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Comparative study on the osseous changes of the TMJ and mandibular asymmetry after conservative or operative treatment in condylar fracture patients

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ABSTRACT

Purpose : To compare the effects of the conservative treatment and operative treatment by observation of osseous changes of the TMJ and mandibular asymmetry in condylar fracture patients.

Materials and Methods : 33 condylar fracture patients (17 with conservative and 16 with operative treatment) were included in this study. After a minimum of 6 months after the surgical procedure, patients were given a follow up examination of the osseous changes using a transcranial view. Differences in the osseous changes of both groups were compared and the asymmetry indices were calculated on a postero-anterior skull view.

Results : The TMJ of the operative treatment group showed more significant osseous changes than the conservative treatment group. The affected TMJ showed more significant osseous changes than the unaffected TMJ in the both groups. The unaffected TMJ of the conservative group and the affected TMJ of the operative group showed significant osseous changes. The mandibular asymmetry indices in the conservative and operative group were 5.12 and 7.30 respectively at the time of treatment, and 2.39 and 3.41 respectively at the follow-up. But the mandibular asymmetry between the both groups showed no statistical differences.

Conclusion : The TMJ of the operative group showed more significant osseous changes than the conservative group, but the mandibular asymmetry between the both groups showed no statistical difference. ***(Korean J Oral Maxillofac Radiol 2003; 33 : 223-9)***

KEY WORDS : Condylar Fractures; Temporomandibular Joint; Mandibular Asymmetry

Trauma to the maxillofacial region has been increasing because of cultural development, complexity of living and increased number of cars.[1]

Mandible is joined to the skull by the temporomandibular joint and the possibility of damage by external force is increased due to the remarkably prominent anatomic form in the maxillofacial area.[2] Mandibular fractures are extremely frequent in facial trauma, and 25-35% involve the condyle.[3]

The complexity of this region, as well as its anatomic proximity to other craniofacial structures, and the variety of contents and functions may lead to temporomandibular ankylosis, limitation of anterior condylar movement and developmental abnormality in children.[4] Thus, the treatment method of the mandibular condylar fractures must be carefully considered.

The conservative treatment methods of condylar fractures induces progressive mandibular movement by using elastic bands after removing intermaxillary fixation or inducing mandibular movement at an early stage by using functional orthodontic equipment, and the operative treatment method to get the fractured fragment back to the correct anatomic position surgically.[5]

Proper management of condylar fractures is one of the most controversial topics in maxillofacial trauma. Silverman[6] suggested using the operative treatment of the condylar fracture in 1925, while Belinger[7] recommended the conservative treatment in 1943. Walker[8] reported the conservative treatment method with intermaxillary fixation in 1957, Petzel[9] reported using pinscrews in 1982, and Brown and Obeid[10] reported using K-wire in 1984.

The conservative treatment has usually displayed the good results because this method does not result in neuropathy or postoperative complications such as healing cicatrix. There is no technical problems with respect to anatomic complexity while treating on the temporomandibular joint area.[1] Delaire[11] recommended conservative treatment in the case of condylar fracture, regardless of displacement, and the results of this study were generally good. However, the major problems resulting from the conservative treatment are early dysfunc-

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tions of TMJs and late arthritic changes occurring 10 to 50 years later. Therefore, treatment selection criteria of the condylar fractures should be established. At this time there is no consensus concerning the appropriate therapeutic approach.

Evaluation of the success of healing after the condylar treatment usually is done on the basis of standard radiographs on which both quantitative and qualitative measurements can be made.[12] Quantitative and qualitative evaluations usually involve mandibular asymmetry and the condylar relation to the glenoid fossa.[13]

Accurate knowledge about the osseous changes of the TMJs is important to differentiate a change in function and degraded articular disease, and to evaluate postoperative prognosis also. But, research of osseous changes of the TMJs and mandibular asymmetry in condylar fracture patients has been insufficient.

This study will be compare the effects of the conservative treatment with those of the operative treatment by observing the osseous changes of the TMJs on the transcranial radiographs and the mandibular asymmetry on the cephalometric posteroanterior skull radiographs.

Materials and Methods

1. Materials

Subjects consisted of 33 patients with mandibular condylar fractures who were treated in the Department of Oral & Maxillofacial Surgery, Chonbuk National University Dental Hospital from 1991 to 2001. 17 patients had been treated conservatively and 16 patients had been treated operatively. In the conservative group, there were 13 males and 4 females, and in the operative group, there were 14 males and 2 females. The mean age of the subjects was 23.9 years, ranging from 4 to 51 years (Table 1). The follow-up period of the conservative group was 1.6 years and the operative group was 1.7 years (Table 2).

Table 1. Distribution of age and gender of the patients

Age	Conservative treatment		Operative treatment	
	Male	Female	Male	Female
0-9	2	2	0	0
10-19	3	2	3	1
20-29	5	0	5	1
30-39	1	0	4	0
40-49	1	0	1	0
50-	1	0	1	0
Total	13	4	14	2

Table 2. Distribution of the follow-up period

Period (year)	Conservative treatment	Operative treatment	Total
0.5-1.0	9 (52.9%)	5 (31.3%)	14 (42.4%)
1.0-2.0	2 (11.8%)	4 (25.0%)	6 (18.2%)
2.0-3.0	2 (5.9%)	6 (31.3%)	6 (18.2%)
3.0-4.0	2 (11.8%)	0	2 (6.1%)
4.0-	3 (17.6%)	2 (12.4%)	5 (15.1%)
Mean	1.6	1.7	1.7

2. Methods

1) Taking radiographs

(1) Transcranial radiograph

A transcranial radiograph was taken by the Heliodent MD (Siemens, Germany) using the attached AX-Aligner (T. Hanau). The X-ray film cassette was positioned against the facial skin surface on the side of interest. After positioning the Frankfort plane parallel to the floor, the lowermost point of the inferior orbital rim was aimed at the AX-Aligner indicator. The X-ray tube was brought into position on the contralateral side of the skull so that the central beam was projected inferiorly 25 degrees and anteriorly 20 degrees. The radiographic conditions were 60-70 kVp, 7 mA, 0.12 s, with a 1.7 mm Al filter.

(2) Cephalometric posteroanterior skull radiograph

A cephalometric posteroanterior skull radiograph was taken by the CX-90SP (Asahi, Japan). To obtain the radiographic reproducibility, the head was centered in front of the cassette, fixing the ear rod to the external acoustic meatus, paralleling the canthomeatal line to the floor. The central beam was projected perpendicular to the plane of the film, and the beam was coincident with the midsagittal plane of the head at the level of the bridge of the nose. The radiographic conditions were 50-80 kVp, 80 mA, 0.1-1.0 s, with a 2.7 mm Al filter.

2) Film processing

The projected films were automatically proccessed using FPM 3500 (Fuji, Japan).

3) Observation of the osseous changes of TMJ and measurement of mandibular asymmetry

(1) Osseous changes of TMJ

The osseous changes of TMJs were observed on the transcranial radiographs. The osseous changes of the condylar head and articular eminence were flattening, sclerosis and erosion.

(2) Mandibular asymmetry

The mandibular asymmetry was measured on the cephalometric posteroanterior skull radiograph. The reference line, A

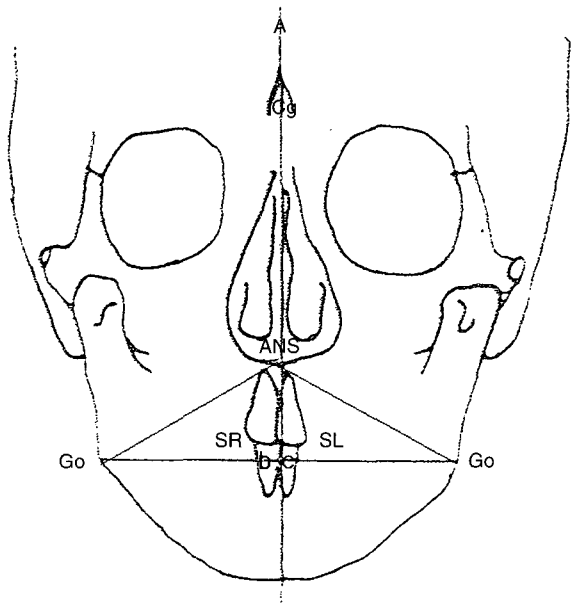

Fig. 1. Reference points and lines for mandibular asymmetry on the cephalometric posteroanterior skull radiograph. A, reference line; Cg, crista gali; ANS, anterior nasal spine; Go (right and left), Gonion; b,c, points described by drawing a vertical line from both Go to A line; and SR, SL (right and left), area of a right-angled triangle

was established by connecting the point of crista galli to the point of anterior nasal spine. The points; b, c were described by drawing a vertical line from both gonions (right and left) to A line. The areas; SR, SL of a right-angled triangle (right and left) were calculated (Fig. 1, by Park et al.[14]).

The ratio of the difference of the areas between right-angled triangles of the right and left side were calculated by using the following formula.[15]

$$AI(\%) = \frac{SL - SR}{SL + SR} \times 100$$

and the asymmetry index was called as AI.

4) Data analysis

The data analysis was assessed by the independent *t*-test and paired *t*-test. For the analysis, the Statistical Package for Social Science (SPSS Inc, Chicago, III; 1997) was used.

Results

1. Classification of mandibular condyle fractures

9 out of 17 patients in the conservative group, and 5 out of 16 patients in the operative group showed unilateral condylar fractures without other mandibular fractures. 3 patients showed bilateral condylar fractures in the conservative group, 8 patients in the conservative group and 11 patients in the operative group showed condylar fractures associated with mandibular fractures (Table 3).

Table 3. Classification of condylar fractures

Group	No. of patients	Unilateral condylar fracture only	Bilateral condylar fracture	Associated with mandibular fracture
Conservative	17	9	3	8
Operative	16	5	0	11

Table 4. Relationship between affected and unaffected side in osseous changes of TMJs (%)

Side	No change		Sclerosis		Flattening		Erosion	
	C	O	C	O	C	O	C	O
Affected	13 (33.3)	2 (5.4)	15 (38.5)	16 (43.2)	11 (28.2)	18 (48.6)	0	1 (2.8)
Unaffected	24 (92.3)	12 (41.4)	0	9 (31.0)	2 (7.7)	7 (24.1)	0	1 (3.5)
Significance	**.010***	.110	.241	**.015***	.144	**.032***		.182

*statistical significance by *t*-test ($P < 0.05$)
C : Conservative group O : Operative group

Table 5. Relationship between conservative and operative group in osseous changes of TMJs (%)

Group	Side	Site	No change	Osseous change	Significance	Significance
Conservative	A	Con.	6 (35.3)	11 (64.7)	.236	.806
		Art.	7 (31.8)	15 (68.2)	.509	
	U	Con.	12 (92.3)	1 (7.7)	**.006***	
		Art.	12 (92.3)	1 (7.7)	**.000***	
Operative	A	Con.	0	17 (100)	**.000***	.693
		Art.	2 (10.0)	18 (90.0)	**.001***	
	U	Con.	5 (20.8)	19 (79.2)	.239	
		Art.	7 (41.2)	10 (58.8)	.818	

A : Affected TMJ; U : Unaffected TMJ; Con.: Condylar head; Art.: Articular eminence

2. Osseous changes of TMJs

The osseous changes of the affected and the unaffected sides in the conservative group showed sclerosis 38.5% and 0%, flattening 28.2% and 7.7%, respectively (Table 4, Fig. 2, 3). There was significant difference between the affected side and the unaffected side in groups showing no osseous change ($P < 0.05$). On the other hand, the osseous changes of each affected and unaffected side in the operative group showed sclerosis 43.2% and 31.0%, flattening 48.6% and 24.1%, and erosion 2.8% and 3.5%, respectively (Table 4, Figs. 4, 5). The

Table 6. Comparison of mandibular asymmetry

Group	AI	1	2	3	4	5	6	7	8	9	Mean	Sig.	Sig.
Conservative	1st AI	8	5	2	2	15	10				6.83	**.047***	.943
	2nd AI	0	7	2	2	10	2				3.59		
Operative	1st AI	1	0	9	9	1	3	1	0	7	3.38	.945	
	2nd AI	1	3	4	4	0	3	5	8	3	3.49		

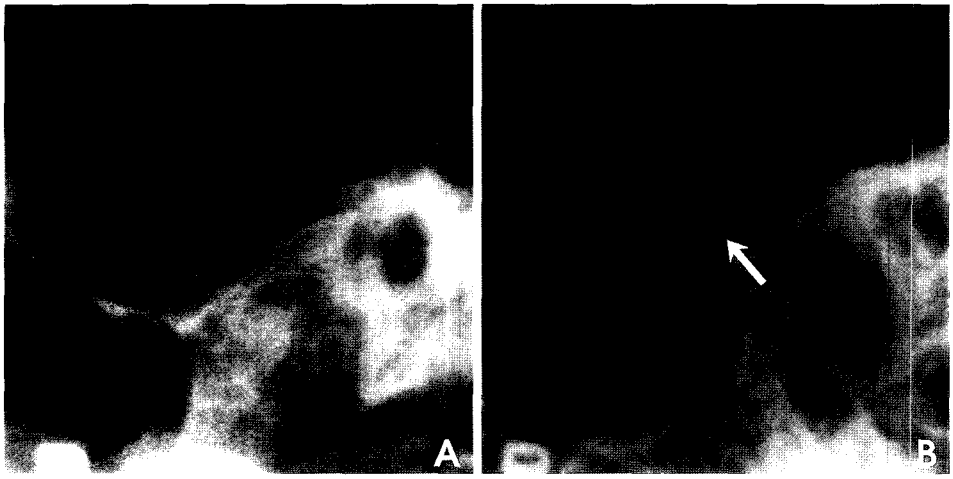

Fig. 2. Transcranial radiographs show flattening on the articular eminence at affected side in the conservative treatment patient. A, immediately after treatment B, 21 months after treatment

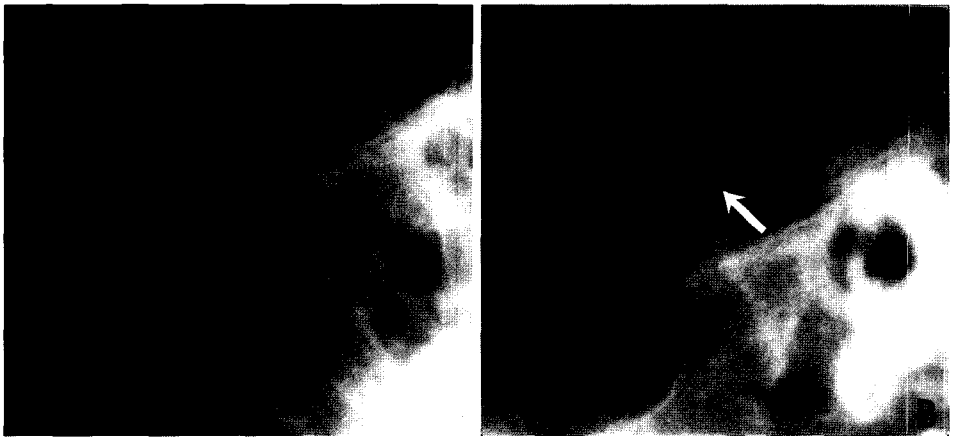

Fig. 3. Transcranial radiographs show sclerosis on the articular eminence at unaffected side in same patient as Fig. 4. A, immediately after treatment B, 21 months after treatment

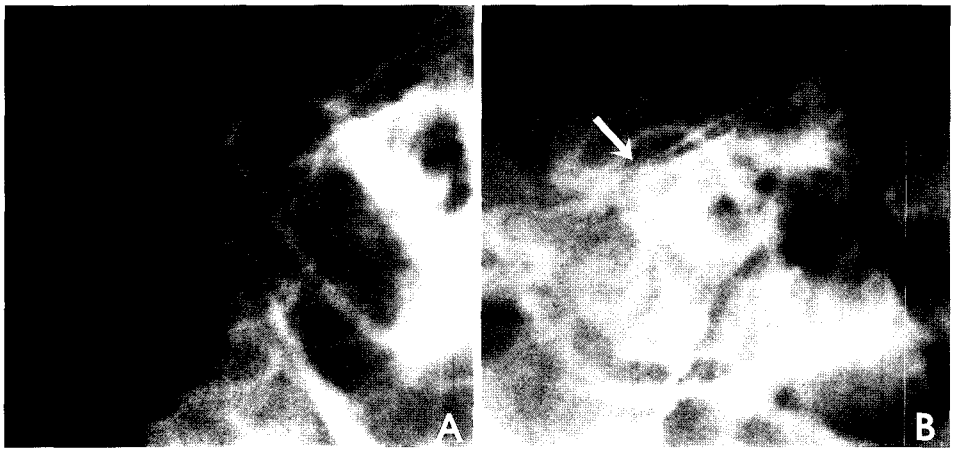

Fig. 4. Transcranial radiographs show sclerosis and irregular osseous change on the condylar head at affected side in the operative treatment patient. A, immediately after operation B, 9 months after operation

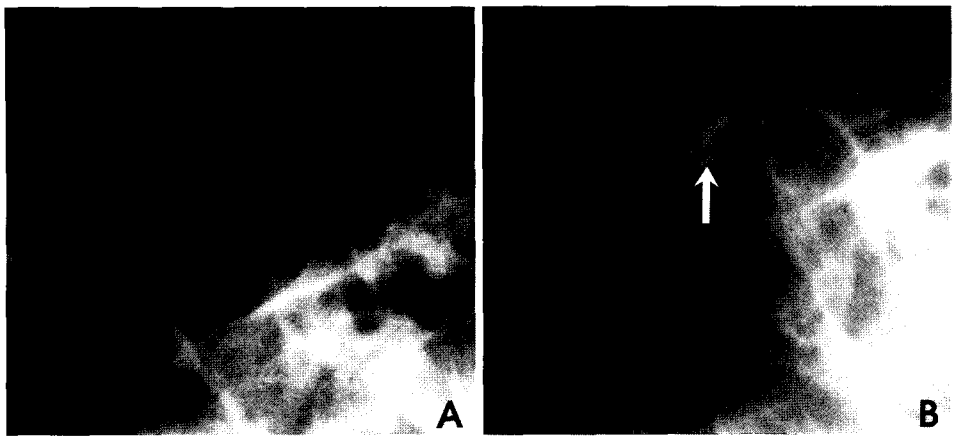

Fig. 5. Transcranial radiographs show erosion and sclerosis of the articular eminence at unaffected side in same patient as Fig. 6. A, immediately after operation B, 9 months after operation

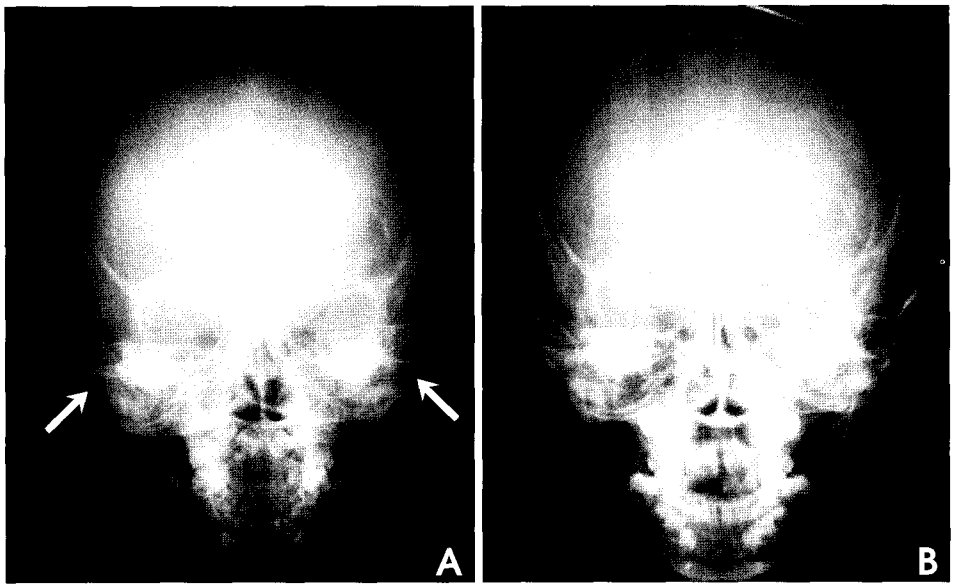

Fig. 6. Cephalometric posteroanterior skull radiographs show the mandibular asymmetry in the conservative treatment patient. A, immediately after treatment (AI: 8.2) B, 3 years after treatment (AI: 0)

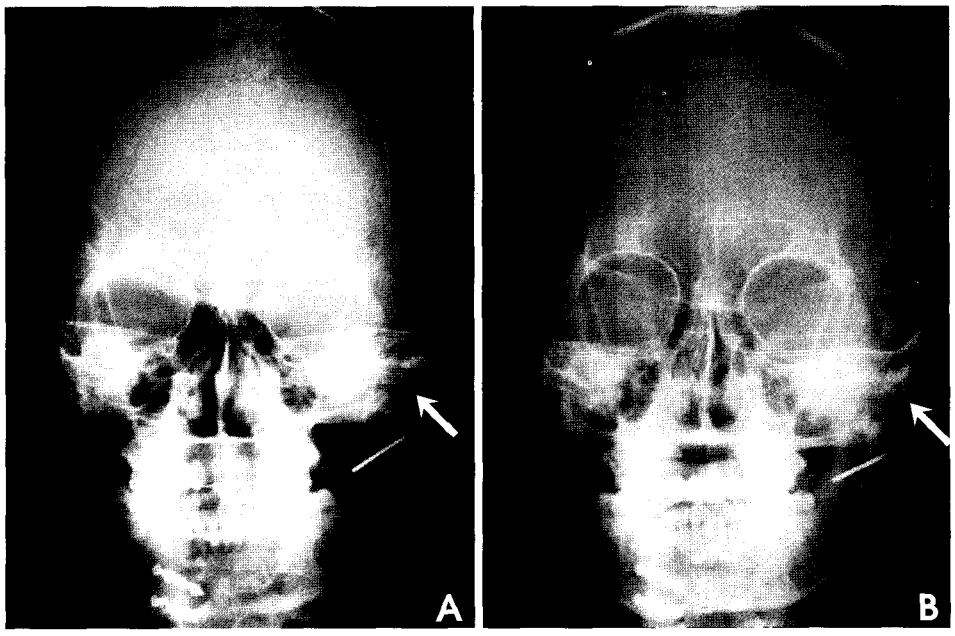

Fig. 7. Cephalometric posteroanterior skull radiographs show the mandibular asymmetry of the operative treatment patient. A, immediately after operation (AI: 8.9) B, 5 years after operation (AI: 3.9)

significant osseous changes were observed in both sclerosis and flattening groups ($P<0.05$). There was no significant osseous changes of the unaffected side in the conservative group, but significant osseous changes of the affected side in the operative group ($P<0.05$, Table 5). There was no significant difference of osseous changes between the conservative group and the operative group in both affected and unaffected sides ($P>0.05$, Table 5). And there was no significant difference of osseous changes between affected and unaffected side in both groups ($P>0.05$, Table 5).

3. Mandibular Asymmetry

The asymmetry index was decreased in accordance with the time in the conservative group ($P<0.05$, Figs. 6, 7), but there was no tendency in the operative group ($P>0.05$, Table 6). There was no significant difference of asymmetry indices between the conservative and the operative group.

Discussion

The treatment goal of the condylar fracture is the re-establishment of preoperative function of the masticatory system. In the treatment of condylar fracture as well as other mandibular fractures, proper occlusion, function, and normal facial contour must be reconstructed.[16] The condylar fractures are usually treated conservatively, and this has proved to be satisfactory in the long-term results.[17] But, the operative treatment of condylar fractures has been frequently reported.

Not all condylar fractures should be treated conservatively regardless of the pre-existing or traumatically induced problems. The decision on how to treat most condylar fractures should be based on the evaluation of the radiographs, as well as the patient's age, medical and dental history, pathogenesis and severity of injury, and behavior patterns that might modify the treatment expectation.[18]

In this study, a transcranial radiograph was used for observing the osseous changes of TMJs because it is a relatively useful method for observing the osseous changes of the condylar head and articular eminence at the same time.[19]

When the TMJ is injured, the condylar head and articular eminence become in direct contact. This contact lead to osseous changes.[20] The osseous changes are classified by flattening, sclerosis, and erosion.[21] Of the osseous changes, flattening on the anterosuperior area of the condylar head is frequently found. Carlsson and Lindvall et al.[22,23] reported that the osseous changes occur usually on the anterior and lateral surfaces of the condylar head.

In this study, there was no osseous changes on unaffected side in the conservative group, but significant difference of osseous changes on the affected side in the operative group. There was no significant difference between affected and unaffected side in both groups, however a difference was found between the conservative and operative group on both sides.

Some reports showed that the conservative treatment has the poorer results. Santler et al.[24] reported that the operative treatment shows the better results when the condylar fragment displacement is large. Worsaae et al.[25] recommended that when a displaced unilateral condylar neck fracture is present, the conservative treatment has resulted in more side effects such as dysocclusion, mandibular asymmetry, masticatory dysfunction, and TM disorder.

Therefore, to overcome the problems of the conservative treatment, various operative treatment methods have been introduced by many authors,[26,27] and have been increasing due to the advanced surgical methods and improved skills recently.[1] For better treatment results of the condylar fractures, it is important to prove what factors affect the prognosis and when these factors are applied.

Our results show that the conservative group has better results than the operative group.

Several authors suggested using the operative treatment in cases where a unilateral fracture is more than 45° from the ramus axis from a frontal view,[3,16] or when the condylar head is dislocated from the glenoid fossa.[28] However, the operative treatment indications in relation to the dislocation angle in the condylar fractures are still under discussion. Zide and Kent[18] described the classical absolute and relative indications for the operative treatment in 1983.

In this study, 2 developing children and 1 adult had bilateral condylar fractures and they were all treated conservatively. In developing children, the osseous changes were observed on transcranial radiographs and the mandibular asymmetry was decreased significantly on the posteroanterior radiographs. Eckerdal et al.[29] suggested that treating condylar fractures in children can get good result using the conservative treatment. Another adult with bilateral condylar fractures was treated conservatively. The osseous changes of both affected sides were not significantly different on the transcranial radiographs, but mandibular asymmetry was not decreased significantly on the posteroanterior radiographs.

In the long-term follow up, incomplete anatomic restoration of the condylar fractures can cause mandibular asymmetry. The inadequate continuous adjustment of the elastic applied to

the arch bars in the conservative group and the displacement of the fractured fragment in the operative group can lead to reduced ramal height and mandibular asymmetry.[3] According to Lindahl,[30] the persistent dislocation of the condylar fragment must be one of the principal causes of the mandibular asymmetry or the masticatory functional disorder following the condylar fractures.

In this study, the mandibular asymmetry was decreased significantly in accordance with the time in the conservative group, but the fixed tendency was not found in the operative group. There was no significant difference of mandibular asymmetry between two groups.

Finally, we hope this study provides useful information for deciding the treatment and prognosis of the condylar fracture patients. Hereafter, complementary studies concerning various affecting factors should be continued, and the number of the subjects should be increased.

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