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COMPARATIVE STUDY ON THE CLINICAL AND RADIOGRAPHIC FINDINGS OF TEMPOROMANDIBULAR JOINT DYSFUNCTION PATIENTS

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《국문초록》

악관절 기능장애 환자의 임상적 방사선학적 소견에 관한 비교 연구

서울대학교 치과대학 치과방사선학 교실

고 강·안형규

악관절 기능장애 환자 118명을 대상으로 하여 임상적으로 악관절 잡음, 개구량, 동통 및 병력을 조사하고 골변화 양상 및 악관절내에서의 과두위치 등을 방사선학적으로 관찰하였으며, 조영술식을 이용하여 악관절내의 원판 위치 및 천공등을 관찰하여 이들 조사결과를 비교 검토한 결과 다음과 같은 결론을 얻었다.

1. 악관절 기능장애 환자에서 악관절부위의 골변화는 환자의 병력과 밀접한 관계가 있었다.
2. 최대 개구시 40mm미만을 개구하는 환자에서 더욱 심한 골변화를 보였다.
3. 악관절 기능장애 환자의 교합상태에서 과두가 악관절강의 후방에 위치한 경우 개구시 더욱 쉽게 과두가 관절융기 전방으로 이동 하였으며, 교합시 과두가 전방에 위치한 경우 후방에 위치한 경우보다 더욱 심한 골변화양상을 보였다.
4. 교합시 관절간격의 감소는 과두의 악관절내 어떠한 위치보다 병변이 진행된 상태였다.
5. 비환원성 내장증 환자의 특징적 증상은 clicking후 개구장애를 나타내었으며 비환원성 내장증을 환원성 내장증보다 더욱 진행된 상태였다.

I. Introduction

In recent years, the number of temporomandibular joint dysfunction patients has markedly increased but the complexity of temporomandibular joint anatomy and its functions make the pin-pointing of this pathosis difficult.[1)]

Like the complexity of its anatomy and functions, the name of this disease varies according to the investigator's point of view.[1,6,7,23,36,42)]

Moreover, concerning its etiologic factors, there is much room for controversy. The literatures are in conflict; one group emphasizes stress factors while others accentuate various aspects of occlusion.[7,23] The former advocates that this disorder is due to psychological stresses and/or muscular disorder.[44,45,46] On the other hand, the latter claims that occlusal interference and tooth missing are the main etiologic factors causing this dysfunction. But in the late 1970's, the role of anterior disc displacement was specifically clarified by Wilkes, who combined observations from arthrography with those from surgery. He concluded that the mechanism of the TMJ dysfunction is responsible for articular disc attachment. His observations were confirmed by Farrhar & McCarty, Katzberg, Dolwick, and Bronstein,[3,4,6,9,48,49] et al.

These investigators opened a new era of diagnosis and treatment for the temporomandibular joint dysfunction. The aim of this study is to compare clinical symptoms with radiographic findings of the TMJ dysfunction patients to draw clear guidelines for determining when a radiologic interpretation and diagnosis of the TMJ should be performed.

2. Materials and Methods

This study was made on 118 temporomandibular joint dysfunction cases referred to the Department of Oral Radiology during 1984-1986. These patients were examined by clinical and radiographic methods.

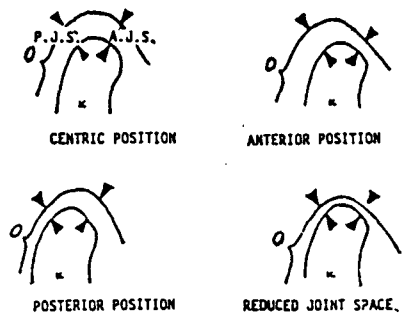
A. Clinical Examination

Patients was examined by radiologists using special protocol for TMJ dysfunction patients (Table 1).

B. Radiographic Examination

1) Oblique lateral transcranial projection

Oblique lateral transcranial projection were performed at intercuspal position and at maximum mouth opening position, by the use of modified Schüller's technique. The condylar position in the fossa was evaluated by the following criteria (Table 2, 3 & Fig. 1, 2).



A.J.S.: Anterior Joint Space. P.J.S.: Posterior Joint Space.

Fig. 1. Condyle position in the fossa at intercuspal position

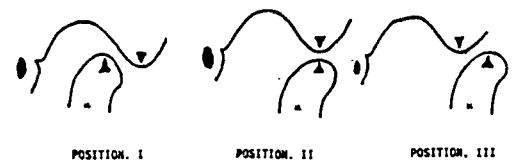


Fig. 2. Condyle position in the fossa at maximum mouth opening position

Table 1. Clinical Examination

Age	Sex	C.C.	Location	Habit	Tooth loss	Max. O.	Others
23	M	pain	left	bruxism	2/0	38mm	P.D.

Table 2. The condylar position in the fossa at intercuspal position

Centric Position	:	Equal width of radiolucent space around the condyle
Posterior Position	:	Radiolucent space smaller posterior to the condyle than anterior
Anterior Position	:	Radiolucent space smaller anterior to the condyle than posterior
Reduced Joint Space	:	Posterior radiolucent space + Anterior radiolucent space/2 $<$ 1 mm

Table 3. The position of the condyle at maximum mouth opening

Position I	:	Condyle located in the posterior slope of the articular eminence
Position II	:	Condyle located at the articular eminence
Position III	:	Condyle located in the anterior slope of the articular eminence

2) Tomography

Lateral tomography of the TMJ was then performed in 7 planes at 2mm intervals using a multi-film cassette. In each instance, the patient's head was centered to ensure better accuracy. Patient and machine were controlled to middle portion of the condylar head be taken on the 4th plane. Bone change and the condylar position in the fossa were examined by the following criteria (Table 2, 4).

3) Arthrography

Thirty-two of the total of 118 patients were projected by single and double contrast arthrography using hypocycloidal serial tomography. The arthrograms were interpreted as described by Wilkes, Farrhar & McCarty, and Katzberg,[9,19,48,49] et al. Thus, the joints were classified as having normal disc position, partial or complete anterior disc displacement with reduction, and partial or complete anterior disc displacement without reduction. Perforation of the disc was diagnosed by opacity of the upper compartment after an injection of contrast medium into the lower compartment.

3. Results

The age and sex distribution is shown in Table 5. The mean age was 39 years. The proportion of male to female was 1:5.2. Eighty of 118 patients complained of unilateral symptoms and remaining 38 patients showed bilateral symptoms (Table 6).

22.9% of the patients revealed clicking sound and 11.9% showed crepitation (Table 7).

Table 4. Degree of bone changes

Degree 0	:	No bone change
Degree 1	:	Discontinuity of cortical plate
Degree 2	:	Destruction of cancellous bone and/or sclerosis, osteophyte and deformity

Table 5. Number of patients according to sex and age

Sex/Age	13-19	20-29	30-39	40-49	50-59	60-	Total
Male	2	4	5	6	2	0	10
Female	10	19	21	15	20	14	99
Total	12	23	26	21	22	14	118

Table 6. Affected side

Unilateral		Bilateral	Total
Right: 47	Left: 33	38	118

Table 7. TMJ sound in 118 patients

No sound	Clicking	Crepitation	Total
77 (65.2%)	27 (22.9%	14 (11.9%)	118

Table 8. Relationship between bone change and clinical findings

	Degree 0		Degree 1		Degree 2	
Mean age	32Y	10M	30Y	8M	48Y	4M
Mean duration	2Y	3M	3Y	2M	5Y	3M

A. Relationship Between Clinical History and Bone Change

Four patients were excluded from this item because of the inadequate quality of their radiographs or because of the uncertainty of the clinical history. From these 114 patients, seventy-six patients (66.7%) showed osseous change in the TMJ lesion. Table 8 shows the relationships among bone change, clinical history and patient's age.

B. Bone Change Associated with Clinical Symptoms

In the comparison between Group 1 (patients more than 40mm mouth opening) and Group 2 (less than 40mm), Group 2 patients showed severer bone change than Group 1 patients (Table 9).

C. Bone Change Associated with Condylar Position

In 142 cases out of the 156 (multiply bilateral patients), the condylar position in the fossa at intercuspal position, maximum mouth opening position, and bone change were scrutinized by oblique lateral transcranial projection and serial tomography. In Group 1 patients, posterior position; 42.9%, anterior position; 26.5% and centric position; 30.6%, were seen at intercuspal position. The bone change and the condylar position are exhibited in Table 10 (see

Table 9. Relationship between bone change and clinical symptoms

Clinical symptoms		Degree 0	Degree 1	Degree 2	Total
Group 1	Pain	9	16	9	34
	Noise only	8	2	1	11
Subtotal		17 (37.8%)*	18 (40.0%)	10 (22.2%)	45
Group	Pain	11	6	32	49
	No pain	8	3	2	13
Subtotal		19 (30.6%)	9 (14.5%)	*34 (5.8%)	62
Others		2	2	3	7
Total		38 (33.3%)	29 (25.4%)	47 (41.2%)	114

Table 10. Bone change and the condyle position in Group 1 patients

Intercuspal position	Max. open	Dgree 0	Degree 1, 2	Total
*Posterior position	Position I	0	3	3
	Position II	3	2	5
	Position III	16	4	*20
Subtotal		19 (67.9%)	9 (32.1%)	28
Anterior position	Position I	1	4	5
	Position II	4	5	9
	Position III	0	0	*0
Subtotal		5 (35.7%)	9 (64.3%)	14
Centric position	Position I	1	3	4
	Position II	1	5	6
	Position III	3	6	9
Subtotal		5 (26.3%)	14 (73.7%)	19
Total		29 (47.5%)	32 (52.5%)	61

"*"). In 28 cases of posterior position, only 9 cases (32.1%) revealed bone change, while in the case of anterior position, 64.3% showed osseous change. When the condylar movement at maximum opening state was examined, the relationship between the condylar position and articular eminence was revealed as shown in Table 10, 11.

There are 20 cases of transfer from posterior, condylar position at intercuspal position to Position III, while there is no case from anterior position to Position III.

In Group 2 patients, thirteen reduced joint space cases were excluded from the total to be treated under a separate column at the end. Remaining sixtyeight cases were found to have Position I; 50.0%, Position II; 30.9%, Position III; 19.1% when seen at the maximum mouth opening position. Especially among Position III cases, 11 cases were posterior position in the fossa at intercuspal position (See "*" in Table 11).

D. Arthrotomographic findings.

Out of 32 patients, 2 patients were observed by arthrotomographic inspection bilaterally and the remaining 30 patients were inspected unilaterally. Nine patients were arthrotomographically found to have anterior disc displacement with reduction. Seventeen patients exhibited unilateral transient or permanent limitation of mouth opening and 9 of them had the history of clicking. Arthrotomographically, these 17 patients were found to have anterior disc displacement without reduction. Two other patients with bilateral complaints were arthrotomographically examined. One case had a bilateral anterior disc displacement without

reduction, while the other case had the same with reduction on oneside and without reduction on the other (Table 12, 13).

The remaining four patients were arthrotomographically shown to have the disc, at normal superior position without obstructing the anterior translation of the condyle in two and fibrous ankylosis in the other two.

E. Comparison of Oblique Lateral Transcranial Projection with Tomography on the Condylar Position at Intercuspal Position

In tomography, the second or third plane was selected for comparison with oblique lateral transcranial projection. Between the two radiographic films, 78.3% of the condylar position in the fossa at intercuspal position agreed.

Table 11. Bone change and the condyle position in Group II patients

Intercuspal position	Max. open	Degree 0	Degree 1, 2	Total
Posterior p.		3	10	13
Anterior p.	Position I	3	8	11
Centric p.		7	3	10
Subtotal		13 (38.2%)	21 (61.8%)	34
Posterior p.		3	7	10
Anterior p.	Position II	1	4	5
Centric p.		4	2	6
Subtotal		8 (38.1%)	13 (61.9%)	21
Posterior p.		7	4	*11
Anterior p.	Position III	0	2	*2
Centric p.		0	0	0
Subtotal		7 (53.8%)	6 (64.2%)	13
Total		28 (41.2%)	40 (58.8%)	68
Reduced joint space		1	12	13

Table 12. Clinical findings with respect to arthrographic diagnosis

	With R.	Without R.	Ankylosis	Normal Pos.
Mean age	32.6 Y	41.4 Y	54.0 Y	35.5 Y
Max. open	40.1 mm	32.5 mm	17.5 mm	34.8 mm
Past history	5.1 Y	4.0 Y	–	–
Limit of open & Clicking history	0	*9	0	0
No clicking	1	3	1	1
Present clicking	5	1	0	0
Uncertainty	1	5	1	1
Crepitation	0	*3	0	1

Table 13. Radiographic findings with respect to arthrotomographic diagnosis

Radiographic findings	With R.	Without R.	Ankylosis	Normal Pos.
Anterior position	0	1	0	1
Centric position	4	8	0	1
Posterior position	6	8	1	0
Reduced J. space	0	3	1	0
Bone Change				
Positive	2	9	2	1
Negative	8	11	0	1
Disc perforation	0	6	0	1

4. Discussion

A. Relationship Between Bone Change and Clinical History

According to Rasmussen,[36-38] the development of the temporomandibular joint arthrosis is divided into six phases. Phase 1 and 2 make up the initial stage of clicking and locking, phase 3 and 4 constitute the intermediate stage of temporomandibular joint pain and constriction, and phase 5 and 6 make up the terminal stage of crepitation and constriction followed by the freedom from symptoms. Three stages endure 4, 1, and 1/2 year respectively. In this study, mean term of advancing bone change could be classified with Rasmussen's result; Patient without bone change and slight bone change (Degree 0, 1) would be classified into the initial and intermediate stage; and bony sclerosis and/or osteophyte (Degree 2) are regarded as a terminal stage. However, to tell patient's conditions solely from bone change and its degree of advancement based on X-ray readings entails certain risks, and for that reason it is advisable to take clinical symptoms into account for a more accurate diagnosis.

B. Relationship Between Clinical Symptom and Bone Change

Amount of mouth opening was closely related to bone change (Table 5, 6, 7). Especially Group 2 patients (under 40mm mouth opening) presented more bone changes than Group I patients. Earlier investigators[4,19] claimed that the patients of anterior disc displacement without reduction is in a more advanced pathosis than those of displacement with reduction. Researchers found that the lengthening of posterior attachment would bring about the increase of mouth opening in the patients of anterior disc displacement without reduction. Though the limitation of mouth opening represents a more advanced pathosis than the one without constriction, it would be risky to judge the patient's state simply by the amount of mouth opening.

C. Relationships Between Clinical Condition and Condyle Position

There are two major mechanical theories as to how the human mandible functions mechanically during mastication.[12,13] One theory

asserts that the mandible functions as a Class III lever with the fulcrum at the condyle, the summed vectors of the mandibular elevator muscles acting as the total force and biting teeth force as the resistance. Meanwhile the other theory proposed by Smith[41] described mandible as a beam with multiple supports (Stationary beams). These theories are related to the direction of joint loading, specification of muscle vectors and bite point and the role of the disc. And next, examining the movement of the condyle in the fossa at mouth opening and mouth closed. Moss, Stern, Grant[12,13,29,30,42] and others proposed "Instantaneous axes of rotations". They asserted that axis of the rotation is changed by the state of mandibular movement. Anatomists have pointed out that the posterior slope of the eminence and the anterior aspect of the condyle head are covered with thickened fibrous connective tissue, indicating a loading area of mandibular movement. Between upper and lower joint compartment, disc reduces occlusal force in the loading area by sliding movement. In this study, it is shown that posterior position of the condyle in the fossa at intercuspal position can easily move to Position III (Table 10). In Group 2 patients, 11 cases among 13 cases transferred at the condyle to Position III from posterior position in the fossa at intercuspal position, while only one case moved to Position III from anterior position. These phenomena could be explained by Grant's instantaneous center of rotation theory.[12] If axes of the rotation center should change from R to W (Fig. 3) with open mouth, then posterior position of the condyle in the fossa will easily move to the anterior slope of the articular eminence than anterior position. (Fig. 4: Posterior position, Fig. 5: Anterior position in the fossa at mouth closed: see "*") Like this, posterior position of the condyle in the fossa at intercuspal position may be more easily transferred to Position III than anterior position of the condyle in the fossa. With this fact in mind, it may be possible to say that in temporomandibular joint dysfunction patients, posterior position of the condyle in the fossa at intercuspal position is the functional adaptation of this

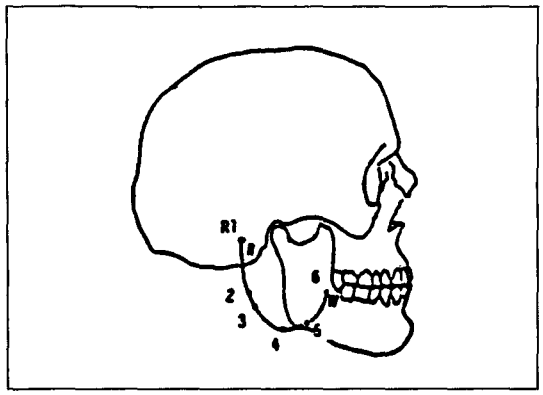


Fig. 3.

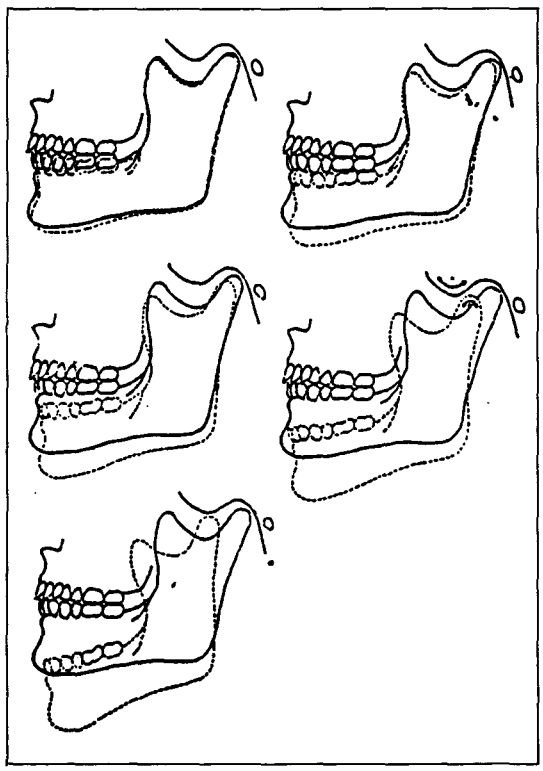


Fig. 4. Posterior Position

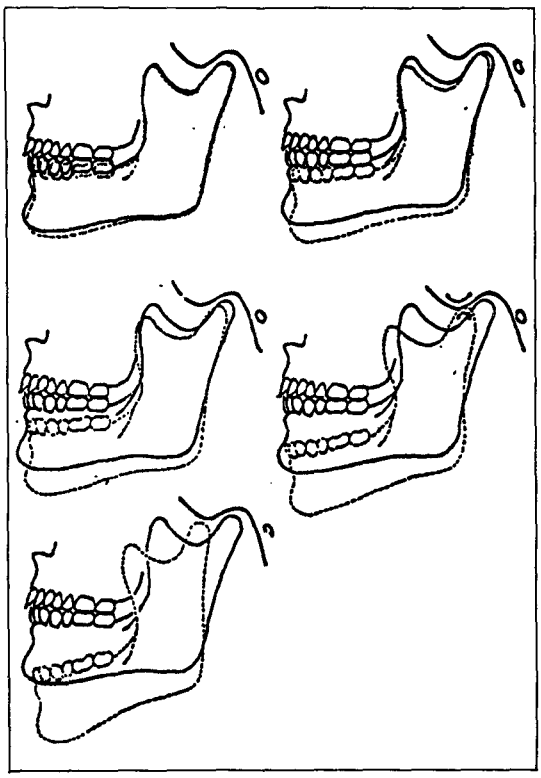


Fig. 5. Anterior Position

pathosis and/or radiographic sign. But actually a majority of the TMJ dysfunction patients show anterior disc displacement. It suggests an internal derangement of the TMJ led by mastication. When we close our mouths the disc indirectly receives occlusal force of sliding to articular eminence. Further radiographic studies are necessary for clarifying the relationship between the masticatory pattern and the condyle position in the fossa. Ramfjord & Ash[35] reported that most TMJ dysfunction patients masticated on the affected side rather than on the sound side, which may be explained by the fact that the balancing side of the TMJ portion is more loading than the working side at mastication. It may be supposed that the symptomless bone change cases dealt with in the present study are due mainly to an excessive lop-sided mastication.

D. Arthrographic Examination

This study showed that anterior disc displacement without reduction was clinically characterized by a history of clicking followed by a limitation of mouth opening. Likewise, anterior disc displacement without reduction patients were of more osseous change and/or perforation than those with reduction. From this result, an anterior disc displacement without reduction may be considered to be in a more advanced pathosis than that with reduction. But anterior disc displacement with reduction does not always switch over to anterior disc displacement without reduction. Two patients were arthrotomographically diagnosed as fibrous ankylosis. The clarification of its pathosis needs further investigations.

E. Comparison of Transcranial Projection and Tomography

The oblique lateral transcranial projection image corresponds with the third lateral plane of the tomography. Serial tomography is more excellent for examining TMJ osseous change.

5. Conclusion

Patients complaining of temporomandibular joint disorders with clicking, crepitation, pain, and limitation of mouth opening were subjected to clinical and radiographic examinations using hypocycloidal serial tomography, oblique lateral transcranial projection including arthrotomography and special protocol for TMJ dysfunction patients. From this study the following correlations between radiographic findings and clinical symptoms were found.

1. In TMJ dysfunction patients, the degree of bone changes are closely related to the history of the clinical symptoms.
2. Patients with limitation of mouth opening (less than 40mm) were of severer bone change than those with more opening facility.
3. In TMJ dysfunction patients, the posterior position of the condyle in the fossa at intercuspal position showed easier forward movement to the articular eminence than the anterior position. Patients with the anterior position of the condyle in the fossa at intercuspal position showed severer bone change than those with posterior position.
4. Reduced joint space at intercuspal position suggests a more advanced pathosis than that in any other condyle position.
5. Limitation of mouth opening with history of clicking is the clinical symptom of the anterior disc displacement without reduction. In internal derangement, the anterior disc displacement without reduction is in a more advanced pathosis than the anterior disc displacement with reduction.

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