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Original Article

Evaluation of the presence of effusion in patients with temporomandibular joint disorder

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Abstract

Aim: The aim of this study is to investigate the relationship between effusion and disc displacement that were detected in MRIs of temporomandibular joint disorder (TMD) patients

Material and Methods: MRIs of 60 patients who had pain and/or dysfunction in the TMJ region were evaluated for the presence of effusion. TMC disc positions of 60 MRI results were divided into three groups: normal disc position (control group, n: 20), disc displacement with reduction (R group, n: 20) and disc displacement without reduction (NR group, n: 20). When evaluating the presence of effusion, hyperintense thin lines or absence of effusion was evaluated as no effusion; while signal intensity of more than 2 mm at the anterior-posterior length or superior-inferior height at the joint space was evaluated as the presence of effusion.

Results: According to MRI findings, effusion was observed in 2 of the 20 joints (10%) in the control group, 8 of the 20 joints (40%) in the R group and 17 of the 20 joints (85%) in the NR group. When the groups were compared with each other, there was a statistically significant difference between the groups ($p<0.05$).

Conclusion: In TMD, where normal disc position deteriorates to disc displacement, the prevalence of effusion also increases. It is thought that changes in effusion levels can be used as a marker for evaluating the prognosis of TMD.

Keywords: Temporomandibular Joint; Disc Displacement; Effusion.

INTRODUCTION

Temporomandibular joint disorders (TMD) are defined as diseases that affect the stomatognathic system (1). The clinical symptoms of TMD are characterized by pain, palpation sensitivity in the temporomandibular joints (TMJ) and masticatory muscles, joint noises, and irregular and restricted jaw movements. At least one TMD symptom is observed in about one-third of the adult population (2).

TMJ internal derangement (ID) is defined as the abnormal relationship between the mandibular condyle and the articular disc and is the most common type of TMD. Approximately 80% of patients with symptomatic TMD have ID (3). Disk displacement is the most common form of TMJ internal derangement and these can be observed either with or without reduction (4).

For the diagnosis of TMD patients, a detailed evaluation of the anamnesis is carried out, after which an intraoral and extraoral physical examination is performed, and the diagnosis is confirmed by imaging techniques if necessary. Magnetic resonance imaging (MRI) is commonly used to evaluate the position and configuration of the disc, posterior disc attachment and the condition of the mandibular bone marrow, and to assess the presence of joint effusion in the TMJ region (5). Fluid accumulation in intra-articular space in TMJ is defined as effusion. Effusion is observed as high-resolution signals on T2-weighted MRI. It is thought that joint effusion marks the inflammatory process (6). In some studies, synovial fluids with joint effusion have been shown to have increased levels of proteins and proinflammatory cytokines (7-9).

In this study, we aimed to evaluate the relationship between effusion and disk displacement by using MRIs obtained from patients with TMD.

MATERIAL and METHODS

Study Design

In this study, MRI findings of 30 patients with 60 bilateral TMJs, who were admitted to Adıyaman University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery

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between January 2018 and November 2018 with TMD symptoms, were evaluated. Adult patients with TMD were included in the study. The clinical TMD diagnosis was conducted in accordance with previously established clinical diagnostic criteria for TMD (10). Patients who were pregnant or had systemic conditions affecting joint-muscles and rheumatologic diseases were not included in the study. Our aim was to compare the effusion between the healthy joints and the joints with disc displacement.

The present study was approved by the ethics committee of Adiyaman University Medical Faculty Ethics Committee for Non-Interventional Clinical Research with the number 2018/6-20.

MRI

MRI examinations were performed using a 1.5-or 3-T MR scanner (Magnetom Avantoor Magnetom Skyra; Siemens Healthcare, Erlangen, Germany) with a 7.5-cm surface coil. The MRI protocol included bilateral oblique sagittal and oblique coronal T1weighted (repetition time/echo time= 500-520/12-16 milliseconds) and T2 weighted images (repetition time/echo time= 2300-2600/40-100 milliseconds) with 3 mm slice thickness, 256X160 matrix, 150 mm field of view, in both closed and maximum open mouth position. MR images were corrected to the horizontal angulation of the long axis of the condyle. A wooden intermaxillary device was used for the open mouth views. All MRI findings were evaluated by an experienced radiologist.

In the MRI, the joint disc is defined as the hypointense area with a biconcave shape above the condylar structure in the sagittal sections. According to its position, the joint disc is categorized as follows in the literature (11-14).

• Superior (normal) disc position: The posterior band of the disc in the intercostal position is located in the apex of the condyle head, and in the position of the maximal aperture, the fine intermediate zone of the disc is between the condyle and the articular cavity.

• Disc displacement with reduction: In the closed position of the jaws, the posterior band of the disc is located at the anterior of the condyle head, but, in the position of the maximal oral aperture, normal disc condyle association is observed.

• Disc displacement without reduction: The posterior band of the disc is located at the anterior of the condyle during both closed jaw position and at the position of the maximal oral aperture.

In this study, a total of 60 MRI images of TMJ patients with normal disc position were divided into Control Group, Disk Displacement with Reduction Group (R Group), and Disk Displacement without Reduction (NR Group), and 20 images from each group were analyzed.

Joint effusion is observed as high signal intensity in the joint space on T2-weighted MRI images. In our study, effusion was coded as 'present' and 'absent' as in Manfredini et al's study (11).

• No effusion: Thin line hyperintensity in the joint range or no effusion.

• Effusion present: High signal intensity area of more than 2mm at anterior-posterior length or superior-inferior height in the joint range.

Statistical Analysis

The data obtained in this study were analyzed with IBM SPSS Statistics Version 22 program. Shapiro-Wilk test was used to analyze whether the variables have a normal distribution, because of the number of units. When interpreting the results, 0.05 was used as the level of significance; in the case of $p<0.05$, the variables were described not to have a normal distribution, but in the case of $p>0.05$, it was accepted that the variables have a normal distribution. When examining the differences between the groups, the Mann Whitney U Test was used because the variables did not have a normal distribution. The chi-square analysis was applied to examine the relationships between the groups of nominal variables. 0.05 was used as the level of significance; $p<0.05$ was accepted to be significant and $p>0.05$ was accepted to be not significant.

RESULTS

There was no statistically significant difference between the groups in terms of gender ($p>0.05$). There were also no statistically significant differences between the groups in terms of age ($p>0.05$). Therefore, there was a homogeneous distribution with respect to gender and age.

As a result of 60 TMJ evaluations, the presence of effusion was detected in 27 joints (45%) (Figure 1-2) and no joint effusion was detected in 33 joints (55%). According to the MRI findings, the effusion was observed in 2 of the 20 joints (10%) in the Control Group, 8 (40%) of the 20 joints in the R Group and 17 (85%) of the 20 joints in the NR Group. It was determined that the presence of effusion was the highest among the NR Group, followed by the R Group and lowest in the Control Group.

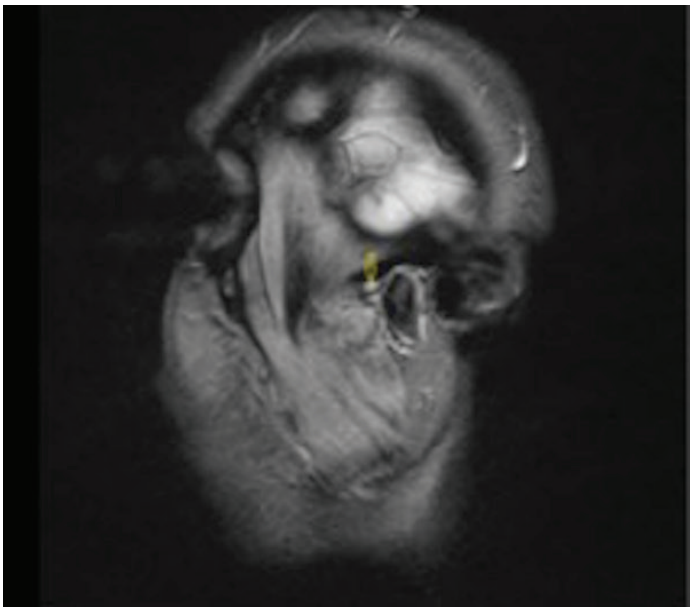

Figure 1. T2-weighted magnetic resonance images show the joint effusion

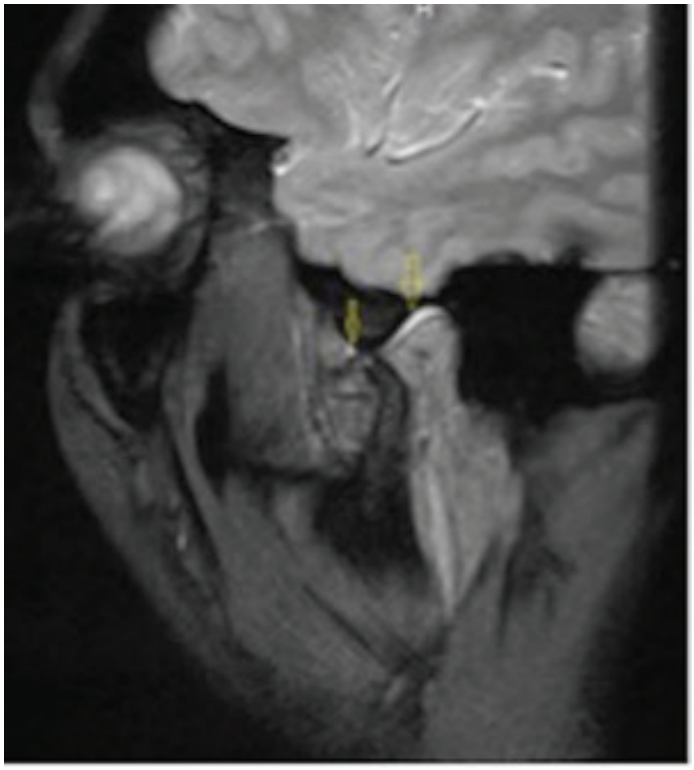

Figure 2. T2-weighted magnetic resonance images show the joint effusion

A statistically significant difference was found between the groups with respect to the effusion values. There was a statistically significant difference between the Control Group and the R Group (Table 1). A statistically significant difference was found between the Control Group and the NR Group (Table 2). In addition, there was a statistically significant difference between the disc displacement groups (Table 3) (p<0.05).

Table 1. Compassion of effusion between "normal disc position" and "Disc displacement with reduction"

	Effusion YES	Effusion NO	Total	Mann Whitney Test p Value
Normal disc position	2 (10%)	18 (90%)	20 (100%)	0.031*
Disc displacement with reduction	8 (40%)	12 (60%)	20 (100%)	

*Statistically significant (p<0.05)

Table 2. Compassion of effusion between "normal disc position" and "Disc displacement without reduction"

	Effusion YES	Effusion NO	Total	Mann Whitney Test p Value
Normal	2 (10%)	18 (90%)	20 (100%)	0.00*
Displacement without reduction	17 (85%)	3 (15%)	20 (100%)	

*Statistically significant (p<0.05)

Table 3. Compassion of effusion between "Disc displacement with reduction" and "Disc displacement without reduction"

	Effusion YES	Effusion NO	Total	Mann Whitney Test p Value
Disc displacement with reduction	8 (40%)	12 (%60)	20 (100%)	0.004*
Displacement without reduction	17 (85%)	3 (15%)	20 (100%)	

*Statistically significant (p<0.05)

DISCUSSION

Clinical examination alone is often insufficient to obtain adequate information about TMJ. MRI is considered to be the gold standard because it allows the evaluation of the soft tissues, the position, and contour of the joint disc, and changes in bone tissue. The most important advantage of this imaging technique is that it allows the analysis of hard and soft tissues of the TMJ together, such as condyle, articular fossa and articular eminence, joint disc and ligaments. In addition, the synovial fluid could also be analyzed with MRI (4,15).

ID, the most common form of TMD, is defined as the abnormal relationship between the condyle and the articular disc (16). In several studies on the location of the disc, it has been reported that 80-95% of the MRI-acquired images and the anatomic positions of the TMJ match in position (17-19). However, MRI results may be affected by factors such as the MRI technique, imaging protocol, diagnostic criteria and the performance of the observer (20). In this study, the MRI protocol includes 1.5 T field strength, TMJ, T1 and T2 weighted oblique-coronal and oblique-sagittal images. Therefore, this protocol has a minimal effect on possible outcomes. On the other hand, there are many studies on observing the disc position by using MRI. The present study was performed according to the diagnostic criteria described by Manfredini et al., and 40 of the 60 (66.6%) joints were diagnosed with the internal derangement (11).

Joint effusion is determined as a high signal intensity area in the upper and lower joint spaces in T2 weighted MRI. In T2-weighted MRI, the effusion in the upper cavity of the TMJ is considered as synovitis in the internal derangement (21). Different classification systems have been used to analyze and determine the amount of joint effusion, and in many studies, effusion was classified as 'absent' or 'present' (2,11,15,16,22,23). There are also studies that classify effusion as; grade 0: no or little effusion; grade 1: mild effusion; and grade 2: severe effusion (24,25). Similarly, several studies divided the levels of effusion into four or five groups (4,20,21,26). In this study, the 'present'/'absent' approach used by Manfredini et al. was used (11).

The displaced disc in the TMJ causes abnormal mechanical stress and production of inflammatory mediators, resulting in effusion. The pathophysiological relationship between

the joint effusion and disc displacement is explained by this process (6). Güler et al. reported a significant relationship between joint effusion and total protein content in their study where they evaluated the relationship between the presence of effusion in MRI and total protein concentration in the synovial fluid (9). Segami et al. reported that joint effusion occurred in the presence of significant synovitis, and consisted of high concentrations of total protein and inflammatory cytokines (8). They also emphasized that IL-6 and IL-8 play an important role in the pathogenesis of TMJ diseases. Several studies indicate that there is a correlation between effusion and inflammation mediators (7-9,27).

TMJ effusion is an inflammatory response during condyle disc dysfunctions (28). Studies have reported that effusion is observed at varying rates. Larheim et al. reported that TMJ internal derangement was detected in most of the joints that had effusion, while some fluid was detected in asymptomatic joints as well (29). Rudisch et al. showed a significant relationship between the internal derangement and effusion in a study examining TMJ patients with pain (28). In a study by Westesson and Brooks, it was observed that 40% of the patients with reduced disc displacement, 50% of the patients without reduced disc displacement, and 7% of the healthy participants had effusion (30). In the present study, the rate of effusion in patients with disc displacement was 59.6%, whereas this rate was found to be 13.3% in patients without disc displacement. Huh et al. showed that joint effusion was observed to be more common in patients with joint disc-displacement without reduction compared to patients with joint disc-displacement with reduction (25). In our study, it was found that effusion was increased in patients with joint disc displacement without reduction than disc displacement with reduction joints.

Manfredini et al. examined the relationship between disc displacement and joint effusion and reported that 12% of the joints with normal disc position, 20% of the joints with disc displacement with reduction and 26% of the joints with disc displacement without reduction had effusion (11). Overall, they concluded that there was a statistically significant difference between disc displacement without reduction and effusion. Manfredini et al. (11), Thomas et al. (22) and Zhuo and Caide (31) reported in three different studies that effusion was higher in joints with disc-displacement without reduction. Orlando et al. reported that there was a significant relationship between disc displacement and effusion, and there was increased effusion in the joints with disc displacement without reduction (16). However, they emphasized that disc displacement may not be a dominant factor in effusion formation in TMJ and local and systemic conditions should also be considered in addition to the disc-condyle relationship. In contrast to these studies, other studies have suggested that there is no difference with respect to the presence of effusion between joints with disc displacement with reduction and joints with disc displacement without reduction (6,20,26,32).

Effusion may be associated with degenerative bone changes in the TMJ. Internal trauma in the mandibular condyle due to displaced disc and joint effusion pressure may cause osteonecrosis in the TMJ. With increased effusion, diffusion of the synovial fluid may increase and the metabolic activities of the chondrocytes may be disrupted. This may lead to early metabolic changes (9). Emshoff and Rudisch (33) reported that they observed effusion in 46% of the 32 osteoarthritis patients with pain and disc-displacement without reduction and reported that this rate was between the previously reported levels of 13-88% (34,35). Roh et al. found an increase in the incidence of condyle degeneration and effusion in anterior disc displacement patients and emphasized that there was a systematic increase in effusion rates in these cases (4). They have reported that condyle degeneration and effusion are twice as high in patients with disc displacement with reduction and four times higher in patients diagnosed with disc displacement without reduction. On the other hand, they added that not every patient with disc displacement has to have effusion and degeneration; and effusion and degeneration could be present in patients with no disc displacement.

In our study, effusion was observed in 10% of the joints with normal disc position, 40% of the joints with disc displacement with reduction and 85% of the joints with disc displacement without reduction. The levels of effusion were higher at the advanced stages of disc displacement. The findings of this study suggest that surfaces of the joints with disc-displacement without reduction are subject to more mechanical stress and thus biochemical inflammation mediators are produced more and effusion is more widely observed. The results of this study are in line with the findings of other studies (4,11,16,22,28,30,31). Effusion is more common in the joints with internal derangement. In patients with normal disc position, effusion is less common.

TMD can be treated with conservative treatment approaches such as physical treatment, inter-occlusal devices and drug therapy. In the situations in which the conservative treatment is insufficient, minimal invasive surgical approaches such as arthrocentesis can be preferred (36). When we researched the literature, the information about pre- and post- effusion findings in the patients with TMD are variable (36-39). There are studies that show that there is no change in post-TMD treatment effusion amount (36,39), like there are studies that states post-treatment effusion amount is decreased (37,38). Also, while some studies stated that the existence of effusion is a standard, which can affect the success of the treatment (23,33), there are studies that claims the exact opposite of this (40).

CONCLUSION

The incidence of effusion in the TMD increases when there is deterioration from the normal disc position to disc displacement with reduction. It is thought that the presence of effusion can be used as a marker for the

prognosis of TMD. More studies on TMD and effusion are needed to confirm and expand the results in this study.

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