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Correlation between internal derangement and osteoarthrosis in the temporomandibular joint using magnetic resonance imaging

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ABSTRACT

Purpose : To evaluate the relationship between internal derangement and osteoarthrosis in the temporomandibular joint (TMJ) using magnetic resonance imaging (MRI).

Materials and Methods : One hundred and six MR images of TMJs in 53 patients were evaluated. Disc displacements and osseous changes of the TMJs were assessed. Lateral and rotational disc displacements were also evaluated on coronal images.

Results : No significant differences in the frequency of osseous changes of the TMJs between disc displacement with reduction and disc displacement without reduction groups were found. The erosion of the condylar head and the sclerosis of the articular eminence were more frequent in the internal derangement group than in the no disc displacement group. The flattening was the most frequently observed osseous change of both the condylar head and articular eminence.

Conclusion : The relationship between internal derangement and osteoarthrosis is obscure, but it is thought that both disorders adversely affect each other. (***Korean J Oral Maxillofac Radiol 2002; 32 : 221-5***)

KEY WORDS : temporomandibular joint disc; osteoarthrosis; magnetic resonance imaging

Internal derangement (ID) and osteoarthrosis are the most frequently observed temporomandibular disorders (TMD).

ID of the temporomandibular joint (TMJ) may be defined as an abnormal positional relationship of the articular disc to the mandibular condyle, articular fossa and articular eminence.[1,2] Osteoarthrosis has been defined as a non-inflammatory joint disease that is characterized by progressive deterioration and loss of articular surface and simultaneous remodeling of the underlying bone.[3,4]

It is widely recognized that ID and osteoarthrosis are closely related disorders. Several authors described that ID is a predisposing factor for osteoarthrosis.[5-8] However, the precise relationship between these disorders remains controversial. Kondoh et al.[9] found no relationship between the irregularities of the articular surface and ID.

Magnetic resonance imaging (MRI) has been widely used in the evaluation of the disc position, disc configuration, and osseous changes of the TMJ.[10-12] MRI shows a high spatial resolution with an accuracy of 85-100% for the identification of ID or degenerative osseous changes with flattening, sclerosis, erosion and osteophyte formation of the TMJ.[13] In particular, the oblique sagittal and coronal sections of MRI have superior soft and hard tissue resolution.[14] Tasaki and Westesson[10] reported a 95% accuracy in the assessment of disc position and configuration, and 93% accuracy in the assessment of osseous changes of the TMJ.

Anterior disc displacement (DD) may occur alone or together with a medial or lateral shift of the disc over the condylar head. Sideway displacement implies that the disc is displaced medially or laterally without anterior displacement. And rotational displacement implies a combination of anterior and medial or lateral DD.

The purpose of this study was to evaluate the relationship between ID and osteoarthrosis in the TMJ using MRI.

Materials and Methods

1. Materials

One hundred and ninety six TMJs in 98 patients representing signs and symptoms were examined at the Department of Oral & Maxillofacial Radiology, Chonbuk National University Dental Hospital between January 1995 and September

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Table 1. Distribution of age and gender of the patients

Age	Gender	
	Male	Female
11-20	22	5
21-30	11	6
31-40	3	2
41-50	1	1
51-60	0	1
60-	0	1
Total	37	16

2002. Patients with a history of trauma and orthognathic surgery were excluded from the study. This study was based on 53 of 98 patients (16 females and 37 males) ranging in age from 13 to 62 years with a mean age of 24.3 years (Table 1).

2. Methods

MR images were obtained in 106 TMJs by 1.5 T MRI system (Magnetom vision, Siemens, Germany) with circular bilateral 7.5 cm surface coil placed around the TMJs and included 3 mm section thickness with a 256 × 256 matrix. A spin echo (SE) multisection imaging method was used for T1-weighted images (TR/TE = 400/15), T2-weighted images (TR/TE = 2000/105) and proton density images (TR/TE = 2000/52). The TMJs were scanned in mouth-closed and -open position. Sagittal and coronal images were also obtained.

The disc position was considered normal if the posterior band of the disc was located at the 12-o'clock or superior position relative to the condyle. DD was diagnosed if the posterior band of the disc was in an anterior, anteromedial, anterolateral, medial or lateral position relatively to the superior part of the condyle.[1, 10]

Diagnosis of the functional disc-condyle relationship was categorized as normal or as disc displacement with or without reduction. The categorization was based on whether the displacement was or was not associated with an interposition of the disc between the condyle and the articular eminence in the open-mouth position.[10]

MRI diagnosis of the TMJ osteoarthrosis was defined as the presence of flattening, sclerosis, erosion, and osteophyte formation of the condylar head and articular eminence.

1) Data Analysis

The MRI findings of ID and osteoarthrosis of the TMJ were statistically assessed by the chi-square test, with Fisher's Exact Test. For all statistical analysis, the Statistical Package for the Social Science (SPSS Inc, Chicago, III; 1997) was used.

Results

Table 2 shows the DD and osseous changes of the TMJ.

A MRI diagnosis of ID of the TMJ was established in 79 of 106 joints (74.5%) with 44 joints having DDs with reduction (DDWR) (41.5%) and 35 joints having DDs without reduction (DDWOR) (33.0%). Anterior DDWR was observed in 14 of 106 joints (13.2%), and anterior DDWOR in 19 of 106 joints (17.9%) and posterior DD was not found (Figs. 1, 2).

Medial DDWR was observed in 9 of 106 joints (8.5%), and medial DDWOR in 2 of 106 joints (1.9%). Lateral DD was not found. Anteromedial DDWR was observed in 19 of 106 joints (17.9%), and anteromedial DDWOR in 10 of 106 joints (9.4%), anterolateral DDWR in 2 of 106 joints (1.9%), and anterolateral DDWOR in 4 of 106 joints (3.8%).

Of the 106 condylar heads, the sclerosis was observed in 11 joints (10.4%), the flattening in 55 joints (51.9%), the erosion in 29 joints (27.4%) and the osteophyte formation in 1 joint (0.9%) (Fig. 3). Of the 106 articular eminences, the sclerosis was observed in 34 joints (31.2%), the flattening in 43 joints (40.6%) and the erosion in 19 joints (17.9%) (Fig. 4).

Osseous changes of the condylar head with anterior or rotational DD were more common than with sideways DD ($p < 0.05$). The flattening of the condylar head with anterior or

Table 2. Disc displacement and osseous changes of the TMJ (n = 106)

Disc Displacement	Condylar head					Articular eminence			
	NS	S	F	E	O	NS	S	F	E
NDD (n = 27)	13	1	13	1		9	9	8	6
Simple									
Anterior disc displacement									
WR (n = 14)	3		7	8		6	4	4	2
WOR (n = 19)	2	1	14	11		2	4	10	3
Sideway									
Medial disc displacement									
WR (n = 9)	6	2	2	2		2	1	5	2
WOR (n = 2)	2							2	2
Rotational									
Anteromedial disc displacement									
WR (n = 19)	4	2	12	4		3	6	11	3
WOR (n = 10)	3	2	7	3	1	3	6	2	1
Anterolateral disc displacement									
WR (n = 2)	1	1	1				1	1	
WOR (n = 4)		2	4				4		

NDD : no disc displacement; NS : non-specific; S : sclerosis; F : flattening; E : erosion; O : osteophyte formation; WR : with reduction; WOR : without reduction

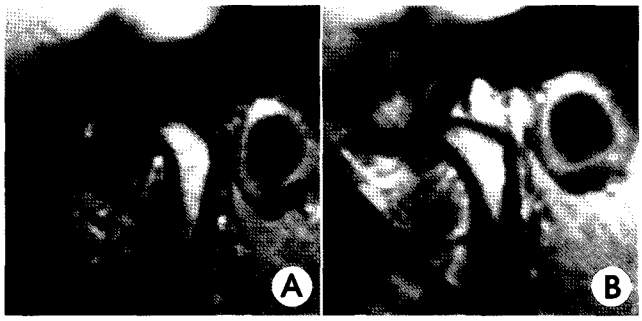

Fig. 1. MR images show anterior disc displacement with reduction (A: close, B: open).

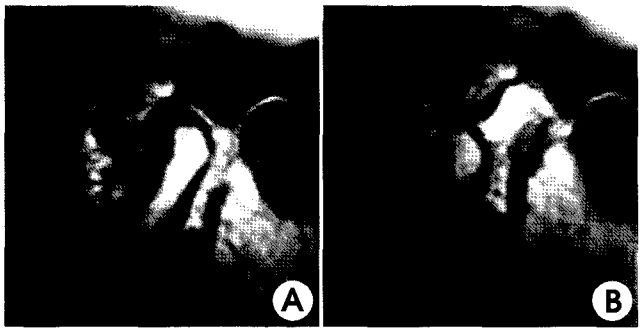

Fig. 2. MR images show anterior disc displacement without reduction (A: close, B: open).

Table 3. Osseous changes of the condylar head

Osseous change	NDD	Internal derangement		Significance
		DDWR	DDWOR	
Non-specific	8 (26.7%)	14 (46.6%)	8 (26.7%)	0.062
Flattening	8 (14.5%)	22 (40.0%)	25 (45.5%)	0.613
Sclerosis	1 (9.0%)	5 (45.5%)	5 (45.5%)	0.095
Erosion	1 (3.4%)	14 (48.3%)	14 (48.3%)	0.004*
Osteophyte formation	0	1 (100%)	0	0.585

NDD : no disc displacement
DDWR : disc displacement with reduction
DDWOR : disc displacement without reduction
*statistical significant by χ^2 test ($p < 0.05$)

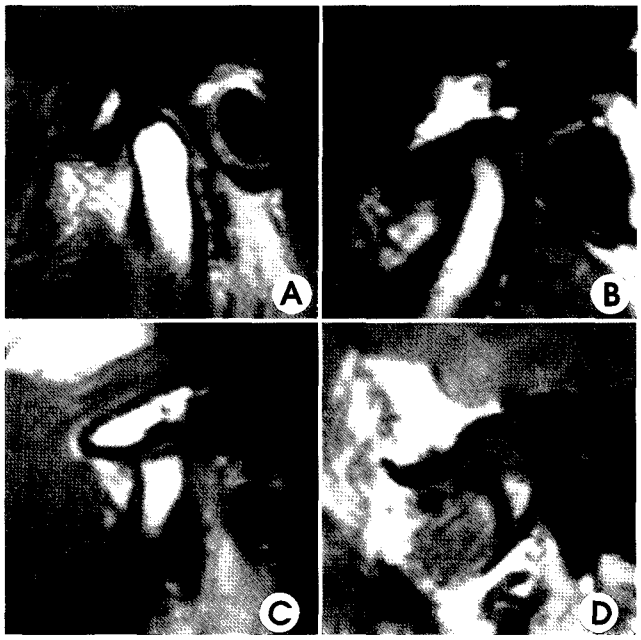

Fig. 3. MR images show osseous changes of the condylar head (A: sclerosis, B: flattening, C: erosion, D: osteophyte formation).

Table 4. Osseous changes of the articular eminence

Osseous change	NDD	Internal derangement		Significance
		DDWR	DDWOR	
No change	9 (36.0%)	11 (44.0%)	5 (20.0%)	0.207
Flattening	8 (18.2%)	21 (47.8%)	15 (34.1%)	0.320
Sclerosis	9 (25.7%)	12 (34.3%)	14 (40.0%)	0.042*
Erosion	6 (35.3%)	5 (29.4%)	6 (35.3%)	0.768
Osteophyte formation	0	0	0	

rotational DD was more common than with sideways DD ($p < 0.05$). On the other hand, the erosion of the condylar head in ID group was more frequent than in NDD group ($p < 0.05$). In DDWOR group, sclerotic change of the articular eminence was more common than in NDD or DDWR group ($p < 0.05$).

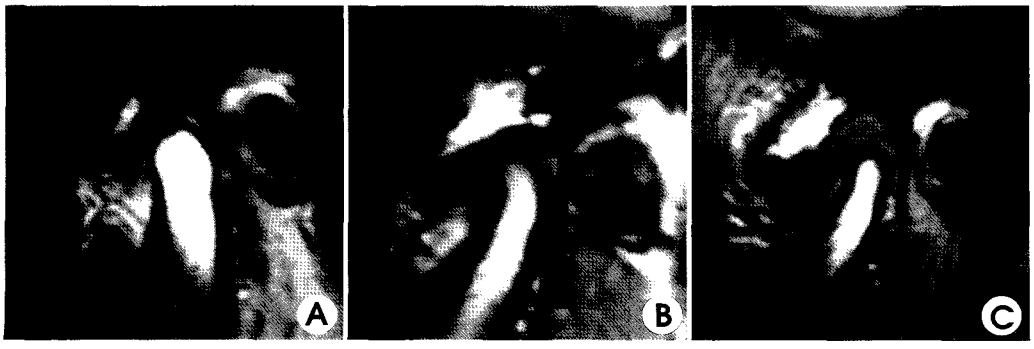

Fig. 4. MR images show osseous changes of the articular eminence (A: sclerosis, B: flattening, C: erosion).

Discussion

The relationship between ID and osteoarthrosis is not clear. Several reports support the view that ID is the cause of TMD. Boering[15] reported that osteoarthrosis was related to ID by the progressive nature of the disorder in an initial (reducing DD), intermediate (permanent DD), and terminal state ('burn-out' osteoarthrosis). Eversole and Machado[16] classified four types of ID and the fourth group was established in degenerative disease. Eberhard et al.[17] described that the most common predisposing factor for degenerative TMJ changes was DD. De Leeuw et al.[4] have shown that radiographically visible degenerative changes become evident within a few months after the disc becomes permanently displaced. However, it has been described that osteoarthrosis is the cause rather than the result of ID. Stegenga et al.[6] noted that DD should be regarded as an accompanying sign of osteoarthrosis rather than its cause. Kondoh et al.[9] found a greater prevalence of morphologic changes in the inferior than in the superior surface of the disc, and they reported that there was no relationship between surface irregularities in the joint and the position of the disc. Autopsy studies showed that early osteoarthrosis such as surface roughness might provoke the DD.[18,19]

The results of this study showed that the erosion of the condylar head and the sclerotic change of the articular eminence were more frequent in ID group than in NDD group. However, the frequency of osseous changes in the TMJ was not different between DDWR and DDWOR group. Therefore, the role of reducing DD in the course of the TMJ osteoarthrosis remains obscure.

MRI is a noninvasive imaging procedure with excellent soft and hard tissue resolution. It has been widely used for examination of the TMJ. Tasaki and Westesson[10] reported the sensitivity, specificity and accuracy of MRI of the TMJ with respect to disc position, disc configuration, and osseous changes in cadavers were 95%, 95%, and 93%, respectively. If oblique coronal MRI is not performed, medial and lateral displacement of the disc cannot be found. Larheim[14] reported that the most frequent abnormal disc position in patients with TMD was the anterior or anterolateral, and medial displacement was more infrequent. Posterior DD was extremely uncommon.

The results of this study showed that the anterior and anteromedial DD were more common than the medial and anterolateral DD. A pure lateral and posterior DD were not found. MRI is probably the optimal technic for examination of the sideway and rotational displacement of the TMJ disc.

When we examined the osseous changes of the TMJ on MRI, we should consider some points. An absence of osseous changes on MRI dose not rule out the presence of osteoarthrosis, since early degenerative changes can hardly be detected on MR images.

Degenerative changes may be considered a maladaptive response and is closely related to adaptation. Both degenerative changes and adaptation may give rise to remodeling. Remodeling may be seen in the TMJ with the condylar flattening. Because minor flattening may not be consistent with osteoarthrosis, it should be examined with great caution.

In this study, the flattening was the most frequently observed osseous change of the condylar head and articular eminence.

Aging is the one of the factors that is likely involved in the deterioration of the articular surfaces. Pereira et al.[20] studied two age groups. In the elderly group, they found degenerative changes in 18% of the joints with normal disc position, and in the young group, nearly one third of the joints with normal disc position had degenerative changes. MRI studies of asymptomatic subjects have shown DD in 33% of these subjects with clinically normal. These results show that, in some instances, anterior DD may be an anatomic variant rather than a pathologic condition.

In conclusion, the relationship between ID and osteoarthrosis is still obscure, but it is thought that both disorders affect adversely each other.

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