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Is There any Differences in Magnetic Resonance Imaging Findings of Painful Temporomandibular Joint Between Patients with and without Vertigo?

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SUMMARY

Background/Aim: *Temporomandibular disorder (TMD) is an umbrella term and consists of pathological situations about temporomandibular joint (TMJ) internal structure, masticatory muscle and associated structures. Otalgic complaints are included in the group of complaints within TMJ associated structures and are frequently seen with TMD. The aim of this study is to evaluate the magnetic resonance imaging findings (MRI) of patients who had unilateral pain in the preauricular region, diagnosed with vertigo.* ***Material and Methods:*** *The present retrospective and cross-sectional clinical study was carried out on patients presenting with preauricular pain referred to XXX University Faculty of Dentistry Department of Oral and Maxillofacial Surgery between 2018 and 2020. There were 2 groups as vertigo and health groups. MRI findings were the primary predictor variables, while pain was the primary outcome variable, recorded on a visual analog scale (VAS).* ***Results:*** *120 patients were included in the study. The patients included in both groups are between 19 and 65 years of age and there is no significant statistical difference between mean ages of the groups ($p>0.05$). The VAS values varies between 6 and 9 in both groups. There is no significant statistical difference between mean VAS values of the groups ($p>0.05$). On the painful side there is no significant difference between the groups in terms of disc/condyle relation ($p>0.05$). On the other hand moderate effusion (61.4%) was significantly higher in the healthy group while severe effusion (54%) was significantly higher in the vertigo group ($p<0.01$).* ***Conclusions:*** *Although both groups had the same pain scale, it was observed that the vertigo group had more dramatic MRI findings in terms of disc/condyle relation and presence of effusion. This study is the first to evaluate the disc/condyle relation and the presence of effusion through MRI in vertigo patients diagnosed with TMD.*

Key words: Disc/Condyle Relation, Effusion, Vertigo, Magnetic Resonance Imaging, Temporomandibular Disorder

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Introduction

Temporomandibular joint (TMJ), considered among the most complex joints in the human body, is a synovial articulation located between the mandibular condyle and the articular eminence of the temporal bone[1]. The term 'temporomandibular disorders' is defined by the American Academy of Orofacial Pain as pathological conditions that include joint internal structure, chewing muscles and related anatomical formations[2,3].

Internal derangement (ID) is the most common type of TMJ structural degeneration[4]. Anterior disc displacement (ADD) is one of the most common findings among the ID group[4]. Another point taken into consideration in the evaluation of TMJ structural degenerations is effusion[5]. Although there are different opinions about the role of effusion in degeneration and its cause-effect relationship, there are studies suggesting that

there is a significant correlation between its presence and the pain factor[5].

Among the degeneration of TMJ-related structures, there are complaints regarding structures such as ear, mandible, face, head and neck[6]. Vertigo is one of the most common symptoms among the ear-related ones[6,7]. Vertigo is defined as dizziness that occur due to asymmetrical neural activity between the right or left vestibular nuclei and is accompanied by nystagmus, ataxia, nausea, and vomiting[8,9]. Numerous publications state that otalgic complaints are common and even related to TMD cases[10-12].

There are many studies in the literature evaluating the relationship between otalgic symptoms and TMD[6,7,11]. On the other hand, no studies have been conducted to date that involves evaluation of patients with vertigo, who have complaints of pain in the preauricular region (TMJ region), based on magnetic resonance imaging (MRI) findings. The aim of this study is to evaluate the MRI findings of patients who had unilateral pain in the preauricular region, diagnosed with vertigo.

Material and Methods

Method of sample selection

The present retrospective and cross-sectional clinical study was carried out on patients presenting with preauricular pain referred to XXX University Faculty of Dentistry Department of Oral and Maxillofacial Surgery between 2018 and 2020. The inclusion criteria for the study sample are that patients had to be older than 18 years of age, present with unilateral TMJ pain and had been diagnosed with TMD based on the Diagnostic Criteria for TMD (DC/TMD). Patients with a history of presence of benign/malignant cyst/nodula, trauma or surgery in TMJ and any systemic disease that will affect TMJ (such as rheumatic disease, connective tissue disease) were not included in the study. Evaluation of the MRI images of the patients was carried out by a single oral maxillofacial surgeon, and an oral maxillofacial radiologist confirmed the images.

The present study involved 2 groups. The inclusion and exclusion criteria were taken into consideration, and it was ensured that the patient's otalgic complaint only included vertigo for the vertigo group, that no otalgic problems were present for the healthy group.

TMJ MRI evaluation

All MRI images were obtained using a 1.5 Tesla Symphony Quantum or Avanto MRI (Siemens Medical, Erlangen, Germany) with a bilateral 80 mm diameter TMJ coil and 3 mm-thick sections with a 190 mm field of view and matrix size of 256. Sagittal and coronal oblique plans were acquired with the help of localizers. Sequences performed include the following: T1-weighted images (200/11 TR/TE) in accessing disc position changes, T2-weighted images (1500/20 RTE/TE) in determining fluid and joint effusion. Both sequences were acquired in occlusion and maximum mouth opening. No motion artifacts were tolerated. T1-weighted MR images were compared in open and closed mouth positions to evaluate the reduction of the disc, and disc displacement was classified as disc displacement with/without reduction.

Disc position was classified under subheadings such as:

Normal disc/condyle relation: Disc position was considered normal if the posterior band was located between 11 and 12 o´clock positions in relation to condyle.

Disc displacement with reduction (DDWR): In the closed mouth position, the disc is located anteriorly to the condyle, and during jaw opening, it returns to its normal position (Figure-1).

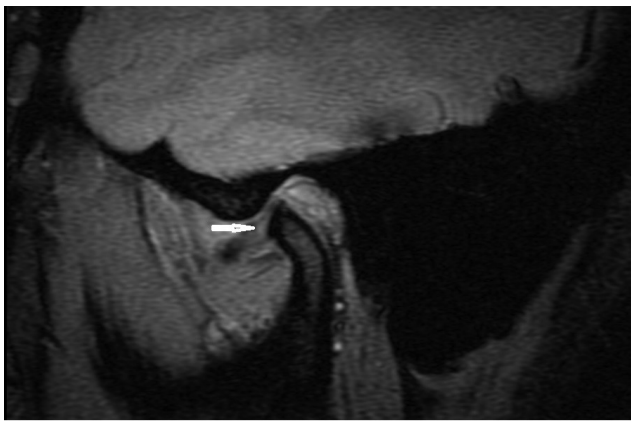

Figure 1. It was found that articular disc maintained its anterior position in the T2 weighted open mouth section. Articular disc determined with white arrow. In addition to this severe effusion was detected in the lower and upper joint space.

Figure 2. In the T2 weighted images it was observed that the articular disc located in the anterior in the closed position is reduced in the open position. Articular disc determined with white arrow.

Disc displacement without reduction (DDWOR): In the closed mouth position, the disc is located anteriorly to the condyle, and during jaw opening, it does not return to its normal position (Figure-2).

Articular effusion was associated with the inflammatory changes in the retrodiscal tissue or synovial membrane, and recognized by a major growth in the intensity of T2 signal detected during MRI evaluation. The recorded categories were as follows:

Grade 0: no effusion,

Grade 1: moderate effusion (joint with high linear density on the surface) (Figure-3)

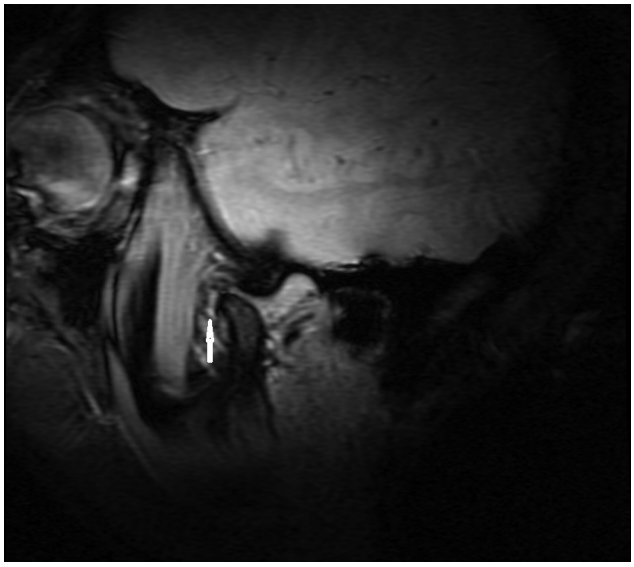

Figure 3. In the T2 weighted MRI image obtained in the opened mouth position, moderate effusion was detected in the anterior joint space.

Grade 2: severe effusion (joint with localized concentration in the lower and upper joint spaces and containing retrodiscal tissue) (Figure-1).

In the present study, pain was the primary outcome variable, recorded on visual analog scale (VAS). The authors of the study utilized the scores specified on the forms, where the patients' right and left pain values were recorded using a calibrated scale with a range of 0 - 10. The other category was demographic variables (age/gender) obtained from the recorded data.

Statistical analysis

Number Cruncher Statistical System 2007 (Kaysville, Utah, USA) program was used for statistical analysis. Data distribution was evaluated using the Shapiro-Wilk Test. The Student T Test was used for comparing two independent groups with normal distribution of quantitative data, and Mann-Whitney U test was used for comparing two independent groups that did not demonstrate normal distribution. Chi-square test was used to identify the relationship among qualitative data. P value was determined as 0.05 and 0.01 level.

Results

Total of 120 patients were included in the study. The vertigo group was comprised of 50 patients, 44% of whom were females (n=22) and 56% were males (n=28). The healthy group was comprised of 70 patients, 52.9% of whom were females (n=37) and 47.1% were males (n=33). There was no significant difference between the gender distribution of the groups (p>0.05).

The patients included in the vertigo group were between 19 and 65 years of age and the mean age was calculated as 39.06±10.81. The patients in the healthy group were between 19 and 65 years of age and the mean age was calculated as 39.3±9.09. There was no significant statistical difference between mean ages of the groups (p>0.05).

The VAS value varies between 6 and 9 in the vertigo group and the mean VAS value was calculated as 7.6±1.16. The VAS value varied between 6 and 9 in the healthy group and the mean VAS value was calculated as 7.6±0.97. There was no significant statistical difference between mean VAS values of the groups (p>0.05) (Table-1).

Table 1. Comparison VAS values between groups

		N	Mean±SD	Min-Max	p
VAS	Group with vertigo	50	7.6±1.16	6-9 (8)	0-232
	Healthy group	70	7.37±0.97	6-9 (7)	

VAS-Visual Analog Scale, Min-Minimum, Max- Maximum, SD-Standart Deviation,
Mann Whitney-U test, *p* value: 0.05

On the painless side; a normal disc/condyle relation was observed in 70% (n=35) ADDwR in 16% (n=8) and ADDwoR (n=7) in 14% of the patients in the vertigo group. A normal disc/condyle relation was observed in 80% (n=56), ADDwR in 10% (n=7) and ADDwoR 10% (n=7) of patients in healthy group (Table-2). There was no significant difference between the groups in terms of disc/condyle relation (p>0.05).

On the painless side; no effusion was observed in 80% (n=40) of the patients in the vertigo group, while moderate effusion was observed in 16% (n=8) and severe effusion in 4% (n=2) of patients. No effusion was observed in 71.4% (n=56) of the patients, while moderate effusion was observed in 21.4% (n=15) and severe effusion in 7.14% (n=5) of patients in healthy group (Table-2). There was no significant difference between the groups in terms of effusion (p>0.05).

Table 2. Comparison disc/condyle relation and joint effusion between groups with painless TMJ

		Groups		p
		Group with Vertigo	Healthy Group	
sc/Condyle relation	Normal	35 (%70)	56 (%80)	0.112
	ADDwR	8 (%16)	7 (%10)	
	ADDwoR	7 (%14)	7 (%10)	
Joint Effusion	No Effusion	40 (%80)	56 (%71.4)	0.10
	Mild Effusion	8 (%16)	15 (%21.4	
	Severe Effusion	2 (%4)	5 (%7.14)	

ADDwR- Anterior disc displacement with reduction, ADDwoR- Anterior disc displacement without reduction Chi-Square Test, p value: 0,01

Table 3. Comparison disc/condyle relation and joint effusion between groups with painful TMJ

		Grup		p
		Group with Vertigo	Healthy Group	
Disc/Condyle relation	Normal	8 (%16)	9 (%12.8)	0.119
	ADDwR	17 (%34)	38 (%54.2)	
	ADDwoR	25 (%50)	23 (%32.8)	
Joint Effusion	No Effusion	6a (%40)	9a (%60)	0.005*
	Mild Effusion	17a (%28.3)	43b (%71.7)	
	Severe Effusion	27a (%60)	18b (%40)	

ADDwR- Anterior disc displacement with reduction, ADDwoR: Anterior disc displacement without reduction Chi-Square Test, p value 0,01, *p<0.01

On the side with pain; 16% (n=8) of the patients in the vertigo group had normal disc/condyle relation. The percentage of patients with ADDwR was observed as 34% (n=17) while percentage of those with ADDwoR was observed as 50% (n=25) (Table-3). In the healthy group 12.8% (n=9) of patients had normal disc/condyle relation. The percentage of patients with ADDwR was observed as 54.2% (n=38) while percentage of those with ADDwoR was observed as 32.8% (n=23) (Table-3). There was no significant difference between the groups in terms of disc/condyle relation (p>0.05) (Table-3).

On the side with pain no effusion was observed in 12% (n=6) of the patients in the vertigo group, while moderate effusion was observed in 34% (n=17) and severe effusion in 54% (n=27). And no effusion was observed in 12.9% (n=9) of the patients in the healthy group, while moderate effusion was observed in 61.4% (n=43) and severe effusion in 25.7% (n=18). Moderate effusion was significantly higher in the healthy group, while severe effusion was significantly higher in the vertigo group (p<0.01) (Table-3).

Discussion

TMD is an umbrella term and consists of pathological situations about TMJ internal structure, chewing muscle and associated structures[13]. The most common clinical symptoms of TMD are reduced mouth opening, sounds in the joint with mandibular movements, and pain upon extra-auricular palpation in the TMJ[14]. The DC/TMD constitutes a well-established diagnostic system whose reliability was proven for TMD diagnosis and assessment[15-17]. Although it remains the most widely used TMD diagnostic system in clinical research, this system don't allow evaluation of the internal alterations or degenerations in TMJ, effusion etc. The use of imaging method is crucial especially for evaluating such alteration in TMJ[1].

The imaging methods employed in the evaluation of TMJ are orthopantomogram, cone-beam computed tomography, multidetector computed tomography, ultrasound, nuclear medicine techniques and MRI[1]. MRI is the imaging technique that is optimal for evaluation of TMD patients. MRI allows assessment of disc/condyle relation, effusion, sub-articular marrow, and

external auditory canal[1]. Moreover, MRI also provides an optimal evaluation of intra-articular inflammation and mass lesions with T2 sequences[1]. In addition to the features mentioned above, MRI is also radiation-free and cost-effective, making it a favorable method for TMJ examination.

There are numerous studies in the literature evaluating the relationship between TMJ MRI findings and pain[5,13,18]. Pain felt during palpation or function, especially in the anterior region of the ear, is among the most common symptoms of TMD[14]. Although the etiology of pain in TMD patients is not fully understood, conditions such as inflammatory changes in the synovial fluid, bone marrow alteration and disc/condyle relation, and compression are listed as the possible causes of pain[19]. It is possible to find studies in the literature evaluating the relationship between pain and effusion and disc/condyle relation[13,18,20]. It is argued that some mediators that accumulate in the joint fluid with the presence of effusion cause both destruction and pain on the joint structure[20]. It is also argued that effusion is observed in joints with ID, so the presences of ID or effusion are changes that should be evaluated together, not individually[13]. In the present study, MRI findings of painful joints were evaluated for both groups. A significant difference was seen between the side with pain and the painless sides in the percentages of ID (ADDwR, ADDwoR) and effusion for both groups, and these findings are consistent with the literature.

It is a known fact that pain is an important clinical indication for TMD as well as a factor that seriously affects the quality of life for patients[18]. The pain felt in TMD patients is not merely limited to the joint area, and can be felt widely. Feinmann and Harrison[21] reported that pain is characterized as unilateral or bilateral in TMJ and its associated craniofacial musculature, in addition to other otologic complaints. Numerous studies stated that otalgic problems such as vertigo and tinnitus are significantly more common in patients with TMD compared to those without it[6,28].

There are many studies in the literature evaluating the relationship between TMD and otalgic complaints[6,7,11,22,23]. In their study, Tuz *et al*[6]. evaluated the ratios of otalgic symptoms seen in patients diagnosed with TMD. A study conducted on 200 patients reported that the most common complaints were vertigo and tinnitus. In their study, Maciel *et al*[22].stated that symptoms such as tinnitus, vertigo, sensory loss and earache were significantly higher in patients with TMD.

In the present study, the MRI findings of vertigo patients with unilateral TMJ pain were evaluated and compared with the other group without any otalgic complaints. The only study in the literature evaluating the frequency of vertigo among the otalgic complaints in elderly individuals with TMD is the only study by de Moraes Matchiori *et al*[7].

In their study, Koca *et al*[13]. stated that the severity of effusion is mostly seen along with ADDwoR. The study carried out by Takahara *et al*[18]. on the other hand, reported that ADDwoR, effusion and pain are interrelated factors. In the present study, the higher frequency of severe effusion in painful joints in the vertigo group compared to the healthy group can be explained by the fact that – although not statistically significant- ADDwoR was higher in the vertigo group than the healthy group ($p<0.01$). In other words, the vertigo group has more dramatic MRI findings in terms of disc/condyle relation and the presence of effusion in painful joints. And the reason behind this fact can be explained with various hypotheses.

In the literature, multiple hypotheses have been proposed to account for the relationship between TMD and otalgic symptoms. In their study, Williamson et al[24] stated that otolaryngological symptoms may develop due to compression in the internal auditory and posterior arteries as a result of abnormal condyle/disc contact caused by disc displacement[24]. Rodriguez *et al*[25]. on the other hand, stated in their study that TMJ dysfunction negatively affected middle ear biofunction, and that this connection occurred through ligaments[25]. In another study, TMJ was thought to cause pressure change in the inner ear fluid, which was said to result in tinnitus and vertigo development[26]. In the light of these hypotheses, it can be said that vertigo may develop not as a cause of, but as a result of pathological changes in the internal structure of TMJ, and may occur along with TMD accompanied by the symptoms.

Conclusions

It has been observed that painful joints in patients with vertigo indicate the presence of ID and effusion, in a way similar to patients with no otalgic problems. In addition, although both groups had the same pain scale, it was observed that the vertigo group had more dramatic MRI findings in terms of disc/condyle relation and presence of effusion. This study is the first to evaluate the disc/condyle relation and the presence of effusion through MRI in vertigo patients diagnosed with TMD. We believe that evaluating disc and condyle structures and other parameters such as bone marrow edema in cases presenting with vertigo and/or other otalgic complaints in future studies will help expand this issue further.

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