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Magnetic Resonance Evaluation Between the Relationship of the Temporomandibular Joint Disk and condylar Head Displacement

Giedre Kobs, Olaf Bernhardt, Georg Meyer

SUMMARY

Objectives: To examine the relationship between condylar position and disk displacement in the temporomandibular joint (TMJ).

Methods: 564 joints with no disk displacement (NDD), 114 joints with reducible displaced disk (RDD) and 36 joints with permanently displaced disk (PDD) were diagnosed. The assessment of the condyle and TMJ disk positions was based on the sagittal plane magnetic resonance (MR) images (the position of the disk was controlled by coronal images).

Results: There were significant differences in condyle position between the joints with NDD and RDD (χ^2-test, P<0,000), while there was no difference between those with NDD and PDD (χ^2-test, right: P=0,112; left: P=0,225). There was also a significant correlation between bilateral condylar position and disk displacement in the TMJ (χ^2-test, P<0,000).

Conclusions: We suggest that if the disk displacement is reducible, the condyle is displaced posteriorly: in joints with PDD the condyle returns to the concentric position. These data also suggest that any change in condylar position induced by a change on the opposite side was essential.

Keywords: magnetic resonance imaging; temporomandibular joint disk; temporomandibular joint disorders; temporomandibular joint dysfunction

INTRODUCTION

Many articles have been published about the possible relationship between condylar position in the glenoid fossa and signs and symptoms related to TMJ dysfunction and internal derangements. Some researchers have associated disk displacement with posteriorly positioned condyles in the fossa [1-6], while others could not confirm such correlation [7-10]. Most of the early studies used only clinical examination to make a TMJ diagnosis, so no objective information about the position of the disk was studied. Several radiographic imaging techniques have been used to determine condylar position in the glenoid fossa, including plain radiography [11-13], tomography [2; 4; 7; 8], computed tomography [14] and arthrography. The condylar position has usually been measured from the cortical outline of the glenoid fossa and articular eminence. However, a histological study has demonstrated that the bony outlines seen on radiographs may not accurately reflect the actual articular surface [15]. The results of numerous comparative studies indicated that clinical or radiographic examination alone is not sufficiently accurate to determine the anatomical background of TMJ dysfunction, especially when the locking is the major symptom [5; 16]. In this study we employed MRI to assess the condyle and disk positions. MR imaging can produce high quality tomographic images with great soft tissue contrast without the need for ionizing radiation, anaesthesia or the injection of contrast agents [17; 18]. This method is considered overall as the gold standard for a thorough assessment of the internal derangement of the TMJ [19-22].

In an attempt to examine the possible relationship between TMJ condylar and disk displacement, we also tested the hypothesis that retropositioned condyles return to their concentric position with advancing disk displacement.

Giedre Kobs, *D.D.S., PhD., Institute of Stomatology, Fakulty of Medicine, Vilnius University, Lithuania.*

Olaf Bernhardt, *D.D.S. PhD., assist. professor, Assistant medical director at the Department of Restorative Dentistry, Periodontology and Pediatric Dentistry, University of Greifswald, Germany.*

Georg Meyer, *D.D.S., PhD., Hab. Dr., Professor and Head of the Department of Restorative Dentistry, Periodontology and Pediatric Dentistry, University of Greifswald, Germany.*

Address correspondence to G. Kobs: Department of Prosthodontics, Institute of Stomatology Faculty of Medicine, Vilnius University, Zalgirio str.117, Vilnius, Lithuania.

MATERIALS AND METHODS

From a population based representative cross-sectional "Study of Health in Pomerania" (SHIP) there were 307 subjects (140 males und 167 females) selected for this investigation. The age of subjects ranged from 20 to 54 years, with a mean age of 35,4.

MRI was performed with 1,0-tesla scanner (Magnetom Impact Expert, Siemens, Germany) using a bilateral TMJ surface coil with 7cm diameter. The imagines were performed with the following Spin-Echo-Sequent Parameters:

- axial (Scout – image) - T1 weighted images, TR = 140, TE = 15, Flip 90
- sagittal – T1 weighted images. Nine images with 3mm slice thickness; TR = 448 ms, TE = 15, Flip = 90, Matrix% 75 (192*256)
- coronal - T1 weighted images, TR = 450, TE = 15, Flip = 90, Matrix% 75 (192*256)

Three (lateral, central und medial), 3 mm orthogonal sagittal images of the TMJ were obtained with the jaw in the maximal intercuspal position (MIP) and then at maximal opening.

The physiological disk position was considered from two points of view:

- the pars intermedia of the disk has to lie in the area of the shortest distance between anterior cranial outline of the condyle and Protuberantia articularis [23];
- the junction line between the middle point of the

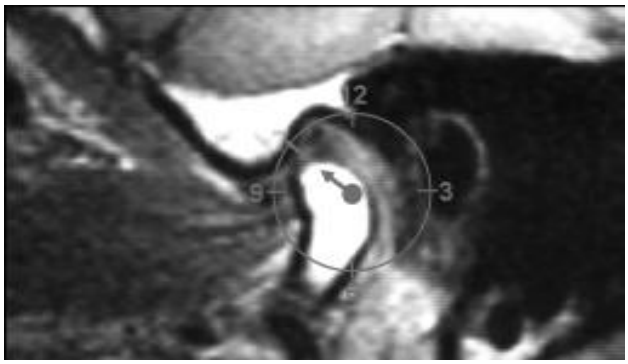

Figure 1. *Physiological disk position*

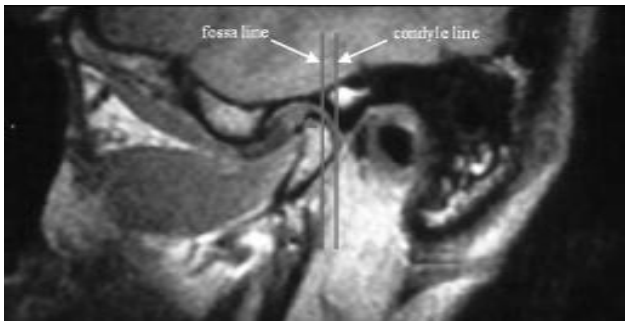

Figure 2. *Retroplaced condyle. The double arrow shows the increased anterior cranial space.*

condyle and the posterior margin of the disk must not be more than 10° from the 12 o'clock position [24] (Figure 1).

Any forward displacement of the disk constituted anterior displacement. The displaced disk was further categorized as displacement with reduction (RDD) if the disk assumed a normal relationship with the condyle in an open-mouth position. However, if the displaced disk remained in an anterior position relative to the condyle in an open-mouth position, it was classified as displacement without reduction i.e. PDD.

For defining the condylar position one vertical line was drawn through the zenith of the fossa glenoidalis and the second though the highest point of the condyle. The normal disk position was defined, if the both lines were congruent. In cases of retropositioned condyles (Figure 2) the condylar line was shifted posteriorly from the fossa line.

The condylar positions were compared between the joints with NDD, RDD and PDD. Differences in distribution were analysed by c^2-test.

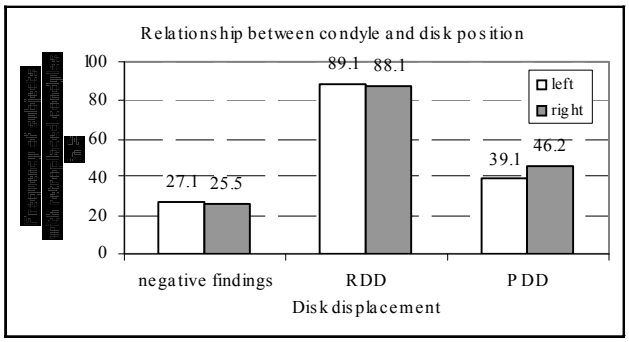

Figure 3. *The occurrence of retroplaced condyle in correlation with the disk displacement extend.*

Table 1. *Correlation between condylar position and disk displacement in the right and left TMJ.*

right		Retroplaced condyle		
		positive findings	negative findings	entire
anterior disk displacement	negative find.	60	175	235
	reference: ⇐	25,5%	74,5%	100,0%
	reference: ⇑	50,8%	92,6%	76,5%
	RDD	52	7	59
	reference: ⇐	88,1%	11,9%	100,0%
	reference: ⇑	44,1%	3,7%	19,2%
	PDD	6	7	13
	reference: ⇐	46,2%	53,8%	100,0%
	reference: ⇑	5,1%	3,7%	4,2%
	entire	118	189	307
	reference: ⇐	38,4%	61,6%	100,0%
	reference: ⇑	100,0%	100,0%	100,0%

left		Retroplaced condyle		
		positive findings	negative findings	entire
anterior disk displacement	negative find.	62	167	229
	reference: ⇐	27,1%	72,9%	100,0%
	reference: ⇑	51,7%	89,3%	74,6%
	RDD	49	6	55
	reference: ⇐	89,1%	10,9%	100,0%
	reference: ⇑	40,8%	3,2%	17,9%
	PDD	9	14	23
	reference: ⇐	39,1%	60,9%	100,0%
	reference: ⇑	7,5%	7,5%	7,5%
	entire	120	187	307
	reference: ⇐	39,1%	60,9%	100,0%
	reference: ⇑	100,0%	100,0%	100,0%

Table 2. *Bilateral correlation between condylar position and disk displacement in the TMJ.*

		retroplaced condyle				
		negative findings	**right**	**left**	**bilateral**	**entire**
anterior disk displacement	**negative findings** number	135	16	23	29	203
	expected number	96,5	27,1	28,4	50,9	203,0
	% of disk displacement	66,5%	7,9%	11,3%	14,3%	100,0%
	% of condyle findings	92,5%	39,0%	53,5%	37,7%	66,1%
	% of entire number	44,0%	5,2%	7,5%	9,4%	66,1%
	right number	2	14	1	9	26
	expected number	12,4	3,5	3,6	6,5	26,0
	% of disk displacement	7,7%	53,8%	3,8%	34,6%	100,0%
	% of condyle findings	1,4%	34,1%	2,3%	11,7%	8,5%
	% of entire number	0,7%	4,6%	0,3%	2,9%	8,5%
	left number	5	3	12	12	32
	expected number	15,2	4,3	4,5	8,0	32,0
	% of disk displacement	15,6%	9,4%	37,5%	37,5%	100,0%
	% of condyle findings	3,4%	7,3%	27,9%	15,6%	10,4%
	% of entire number	1,6%	1.0%	3,9%	3,9%	10,4%
	bilateral number	4	8	7	27	46
	expected number	21,9	6,1	6,4	11,5	46,0
	% of disk displacement	8,7%	17,4%	15,2%	58,7%	100,0%
	% of condyle findings	2,7%	19,5%	16,3%	35,1%	15,0%
	% of entire number	1,3%	2,6%	2,3%	8,8%	15,0%
	entire number	146	41	43	77	307
	expected number	146,0	41,0	43,0	77,0	307,0
	% of disk displacement	47,6%	13,4%	14,0%	25,1%	100,0%
	% of condyle findings	100,0%	100,0%	100,0%	100,0%	100,0%
	% of entire number	47,6%	13,4%	14,0%	25,1%	100,0%

RESULTS

464 joints out of the 614 joints were thought to have NDD, 114 RDD and 36 PDD.

The condyle positions of joints with NDD, RDD and PDD are compared in table 1.

The predictable value of positive test (from retroplaced condyle to anteriorly displaced disk) was 49,2% on the right side and 48,3%, on the left side. The predictable value of negative test was 92,6% on the right side and 89,3%.on the left side.

The Figure 3 shows the correlation from the table 1 between retroplaced condyle and disk displacement.

In the most TMJ with RDD were retroplaced condyles (right und left sides p=0,000; logistic regression; reference category: NDD), whereas no differences were found between joints with NDD and PDD (right: p=0,112; left: p=0,225; logistic regression; reference category: NDD). The difference of condyle position between the joints with RDD and those with PDD was also significant (right side p=0,002 und left side p=0,000; logistic regression; reference category: PDD).

Reciprocal correlation between the position of condyle and disk is evident in Table 2.

The table 2 shows, that TMJ with normal condyle position on both sides (n=146) to 92,5% had no disk displacement. In the joints with unilateral disk displacement on the right side was for instance to 88,4% unilateral (on the right side) or bilateral displacement of a condyle respectively. In the case of bilateral disk displacement there was to 91,3% condyle displacement unilateral or bilateral respectively. The correlation between retroplaced condyle or anteriorly displaced disk respectively from the affected side to the contralateral TMJ side could be confirm with the c^2-test (p=0,000) significantly.

DISCUSSION

This study presents a reconsideration of the TMJ condyle position in the fossa based on MR imaging findings focused on the degree of anterior disk displacement.

It has been reported that condylar displacement is a poor predictor of the presence or absence of disk displacement [4; 6; 25]. Despite a significant correlation between a displaced disk and a condylar position, the results of this study confirm this opinion. The large range of condylar positions in joints without disk displacement [4; 26] is one of the reasons for this low predictability. The low predictable value of positive test (from retroplaced condyle to anteriorly displaced disk) can be also explained by the fact, that a retroplaced condyle moves back to a normal position with advancing disk displacement (i.e., disk displacement without reduction).

The results of this study in reverse order (from anteriorly displaced disk to retroplaced condyle) show, that joints with RDD were significantly associated with posteriorly positioned condyles, while there were no significant differences in condylar position between joints with NDD and PDD. These results in agreement with those of Ronquillo et al. [1], Katzberg et al. [9], Ozawa et al. [5] and Kurita et al. [27] suggested that the condyle may shift posteriorly in the early stages of the internal derangement and then change its position with advancing internal derangement to a concentric position as disk displacement progresses. In the joints with PDD the condyle moved back towards their original position i.e., the narrowed posterior space tends to return to the size of a normal healthy joint.

The functional unit of both TMJ do not exclude the possibility, that change of condylar position on the affected side may result reciprocal dislocation of the healthy side. A study of Sanchez-Woodworth et al. [28] on 422 TMJ examined by MR evaluation confirms high likelihood on bilateral internal derangement in the symptomatic population. In disa-

greement with the results of Kurita at al. [27] these data suggest that any change in condylar or disk position respectively induced by a change on the opposite side was essential.

In conclusion, we suggest that there is a relationship between condylar position and disk displacement. If the disk displacement is reducible, the condyle is located posteriorly, as the disk displacement becomes more severe (i.e. permanently displaced), the condyle returns to its concentric position.

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