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Original Article

Clinical and magnetic resonance imaging study of unilateral sideways disc displacements of the temporomandibular joint

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The aim of our study was to find symptomatic diagnostic factors for sideways displacement of the temporomandibular joint disc, compared with anterior or rotational disc displacement. A consecutive series of 2310 temporomandibular joints were examined with MRI to define the clinical signs and symptoms particularly related to sideways disc displacement compared to anterior disc displacement with logistic regression model. Bone change of the mandibular condyle and age were negatively related factors in differentiating cases with lateral disc displacement from anterior disc displacement without reduction. Range of mouth opening (over 40 mm) was a significant predictor (odds ratio 4.5865 for lateral disc displacement). This study suggested the wide opening of the mouth to become the predictor for the lateral disc displacement among the cases suspected to have disc displacement without reduction.

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Introduction

Most interest concerning temporomandibular joint (TMJ) internal derangement has been focused on disc displacements. The most common direction of TMJ disc displacement is anterior.[1-3] However, disc displacement also occurs in the lateral or medial directions.[4] Magnetic resonance imaging (MRI) of the TMJ has been shown to be valuable in the detection of disc displacement as well as in the assessment of disc configuration in cases suspected of having internal derangement.[5] The major advantages of MRI are that it can produce high quality images of soft tissues without the use of ionising radiation and is noninvasive compared with arthrography. Furthermore, MRI is a viable option not only for the recognition of soft tissue conditions, but also for the assessment of subtle osseous changes on the basis of variations in signal intensity.

There have been 2 reports of the association of clinical features with MRI findings on sideways disc displacement.[6,7] However, there has been no report restricted to unilateral disc displacement and not defined whether sideways disc displacement and

anterior disc displacement have the same clinical signs and symptoms. The purpose of this study was to find symptomatic diagnostic factors for sideways displacement of the disc, compared with anterior or rotational disc displacement, focused on unilateral disc displacement, by means of assessment of the adjusted odds ratio by logistic regression analysis.

Materials and Methods

Cases

The study was based on a consecutive series of 2310 TMJs in 1155 cases examined with MRI in the Department of Oral Surgery, Tokyo Medical and Dental University, and the Department of Oral Radiology, Tsurumi University. The cases had been referred for MRI for suspected bilateral or unilateral internal derangement from January 1998 to March 1999. Because this was retrospective analysis of an existing data set, written informed consent was not obtained from the participating subjects, and was performed in accordance with the guidelines of the Helsinki Declaration, as revised in 1996.

Criteria

All cases were examined according to the same criteria. The MRI was performed on either a 1.5 T imaging unit (SIEMENS; MAGNETOM VISION) or a 0.3 T imaging unit (HITACHI MEDICAL; MRP-7000) with bilateral 3-inch diameter surface coils. Validity was ensured because the diagnostic accuracy of these units has previously been fully confirmed. After an axial localizer image had been obtained, sagittal and coronal T1-weighted and T2-weighted images in the intercuspal position and sagittal T1-weighted images in the open mouth position were obtained. MR images were taken graphically perpendicular (sagittal images) and parallel (coronal images) to the horizontal long axis of the condyle. The imaging protocol is shown in Table 1.

The disc positions of the TMJ were classified according to the following MR criteria:[8,9]

(1) Normal state: In the closed position, the junction of the posterior band with the retrodiscal area was located above the apex of the condylar head (12 o'clock position ± 10 degrees). When the jaw opens, the disc remains interposed between the osseous components and moves anteriorly in a synchronized fashion. In the coronal plane of imaging, the disc is perfectly centered on the condylar head, without transgressing a line through the condylar poles.

(2) Anterior disc displacement without reduction (ADDwoR): In the closed and open mouth positions, the posterior band of the disc is anterior to the superior aspect of the condylar head in all sagittal sections. When the jaw is opened, the disc is anteriorly compressed.

(3) Anterior disc displacement with reduction

Table 1. MR imaging protocol

0.3 T imaging unit (HITACHI MEDICAL; MRP-7000)

Closed jaw	FOV (mm)	TR (msec)	TE (msec)	matrix	Slice thickness (mm)
Sagittal	120	400	23	240	4
Coronal	180	450	23	224	4
Sagittal	200	3330	105	256	5

Opened jaw	FOV (mm)	TR (msec)	TE (msec)	matrix	Slice thickness (mm)
Sagittal	150	600	25	180	5

1.5 T imaging unit (SIEMENS; MAGNETOM VISION)

Closed jaw	FOV (mm)	TR (msec)	TE (msec)	matrix	Slice thickness (mm)
Sagittal	90×120	1000	20	154×256	3
Coronal	90×120	960-1500	15	154×256	3
Sagittal	90×120	2930	96	154×256	3

Opened jaw	FOV (mm)	TR (msec)	TE (msec)	matrix	Slice thickness (mm)
Sagittal	90×120	1850-2500	15	154×256	3

FOV:field of view, TR:repetition time, TE:echo time

(ADDwR): In the closed position, the posterior band of the disc is anterior to the condylar head in all sagittal sections. When the jaw is opened, the disc is recaptured by the condyle and the disc condyle relation appears as normal.

(4) Rotational disc displacements (anteromedial RDD and anterolateral RDD): there is an anterior component along with the medial or lateral displacement as determined from the corresponding sagittal imaging plane.

(5) Sideways disc displacements (LDD: lateral disc displacements and MDD: medial disc displacements): In the coronal plane, the disc crosses over one of the lines through the condylar poles without an anterior component to the displacement. (Fig 1)

(6) Posterior disc displacements (PDD): In the sagittal plane, the whole disc is displaced posterior to the 12 o'clock position on top of the condyle.

The osseous change of the condyle was classified as normal or as irregularities and exposure of bone.

The form of the disc was classified as normal biconcave or as deformed. Deformation included enlargement of the posterior band, uniform thickness, or biconvex configuration of the disc.

Fig. 1. Lateral disc displacement: Coronal T1-weighted image in closed-mouth position, the disc crosses over the lines through the condylar poles.

All patients completed a questionnaire about age, sex, TMJ pain, joint sound, range of mouth opening, duration of the TMJ disturbance, and symptoms other than displacement on the opposite side, and they were given an interview followed by a complete clinical examination.

Statistical analysis

A forward selection stepwise logistic regression model was used to simultaneously assess the relative odds of each of 9 independent variables: age, sex, the presence of TMJ pain, TMJ sound, range of mouth opening, condylar osseous change, disc deformity, symptoms other than displacement on the opposite side and duration of the TMJ disturbance. The endpoint was a binomial variable depending on whether a case had sideways disc displacement or had any other type of disc displacement. Continuous variables with a nonlinear relationship to the logarithm of the odds were separated into two categories by the odds against values of the variables. Probabilities of less than 0.05 were considered statistically significant. Data were analysed using the software package SPSS for Macintosh, Version 6.1 (SPSS Japan Inc.).

The cases with unilateral disc displacement were extracted from all cases in which MRI was performed, and examined to define the clinical signs and symptoms particularly related to sideways disc displacement compared to anterior disc displacement. Objective also includes rotational disc displacement.

Results

Of the 1155 cases, we observed unilateral disc displacement in 331 cases (28.7%). These cases consisted of 266 females and 65 males with a median age of 31 years (range from 11 to 85 years). Of the 331 cases, MRI showed ADDwoR in 144 cases (43.5%), ADDwR in 91 cases (27.5%), anterolateral RDDwoR in 21 cases (6.3%), anterolateral RDDwR in 27 cases (8.2%), anteromedial RDDwoR in 5 cases (1.5%), anteromedial RDDwR in 4 cases (1.2%), LDD in 23 cases (6.9%), MDD in 12 cases (3.6%), and PDD in 4 cases (1.2%). (Table 2)

Of the 23 LDD, the presence of TMJ pain was observed in 6 cases (26.0%), TMJ sound in 10 cases (38.5%), TMJ disc deformation in 4 cases (17.4%), and

bone change of the mandibular condyle in 2 cases (8.7%).

The presence of bone change of the mandibular condyle was a negative factor in differentiating cases with the disease classification of LDD from ADDwoR, with the odds ratio for LDD at 0.1221 (P=0.0069). In addition, age (over 30 years) was also a minor differentiator (odds ratio for LDD was 0.3106, P=0.0207), and range of mouth opening (over 40 mm) was a significant differentiator (odds ratio 4.5865 for LDD). No other factors remained in the regression equation in differentiating cases with the disease classification of LDD from ADDwoR. Sensitivity was 43.48%. Specificity was 93.06%. Predictive value was 86.23%. (Table 3)

The presence of TMJ disc deformation was a negative factor in differentiating cases with the disease classification of LDD from anterolateral RDDwoR, with the odds ratio for LDD at 0.0851 (P=0.0346). The presence of bone change of the mandibular condyle was also a minor contributor (odds ratio for LDD was 0.0643, P=0.0310). In addition, range of mouth opening (over 40 mm) was a powerful predictor (odds ratio for LDD was 35.1695, P=0.0098). Sensitivity was 95.65%. Specificity was 71.43%. Predictive value was 84.09%. (Table 4)

No significant association was found between other classifications.

Table 2. Distribution of internal derangement

Group		N	(%)
Unilateral case	ADDwoR	144	(43.5%)
	ADDwR	91	(27.5%)
	anterolateral RDDwoR	21	(6.3%)
	anterolateral RDDwR	27	(8.2%)
	anteromedial RDDwoR	5	(1.5%)
	anteromedial RDDwR	4	(1.2%)
	LDD	23	(6.9%)
	MDD	12	(3.6%)
	PDD	4	(1.2%)
	total	331	(28.7%)
Bilateral and normal case		824	(71.3%)
	total	1155	(100.0%)

Discussion

Thomson demonstrated sideways disc displacements using CT versus anatomical sections.[10] Khoury observed an abnormal appearance of the lower joint space by lower joint compartment arthrograph, suggesting sideways dislocation of the disc.[11] On the contrary, Liedberg suggested that arthrographic diagnosis of medial and lateral disk displacement might be difficult and entailed substantial risks of both overdiagnosis and underdiagnosis.[12] MRI of the TMJ is now considered to be the most accurate technique for documenting TMJ disc displacements. Sideways disc displacements were also imaged using MRI by Westesson.[5] Liedberg specified that sideways disc displacement implied pure medial or lateral displacement without an anterior component.[13]

Diagnostic accuracy has been improved by the current quality of MR imaging as compared with the image quality in previous studies. This is due to sub-

Table 3. LDD Versus ADDwoR: Significant Contributing Factors From Forward Stepwise Logistic Regression Analysis

Variable		Partial regression coefficient	Standard error	Odds ratio	95% Confidens interval	P - value
Age (year)						
	〈30			1		
	≧30	-1.1694	0.5244	0.3106	0.1111 ~ 0.8680	0.0257
Condyle change						
	No			1		
	Yes	-2.1026	0.7782	0.1221	0.0266 ~ 0.5614	0.0069
Range of opening mouth (mm)						
	<40			1		
	≧ 40	1.5231	0.7991	4.5865	0.9578 ~ 21.9625	0.0366
Constant						
		5.7988	1.1145			

Table 4. LDD Versus anterolateral RDDwoR: Significant Contributing Factors From Forward Stepwise Logistic Regression Analysis

Variable		Partial regression coefficient	Standard Error	Odds ratio	95% Confidens interval	P - value
Range of opening mouth (mm)						
	< 40			1		
	≧ 40	3.5602	1.3792	35.1695	2.3560 ~ 525.0177	0.0098
Condyle change						
	No			1		
	Yes	-2.7449	1.2728	0.0643	0.0053 ~ 0.7786	0.0310
Disc deformity						
	No			1		
	Yes	-2.4643	1.1660	0.0851	0.0087 ~ 0.8362	0.0346
Constant						
		4.7722	1.6139			

stantial improvements in imaging hardware and software. Furthermore, it is now recommended that a combination of sagittal and coronal images should be used to avoid false-negative and false-positive diagnoses.[4,14-16]

On the other hand, Kobayashi recommended that coronal imaging should only be added when anterior disc displacement of the TMJ was not shown by sagittal imaging, because the frequency of sideways disc displacement is not high and it is apparent on sagittal images in some cases.[17]

In this study, information from the closed and open-mouth sagittal and closed-mouth coronal images was used, as it was frequently difficult to diagnose sideways displacements from sagittal images and as some osseous abnormalities could be depicted only in the coronal plane.

In the multiple logistic regression model, selected variables were mostly factors characterizing ADDwoR or anterolateral RDDwoR. Although the aim of this research was to elucidate the characteristics of the clinical finding of LDD, we could obtain only one positive factor. However, we found negative discriminating factors between LDD and ADDwoR or anterolateral RDDwoR. According to the results of this study, if a patient clinically suspected to have LDD is older than thirty years and simultaneously has condylar bone change on X-ray film, this patient is 26.4 times more likely to have ADDwoR than LDD $((0.3106\times0.1221)^{-1}=26.4)$. Similarly, if a patient has condylar bone change and disc deformity, this patient is 182.8 times more likely to have anterolateral RDDwoR than LDD $((0.0643\times0.0851)^{-1}=182.8)$. No significant association was found between other classifications. Diagnostic accuracy might be improved by adding the variance of mandibular movements or other factors in cases with disc displacements.

We assumed that the protrusive movement of the condyle would be less obstructed by a laterally displaced disc. The results confirmed our assumption. As compared with ADDwoR or anterolateral ADDwoR, the patients with LDD had a significantly wider opening mouth and showed significantly less bone changes. Although not significant, they had less TMJ pain than did those with ADDwoR. These findings were considered to be derived from a lack of obstruction by the displaced disc. The LDD patients were significantly younger than those with ADDwoR. This might indicate that LDD occurs in the course of ADD. This is an objective for future research.

Because this study was based on retrospective findings and the clinical entity of sideways disc displacement remains unknown, this investigation should be viewed as a preliminary analysis. Despite the limitation described above, the information from this study is thought to be helpful in establishment of diagnostic methods for sideways disc displacements.

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