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Original Article

The investigation of the prevalence of condylar degenerative changes and its relationship with disc displacement in the magnetic resonance images of the patients with temporomandibular joint disorders

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Abstract

Aim: The purpose of this study is to investigate the relationship between TMJ disc displacement and chondylar degenerative changes.

Material and Methods: The MRIs of 182 TMJs belonging to 91 patients with TMD were evaluated. TMJs were distributed into three groups according to the disc positions as normal disc position (Group 1, n=39), disc displacement with reduction (Group 2, n=49) and disc displacement without reduction (Group 3, n=94). Condylar degenerative change is diagnosed according to presence or absence of erosion, sclerosis, flattening and osteophyte encountered in MRI. When more than one type of degenerative change was observed, the joint was determined to have degenerative changes.

Results: The results of MRI evaluation of 182 TMJs revealed Group 1, Group 2 and Group 3 in 39 (21.4%), 49 (26.9%) and 94 (51.6%) joints, respectively. No degenerative condyle was found in 107 (58.8%) joints whereas degenerative condylar changes were encountered in 75 (41.2%) of 182 TMJs by the MRI evaluation. Condyle degeneration was detected in 2 (5.1%) of the joints with normal disc position whereas 6 (12.2%) and 67 (71.3%) of the joints with reducing and non-reducing disc displacement revealed condyle degeneration, respectively.

Conclusion: A statistically significantly higher rate of condyle degeneration was encountered in the joints with disc displacement without reduction than the joints with disc displacement with reduction and normal disc position. Advancing disc displacement causes condylar degenerative changes.

Keywords: Temporomandibular joint disorders; magnetic resonance imaging; disc displacement; degenerative changes.

INTRODUCTION

Temporomandibular joint disorder (TMD) is described as the abnormal condition in the masticatory muscles, temporomandibular joint (TMJ) and related neurological structures (1). Temporomandibular joint internal derangement (ID) is the most common form of the TMD (2). TMJ internal derangement is defined as the abnormal positional relationship between articular disc, mandibular condyle and articular eminence. Several clinical symptoms such as pain, clicking sound and deviation or irregular jaw motions may accompany (3). TMJ osteoarthritis is a type of degenerative joint disease usually related with ID. It is characterized by erosion, flattening and development of osteophytes (4).

In the present time, magnetic resonance imaging (MRI) is commonly ordered by the clinicians for evaluation of the TMJ structures in the patients with TMD (5). MRI is a non-radiological imaging technique that allows to evaluate the joint disc position and morphological structure of joint disc and hard tissues. It also provides an option to evaluate the functional relationships between the condyle, joint disc, mandibular fossa and articular eminence (6). It has been reported in the previous studies that MRI has a high accuracy rate for the evaluation of TMJ bony structures and disc anomalies (2-8).

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The pathological changes, including especially degenerative changes in the condyle, emerge in the TMJ when disc displacement occurs (9). It has been hypothesized that osteoarthritis may develop as a result of advancing TMJ-ID and especially disc displacement without reduction (5,10,11). Even though, some researchers have reported that degenerative bony changes occur more frequently in the joints with non-reducing disc displacement (5,7,10-13), the association between these phenomena is not entirely clear yet.

The present study aims to investigate the relationship between TMJ disc displacement and the degenerative changes developing in the mandibular condyle.

MATERIAL and METHODS

Subjects

MRIs of the 182 joints belonging to 91 patients who applied to the Oral and Maxillofacial Surgery Clinic of Ataturk University Faculty of Dentistry due to the complaints of pain, restricted mouth opening and/or clicking sound were retrospectively evaluated. The MRIs of patients with major deformities, TMJ fractures or systemic diseases known to affect the TMJ, such as rheumatoid arthritis, were excluded from the study. This study was approved by the Ataturk University Ethics Committee (Project no: 2019/3-7)

MRIs of the TMJ

MRI examinations were performed using a 1.5-or 3-Tesla 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.

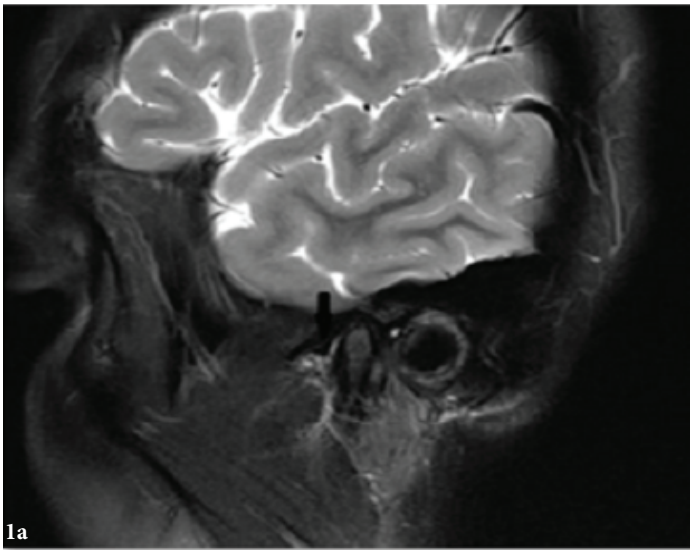
Disc displacement of the TMJ

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 literatüre (1,14,15).

• Superior (normal) disc position (Group 1): 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 (Group 2): 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 (Group 3): 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.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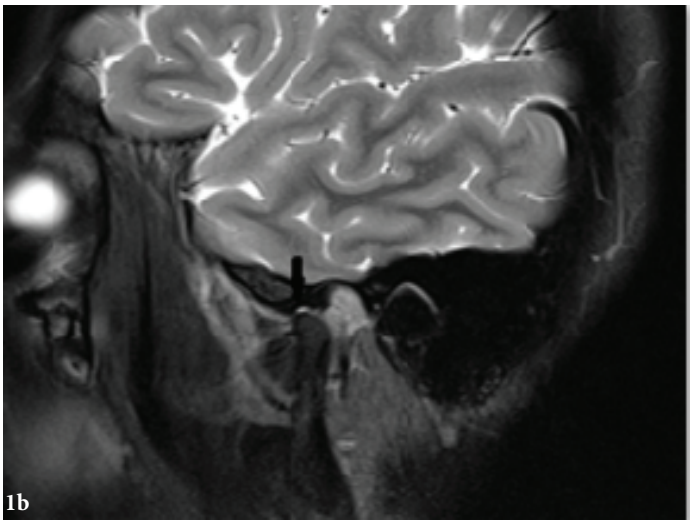
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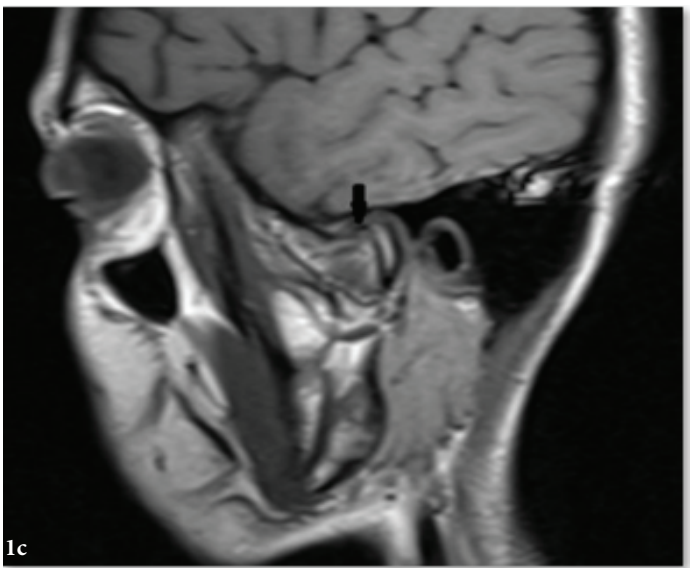
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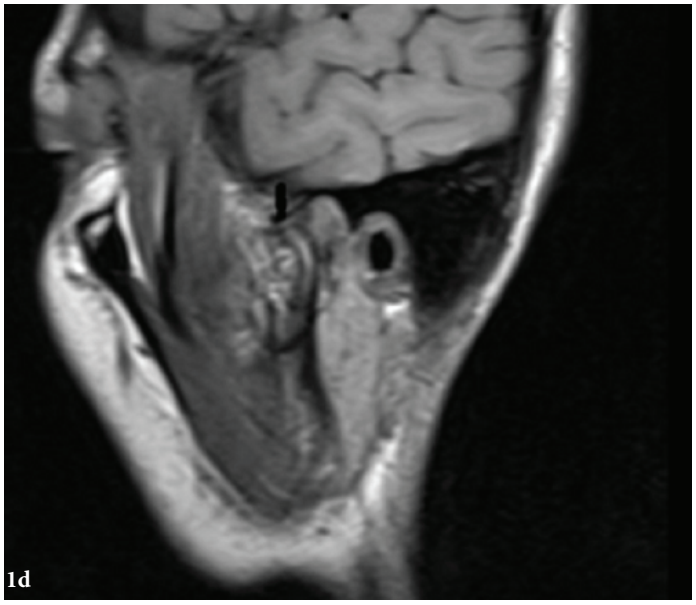

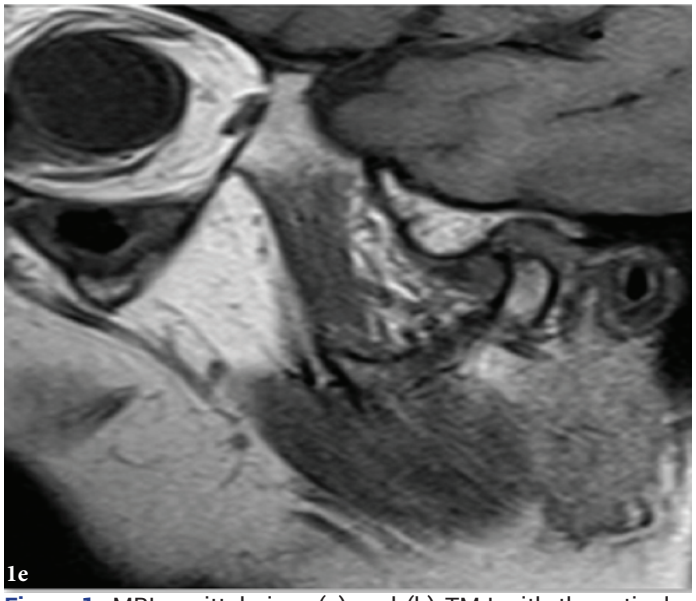

Figure 1. MRI sagittal view. (a) and (b) TMJ with the articular disc in the normal position, (a) closed mouth, (b) open mouth; (c) and (d) disc displacement with reduction, (c) closed mouth, (d) open mouth; (e) disc displacement without reduction and degenerative condylar changes.

In this study, a total of 182 MRI images of TMJ patients with were divided into normal disc position (Group 1), Disk Displacement with Reduction (Group 2), and Disk Displacement without Reduction (Group 3). (Figure 1.)

Degenerative changes of the TMJ

The degenerative change in the condyle is diagnosed with the presence and absence of erosion, sclerosis, flattening and osteophyte encountered by MRI. Erosion is defined as absence or interruption of the cortical lining while sclerosis is a condition in which bone density significantly increases, flattening indicates the loss of the round contour of the condyle and osteophyte is described as marginal hypertrophic bone formation. When more than one type of degenerative change was observed, the joint was determined to have degenerative changes (2).

Statistical Analysis

The data obtained in this study were analyzed with IBM SPSS Statistics Version 22 program (IBM Corp., Armonk, NY, USA). 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 Kruskal Wallis Test was used because the variables did not have a normal distribution. Post hoc test was applied to determine between which groups statistical differences occurred. While interpreting the results, 0.05 was used as the standard for significance, and it was reported that there was a significant difference when $p<0.05$ and there was no significant difference when $p>0.05$.

RESULTS

Totally 182 TMJs were evaluated belonging to 91 patients including 72 females (79.1%) and 19 male (20.9%). Mean age of the patients was 26.5±9.41 years (age range; 15-65 years). There were also no statistically significant differences between the groups in terms of age ($p>0.05$). There was no statistically significant difference between the groups in terms of gender ($p>0.05$). Therefore, there was a homogeneous distribution with respect to gender and age.

Table 1. Distribution of the temporomandibular joints according to the position of the articular disc

Position of the disc	Frequency (n)	Percentage (%)
Group 1	39	21.4
Group 2	49	26.9
Group 3	94	51.6
Total	182	100

Group 1, normal disc position; Group 2, disc displacement with reduction; Group 3, disc displacement without reduction.

Table 2. Distribution of condyle degenerative change according to the position of the articular disc

		Condyle Degenerative changes (%(n))		P value
		Absent	Present	
Position of the disc	Group 1	95(37)	5.1(2)	0.000*
	Group 2	87.8(43)	12.2(6)	
	Group 3	28.7(27	71.3(67)	
	Total	58.8(107)	41.2(75)	

*Kruskal Wallis Test

Table 3. Comparison of condyle degeneration between groups

Group		Standard error	P value
Group 3	Group 2	0,067	0,000
	Group 1	0,059	0,000
Group 2	Group 3	0,067	0,000
	Group 1	0,059	0,550
Group 1	Group 3	0,059	0,000
	Group 2	0,059	0,550

Dependent variable: condyle degeneration
Post hoc test

According to the result of MRI evaluation of 182 TMJs; normal disc position, reducing disc displacement and non-reducing disc displacement were encountered in 39 (21.4%), 49 (26.9%) and 94 (51.6%) joints, respectively (Table 1.). MRI evaluation of 182 TMJs revealed that no degenerative condyle was found in 107 (58.8%) joints whereas degenerative condylar changes were encountered in 75 (41.2%) joints. Condyle degeneration was encountered in 67 (71.3%) of the joints with non-reducing disc displacement whereas that was detected in 6 (12.2%) and 2 (5.1%) of the joints with reducing disc displacement and normal disc position, respectively (Table 2.). Condyle degeneration in the joints with non-reducing disc displacement is statistically significantly higher than the joints with reducing disc displacement and normal disc position ($p<0.05$). No statistically significant difference was found between the joints with reducing disc displacement and normal disc position with respect to condyle degeneration ($p>0.05$) (Table 3.)

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 (2,16).

Ahmad et al. have compared the data from panoramic radiography, computed tomography (CT) and MRI to confirm Research Criteria for TMDs. They have reported that MRI demonstrated an excellent specificity rate in diagnosis of osteoarthritis (17).

TMJ-ID occurs in the presence of an abnormal anatomical relationship between condyle, temporal bone and joint disc. The etiology of TMD usually involves chronic micro or macro traumas that affect the bilaminar zone. These traumas are followed by reducing joint disc displacement at the first stage and subsequently non-reducing joint disc displacement in parallel with advancing diseases (4).

It has been generally accepted that TMJ-ID and osteoarthritis are the strongly associated pathological conditions. It has been supported by many researchers that development of the degenerative changes due to advancing internal derangement can be displayed by imaging techniques (10,18-20).

Campos et al. have investigated condylar degenerative changes in a study and reported a significantly higher rate of condylar degenerative change in the joints with non-reducing disc displacement (5). Ogutcen-Toller et al. have stated in their study that condylar degenerative changes are more frequently observed in the joints with non-reducing disc displacements (21). There are also other studies that supported this conclusion (2,5-7,20,22). On the other hand, some studies have suggested a counter conclusion. Sener and Akgunlu have reported that there is no relationship between degeneration and disc displacement with and without reduction (23). Emshoff et al. have reported that there is no significant relationship between non-reducing disc displacement and osteoarthritis (24). In the present study, we have determined a significant relationship between non-reducing disc displacement and condylar degenerative changes. The outcome of our study supports the studies which stated that non-reducing disc displacement is related with condylar degenerative change (2,5-7,20,22).

Emshoff et al. have reported that condylar degenerative changes were found in 7.4% and 72.2% of the joints with reducing disc displacement and non-reducing disc displacement, respectively (25). Bernhardt et al. have detected condylar degenerative changes in 25% and 45% of the joints with reducing disc displacement and non-reducing disc displacement, respectively (26). Campos et al. have reported that condylar degenerative changes were encountered in 28% and 45% of the joints with reducing disc displacements and non-reducing disc displacements (5). In our study, degenerative changes in the condyle was found in 73.1% of the joints with non-reducing disc displacements whereas the frequency of condylar degenerative changes was 12.2% in the joints with reducing disc displacement.

A series of actions such as production of free radicals, cytokines, catabolites and enzymes which degrade bone matrix may be triggered while TMJ is under mechanical loading. Under normal physiological conditions, these substances play a role in regeneration of the joint tissues as a response to the functional forces. However, functional forces exceed adaptive capacity under pathological conditions and cause degenerative changes on the joint surfaces (20,27). Joint disc protects the underlying tissues in the TMJ. It is noted that degeneration occurs in the condyle due to excessive pressure after disc displacement. This condition clarifies the higher frequency of degenerative changes in the joints with non-reducing disc displacement (20). In the present study, we have determined a very high rate of condylar degeneration in the joints with non-reducing disc displacements. As

a consequence, the outcomes of our study support this research.

It has been reported in the studies which involved long-term radiological follow-ups that degenerative condylar surface changes increase by time in the untreated patients with non-reducing disc displacement of the temporomandibular joint (28-31). This outcome emphasizes the importance of treatment in the patients with non-reducing disc displacement.

In our study, condylar degenerative changes was encountered in 67 (73.1%) of the joints with non-reducing disc displacement whereas 6 (12.2%) and 2 (5.1%) of the joints with reducing disc displacement and normal disc position demonstrated degenerative changes in the condyle, respectively. A very significant relationship was found between the non-reducing disc displacement and condylar degenerative changes. The conclusion of our study supports the outcomes of other studies in the literatüre (2,5-7,20,22,25,26).

The present study has highlighted the importance of imaging techniques in confirming clinical diagnosis of the patients with TMJ disc displacement and detection of the bony degenerative changes. The outcomes of this study have demonstrated that early diagnosis and treatment procedures applied in the early term are very important for prevention of the pathological changes on the joint surfaces in the clinical picture of TMJ ID. Treatment should aim to prevent the progression of reducing disc displacement to non-reducing disc displacement. Thus, the risk for degeneration of the bone surfaces can be minimized.

CONCLUSION

There is a significant relationship between TMJ with non-reducing disc displacement and condylar degenerative change. No statistically significant relationship was found between reducing disc displacement and condylar degenerative change. Early diagnosis and treatment of the TMJ internal derangements are important to prevent the progression of the disease.

Competing interests: The authors declare that they have no competing interest.
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