movements brought on by masks have negative effects on the TMJ. In this case, multiple variables – like on age, gender, and occupational groupings – must be taken into account so that researchers can examine long-term effects and radiologic findings.

CONCLUSION

Individuals who clenched their teeth, unconsciously brought their lower jaw forward, and felt pain in the jaw joint while wearing a mask had a high rate of pathologic findings in TMJ examination or radiographic examination. Shortness of breath, open mouth, clenched teeth, dry mouth, pain in the jaw joint and earache were more common with prolonged mask use. This study states both the infrequency in documented the health issues related to mask-wearing and the relation between TMD and recurring jaw movements due to the use of mask. TMD is more likely to occur among those who wear a mask every day. Selecting the correct mask is beneficial for mask users who should be aware of the movements in jaw like opening and forward sliding activities. Further studies are needed in this regard.

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