

Articular Disc Position and Configuration in Internal Derangement of Temporomandibular Joint

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Internal derangement of the temporomandibular joint (TMJ) is defined as a malrelationship among the condylar process, mandibular fossa, and articular disc. It produces changes of the disc position and configuration. Magnetic resonance imaging (MRI) is an excellent radiographic method for the primary diagnostic evaluation of TMJ internal derangement, especially for confirming the disc displacement and deformation.

The purpose of this study was to evaluate the relationship between the disc position and configuration in the closed and open mouth positions according to the degree of disc displacement and deformation. Of 131 joints with TMJ internal derangement from 98 patients, anterior displacement without reduction of the articular disc was found in 65 joints (49.6%), and deformed disc in about 75.0%. All of the articular discs diagnosed as anterior displacement without reduction of the articular disc accompanying osteoarthritis, were severely deformed. The disc deformation was preceded by anterior displacement of the articular disc and degenerative change of the condylar process. The more the disease process of TMJ internal derangement became worse, the more the articular disc was anteriorly displaced and severely deformed. Therefore, it was concluded that early treatment of TMJ disorder may decrease the disc displacement and deformation.

Key Words: Internal derangement of temporomandibular joint, Disc position and configuration, Magnetic resonance imaging

INTRODUCTION

Internal derangement of the temporomandibular joint (TMJ) is defined as an abnormal relationship among the condylar process, mandibular fossa, and articular disc. It produces changes of the disc position and configuration according to the pathologic advancement of TMJ disease. The pathologic process of TMJ internal derangement is closely related to the amount of anterior disc displacement, reduction of the articular disc, morphological changes of the articular disc, and degenerative change of the condylar process¹. As the condition of TMJ internal derangement takes a turn for the worse, the articular disc may have undergone the positional and morphological changes with degenerative change of the condylar process.

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Magnetic resonance imaging (MRI) is an excellent method for the primary diagnostic evaluation of TMJ internal derangement. And, it provides sufficient informations for determining the type and stage of joint abnormality. Specifically, the disc position and configuration can be clearly seen^{2,3}.

Recent studies⁴⁻¹⁰ on TMJ internal derangement have indicated that a significant information of disc displacement and deformation can be gathered by the use of sagittal and coronal MRI images. The importance of disc position and configuration in TMJ internal derangement is well-known, and the degree of disc deformation is related to the degree of anterior disc displacement and reduction of the articular disc. But, there is insufficient information regarding the disc position and configuration in the closed and open mouth positions, which is essential for planning early treatment of TMJ disorder.

The purpose of this investigation is to evaluate the disc position and configuration in the closed and open mouth positions. Furthermore, we wish to study the relationship between

the disc position and configuration according to the degree of disc displacement and deformation.

MATERIALS AND METHODS

One hundred and thirty one joints from ninety eight patients (24 males, 74 females) with a mean age of 27 years (range, 14~75 years) diagnosed as having TMJ internal derangement at the Department of Dentistry, Ajou University Hospital were studied. There were 65 patients (65 joints) with unilateral internal derangement and 33 patients (66 joints) with bilateral internal derangement.

Sagittal T1- and T2-weighted MR images were obtained in

the closed and open mouth positions using a dual 3 inch (7.6 cm) surface coil of a GE Medical System (Signa 1.5 Tesla advantage). The parameters for T1-weighted CSE (conventional spin-echo) sequence included a TR msec/TE msec of 500/19, 256×192 matrix, 10 cm field of view, 3 mm thick contiguous sections, and two signals averaged. The total imaging time was 3 minutes 20 seconds. The parameters for T2-weighted FSE (fast spin-echo) sequence performed a TR msec/TE msec of 4000/116, 256×256 matrix, 10 cm field of view, 3 mm thick sections, and two signals averaged. The total imaging time was 3 minutes 28 seconds.

Anterior displacement of the articular disc was subdivided into three groups according to the disc position in the closed



Fig. 1. A normal-shaped disc (arrow) in closed (A) and open (B) mouth positions are seen on T1-weighted sagittal magnetic resonance images of the temporomandibular joint with anterior displacement and reduction of the articular disc.



Fig. 2. A planar disc (arrow) in closed mouth position (A) and a normal-shaped disc (arrow) in open mouth position (B) are seen on T1-weighted sagittal magnetic resonance images of the temporomandibular joint with anterior displacement and reduction of the articular disc.



Fig. 3. A planar disc (arrow) in closed mouth position (A) and a folded disc (arrow) in open mouth position (B) are seen on T1-weighted sagittal magnetic resonance images of the temporomandibular joint with anterior displacement but without reduction of the articular disc.

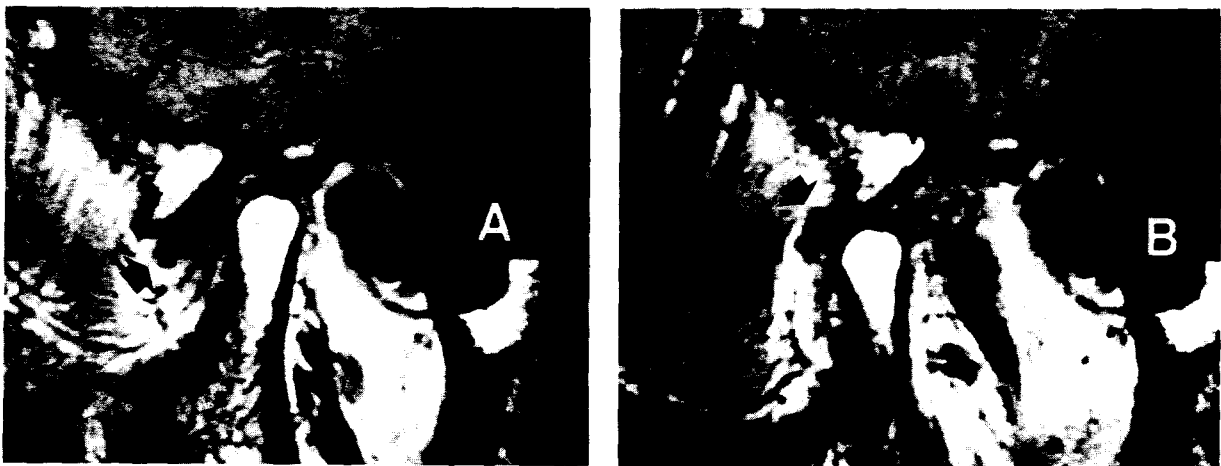


Fig. 4. A amorphous disc (arrow) in closed mouth position (A) and a amorphous disc (arrow) in open mouth position (B) are seen on T1-weighted sagittal magnetic resonance images of the temporomandibular joint with anterior displacement but without reduction of the articular disc.

and open mouth positions; with disc reduction (In the closed mouth position, the articular disc was anteriorly displaced, but it was reduced to normal position in the open mouth position), without disc reduction (In the closed mouth position, the articular disc was anteriorly displaced, and it was not reduced to normal position in the open mouth position), and without disc reduction accompanying osteoarthritis. The disc configuration was categorized according to the disc shape as normal-shaped (biconcave or bow-tie), folded, planar, convex, spectacle-shaped, and amorphous discs in the closed and open mouth positions (Fig. 1, 2, 3, 4, 5).

RESULTS

Of one hundred and thirty one joints with TMJ internal derangement, anterior disc displacement with reduction was noted in 43 joints (32.8%), anterior disc displacement without reduction in 65 joints (49.6%), and anterior disc displacement without reduction accompanying osteoarthritis in 23 joints (17.6%).

The disc deformation was seen in about 75.0% of all joints in the closed and open mouth positions. Of 43 joints



Fig. 5. A spectacle-shaped disc (arrow) in closed mouth position (A) and a amorphous disc (arrow) in open mouth position (B) are seen on T1-weighted sagittal magnetic resonance images of the temporomandibular joint with anterior displacement but without reduction of the articular disc accompanying osteoarthritis.

diagnosed as anterior disc displacement with reduction, the number of deformed disc was 22 joints (51.2%) in the closed mouth position and was 15 joints (34.9%) in the open mouth position. Of 65 joints diagnosed as anterior disc displacement without reduction, the number of deformed disc was 52 joints (80.0%) in the closed mouth position and was 61 joints (93.8%) in the open mouth position. Of 23 joints diagnosed as anterior disc displacement without reduction accompanying osteoarthritis, all discs were deformed in the closed and open mouth positions (Table 1).

Of the deformed discs having anterior displacement with reduction, planar disc was most common in the closed and open mouth positions, but spectacle-shaped and amorphous discs were not found. Of the deformed discs having anterior displacement without reduction, planar disc was most common in the closed mouth position, and folded disc was most common in the open mouth position. Of the deformed discs having anterior displacement without reduction accompanying osteoarthritis, amorphous disc was most common in the closed and open mouth positions (Table 1).

The change of disc configuration from the closed to open mouth position showed that 18 joints (41.9%) had "normal to normal" change in cases of anterior disc displacement with reduction. Fifty one joints (78.5%) had "deformed to deformed" change in cases of anterior disc displacement without reduction. In cases of anterior disc displacement without reduction accompanying osteoarthritis, all discs had "deformed to

deformed" change (Table 2).

DISCUSSION

The articular disc displacement and deformation are very important for diagnosing TMJ internal derangement correlating with the clinical symptoms, radiographic and surgical findings. These can be the major causes of TMJ pain, TMJ sounds such as clicking, popping, and crepitus, mandibular dysfunction, and TMJ osteoarthritis¹¹. Therefore, the disc position and configuration become the focus of classification, diagnosis, and treatment of TMJ internal derangement¹².

The role of TMJ articular disc is not completely understood, but it is thought that the normal disc position and configuration contribute to the joint stability in anatomic and functional respects. The articular disc is able to move passively with the mandibular condyle during sliding movements, and there is also an active component attributed to the disc movement during condylar excursion in the normal position. The biconcave disc configuration, which is normal-shaped disc, may serve to cushion joint loads, as well as to facilitate lubrication and nourishment of the joint surfaces¹³. Therefore, the disc deformation is closely associated with disturbed function of the joint, and should also be considered when one is planning the treatment of TMJ internal derangement^{14,15}.

In TMJ internal derangement, the most frequent disc

Table 1. Relationship between disc position and configuration of TMJ internal derangement in closed and open mouth positions

Disc configuration		Normal	Deformed				Total	
			Folded	Planar	Convex	Spectacle-shaped		Amorphous
Disc position								
Closed mouth	Anterior disc displacement with reduction	21 (48.8)	5	13	4	0	0	43 (100.0)
	Anterior disc displacement without reduction	13 (20.0)	11	23	5	2	18	65 (100.0)
	Anterior disc displacement without reduction accompanying osteoarthritis	0	3	2	1	1	16	23 (100.0)
Open mouth	Anterior disc displacement with reduction	28 (65.1)	1	9	5	0	0	43 (100.0)
	Anterior disc displacement without reduction	4 (6.2)	27	3	6	7	18	65 (100.0)
	Anterior disc displacement without reduction accompanying osteoarthritis	0	0	0	0	3	20	23 (100.0)

Number of joints (%)

displacement and deformation is anterior displacement and enlargement of the posterior band, which is in accordance with the clinical observations. The disc deformation is closely associated with disturbed joint function. Therefore, it seems essential clinically to evaluate the disc configuration as well as to evaluate the disc position when planning the treatment of TMJ internal derangement. Many investigators have reported the disc position and configuration with autopsy specimen of TMJ¹⁵, arthrography¹⁶, arthroscopy¹⁷, magnetic resonance imaging^{6,7}, and three-dimensional computer reconstruction using multiple serial sections¹⁸.

In the previous MRI study⁶ on the disc position and con-

figuration, of 273 patients who had a clinical diagnosis with TMJ disorder, most of the slightly anteriorly displaced discs (90~97%) in the closed mouth position were reduced to normal position in the open mouth position. In cases of the slight anterior disc displacement, it was reduced simultaneously with TMJ clicking sound during mouth opening. Anterior displacement with reduction of the articular disc in our study have indicated that the articular disc was anteriorly displaced in the closed mouth position, but was reduced to the normal position in the open mouth position.

However, as a result of this study, the majority of deformed discs (76.0%) was completely displaced anteriorly without

Table 2. Change of disc configuration of TMJ internal derangement from closed to open mouth position in each disc positions

Disc position	Change of disc configuration				Total
	Normal to normal	Normal to deformed	Deformed to normal	Deformed to deformed	
Anterior disc displacement with reduction	18 (41.9)	4 (9.3)	16 (37.2)	5 (11.6)	43 (100.0)
Anterior disc without reduction	3 (4.6)	11 (16.9)	0	51 (78.5)	65 (100.0)
Anterior disc displacement without reduction accompanying osteoarthritis	0	0	0	23 (100.0)	23 (100.0)

Number of joints (%)

reduction. The deformed disc was not found in the normal position without disc displacement. Therefore, it was concluded that the articular disc began to deform after anterior displacement⁶. These results were not similar to ours. In our study, the articular discs displaced anteriorly with reduction showed normal appearance in 48.8% in the closed mouth position and in 65.1% in the open mouth position. The articular discs displaced anteriorly without reduction showed normal appearance in 20.0% in the closed mouth position and in only 6.2% in the open mouth position. But, the articular discs displaced anteriorly without reduction accompanying osteoarthritis didn't show normal appearance in the closed and open mouth positions (Table 1).

Leeuw et al.¹⁹ reported the disc position and configuration of 55 TMJ magnetic resonance images, which were diagnosed as TMJ internal derangement approximately 30 years ago. They reported that the degree of disc deformation was related to the degree of anterior disc displacement. And, if the articular disc became permanently displaced, its configuration deviated from the normal biconcave configuration with anteroposterior length decrease.

Furthermore, shortening of the anteroposterior disc length with volume decrease was found in all joints with long-standing permanent disc displacement. The disc configuration deviated as soon as the articular disc became permanently displaced, and convex discs with the disc folding on mouth opening were common. Generally, these conclusions were

similar to ours. But, in cases of anterior disc displacement without reduction, planar discs were most common deformation in the closed mouth position, and folded discs were most common deformation in the open mouth position. In cases of anterior disc displacement without reduction accompanying osteoarthritis, amorphous discs were most common deformation in the closed and open mouth position (Table 1).

TMJ internal derangement has mainly been studied arthrographically from the standpoint of anterior displacement with or without reduction of the articular disc. Frequent clinical observations of the disc deformation in joints with TMJ internal derangement implied the need for a systemic study of morphological alterations associated with internal derangement. Westesson et al.¹ studied the relationship among the disc morphology, internal derangement, and joint function in 58 randomly selected autopsy specimens of the TMJ. The results showed that the disc deformation was rarely seen in the joints with superior disc position and in the joints with partially anterior disc position, and the disc deformation occurred somewhat more frequently in 31.0%. The joints with completely anteriorly positioned disc showed the disc deformation in 77.0% and irregularity of the articular surface in 65.0%. In conclusion, they described that anteriorly displaced disc position preceded the disc deformation.

Our investigation performed by use of MRI from 98 patients with TMJ internal derangement. The results showed

that, of 131 joints with anteriorly displaced disc position, the joints having anterior disc displacement without reduction were most common in 49.6%, and the joints with disc deformation were about 75.0% in the closed and open mouth positions. These results have demonstrated a high frequency of the disc deformation in TMJ internal derangement (Table 1).

In our study the disc configuration was very variable according to the disc position. Among the kinds of deformed disc shape, spectacle-shaped and amorphous discs were more severe than folded, planar, and convex discs in the aspect of deformation degree. The more the articular disc displaced anteriorly, the more it was deformed into spectacle-shaped and amorphous discs. Therefore, the articular discs of anterior displacement without reduction accompanying osteoarthritis, which was the most advanced TMJ internal derangement, were mainly amorphous discs in the closed and open mouth positions (Table 1).

In cases of anterior disc displacement with reduction, the normal-shaped discs were more common than the deformed discs in the open mouth position. But, on the contrary, in cases of anterior disc displacement without reduction, the deformed discs were more common than the normal-shaped discs. In cases of anterior disc displacement without reduction accompanying osteoarthritis, all discs were severely deformed into amorphous disc in the closed and open mouth positions. And, the articular discs were deformed more severe in the open mouth position than in the closed mouth position, because 1 joint with spectacle-shaped disc and 16 joints with amorphous disc in the closed mouth position were increased into 3 joints and 20 joints in the open mouth position (Table 1).

In the changes of disc configuration from the closed to open mouth position, the articular discs of anterior displacement with reduction showed normal appearance in 41.9% and "deformed to normal" change in 37.2%. Although the articular disc was deformed during mouth closing, it was normal-shaped disc at the time of mouth opening. This was a special characteristic of anterior disc displacement with reduction. The articular disc of anterior disc displacement without reduction showed "deformed to deformed" change in 78.5%, and did not show "deformed to normal" change. The articular discs of anterior disc displacement without reduction accompanying osteoarthritis showed "deformed to deformed"

change in all cases (100.0%) (Table 2).

Therefore, it was thought that the disc deformation was closely related to degenerative change of the condylar process in association with the disc displacement. Particularly in advanced TMJ internal derangement, the disc deformation in open mouth position was shightly more severe than in closed mouth position. The articular disc was more deformed in the joints with long-standing permanent disc displacement without reduction. And so, the more the disease process became worse, the more the articular disc was anteriorly displaced and severely deformed.

Osteoarthritic change of the condylar process are secondary finding in the pathologic process of TMJ internal derangement. It is a result of continued disco-condylar dysfunction with loss of the disc integrity. Imbalanced lateral pterygoid muscle function and continuous traumatic injuries to the condylar process appear to be the primary etiologic factor. The degree of osteoarthritic change in the joint reflects the severity and chronicity of TMJ internal derangement, especially in causing the disc damage^{20~22}.

In this study, all discs of anterior displacement without reduction accompanying osteoarthritis were severely deformed resulting in amorphous discs. And, it was necessary to evaluate the disc perforation by means of arthrography or arthroscopy, since the severely deformed and displaced disc with degenerative change of the condylar process tended to have the disc perforation.

CONCLUSION

In TMJ internal derangement, the disc configuration was very closely related to the disc position, and the deformed discs were more common than the normal-shaped discs. The disc deformation was preceded by anterior displacement of the articular disc and degenerative change of the condylar process, while the degree of disc deformation was related to the degree of anterior disc displacement and reduction of the articular disc. The more the disease process of TMJ internal derangement became worse, the more the articular disc was anteriorly displaced and severely deformed. Therefore, in our opinion, early treatment of TMJ disorder would lessen the disc displacement and deformation.

REFERENCES

1. Westesson PL, Bronstein SL and Liedberg J: Internal derangement of the temporomandibular joint; Morphologic description with correlation to joint function. *Oral Surg Oral Med Oral Pathol* 59: 323-331, 1985.
 2. Katzberg RW, Schenck J, Roberts D, Tallents RH, Manzione JV, Hart HR, Foster TH, Wayne WS and Besette RW: Magnetic resonance imaging of the temporomandibular joint meniscus. *Oral Surg Oral Med Oral Pathol* 59: 332-335, 1985.
 3. Price C and Fache JS: Magnetic resonance imaging of the temporomandibular joint; Normal appearances. *Dentomaxillofac Radiol* 15: 79-85, 1986.
 4. Santler G, Karcher H and Simbrunner J: MR imaging of the TMJ; MR diagnosis and intraoperative findings. *J Craniomaxillofac Surg* 21: 284-288, 1993.
 5. Kirk WS: Sagittal magnetic resonance image characteristics and surgical findings of mandibular condyle surface disease in staged internal derangements. *J Oral Maxillofac Surg* 52: 64-68, 1994.
 6. Murakami S, Takahashi A, Nishiyama H, Fujishita M and Fuchihata H: Magnetic resonance evaluation of the temporomandibular joint disc position and configuration. *Dentomaxillofac Radiol* 22: 205-207, 1993.
 7. Matsuda S and Yoshimura Y: Magnetic resonance imaging assessment of the temporomandibular joint in disk displacement. *Int J Oral Maxillofac Surg* 23: 266-270, 1994.
 8. Lee JH, Hwang BN and Lee JK: A clinical study of internal derangement of temporomandibular joint diagnosed with magnetic resonance imaging. *Ajou Medical J* 1: 151-162, 1996.
 9. Lee JH, Hwang BN and Lee JK: Clinical evaluation of bilateral internal derangement of temporomandibular joint by magnetic resonance imaging. *J Kor Acad Maxillofac Plast Reconstr Surg* 18: 78-86, 1996
 10. Lee JH: Comparison of disc position and configuration of magnetic resonance imaging with TMJ pain in TMJ internal derangement. *J Kor Assoc Oral Maxillofac Surg* 22: 307-321, 1996.
 11. Dolwick MF, Katzberg RW and Helms CA: Internal derangements of the temporomandibular joint; Fact or fiction? *J Prosthet Dent* 49: 415-418, 1983.
 12. Hall HD: *Intra-articular disc displacement Part II; Its significant role in temporomandibular joint pathology.* *J Oral Maxillofac Surg* 53: 1073-1079, 1995.
 13. Dolwick MF: *Intra-articular disc displacement Part I; Its questionable role in temporomandibular joint pathology.* *J Oral Maxillofac Surg* 53: 1069-1072, 1995.
 14. Delfino JJ and Eppley BL: Radiographic and surgical evaluation of internal derangement of the temporomandibular joint. *J Oral Maxillofac Surg* 44: 260-267, 1986.
 15. Westesson PL and Rohlin M: Internal derangement related to osteoarthritis in temporomandibular joint autopsy specimens. *Oral Surg Oral Med Oral Pathol* 57: 17-22, 1984.
 16. Panmekiate S, Petersson A and Åkerman S: Some anatomical factors of the upper compartment of the temporomandibular joint related to the disc position. *Int J Oral Maxillofac Surg* 20: 375-377, 1991.
 17. McCain JP: Arthroscopy of the human temporomandibular joint. *J Oral Maxillofac Surg* 46: 648-655, 1988.
 18. Dijkgraaf LC, Lambert GM, Otten E and Boering G: Three-dimensional visualization of the temporomandibular joint; A computerized multisectional autopsy study of disc position and configuration. *J Oral Maxillofac Surg* 50: 2-10, 1992.
 19. Leeuw R, Boering G, Stegenga B and Bont LGM: TMJ articular disc position and configuration 30 years after initial diagnosis of internal derangement. *J Oral Maxillofac Surg* 53: 234-241, 1995.
 20. Vichaichalmvong S, Nilner M, Panmekiate S and Petersson A: Clinical follow-up of patients with different disc positions. *J Orofac Pain* 7: 61-67, 1993.
 21. Ren YF, Isberg A and Westesson PL: Condylar position in the temporomandibular joint; Comparison between asymptomatic volunteers with normal disk position and patients with disk displacement. *Oral Surg Oral Med Oral Pathol* 80: 101-107, 1995.
 22. Katzberg RW, Westesson PL, Tallents RH and Drake CM: Anatomic disorders of the temporomandibular joint disc in asymptomatic subjects. *J Oral Maxillofac Surg* 54: 147-153, 1996.
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