

# Outcomes of open versus closed treatment in the management of mandibular subcondylar fractures

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**Abstract** (J Korean Assoc Oral Maxillofac Surg 2014;40:297-300)

**Objectives:** To compare the clinical and radiological outcomes after closed reduction (CR) and open reduction and internal fixation (ORIF) in the management of subcondylar fractures.

**Materials and Methods:** Forty-eight patients presenting with subcondylar fracture between January 2010 and March 2013 were evaluated retrospectively. Fifteen patients were treated with CR and 33 patients with ORIF. The clinical and radiologic parameters were evaluated during follow-up (mean, 7.06 months; range, 3 to 36 months).

**Results:** In the CR group, no patients had any problems with regard to the clinical parameters. The average period of maxillomandibular fixation (MMF) was 5.47 days. The preoperative average tangential angulation of the fractured fragment was 3.67°, and loss of ramus height was 2.44 mm. In the ORIF group, no clinical problems were observed, and the average period of MMF was 6.33 days. The preoperative average tangential angulation of the subcondylar fragment was 8.66°, and loss of ramus height was 3.61 mm.

**Conclusion:** CR provided satisfactory clinical results, though ORIF provided more accurate reduction of the fractured fragment. So there is no distinct displacement of fractured fragment, CR should be selected than ORIF because of no need for surgery.

**Key words:** Subcondylar fracture, Closed reduction, Open reduction and internal fixation

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## I. Introduction

The subcondylar area is the most common site of mandibular condylar fracture<sup>1,2</sup>. The treatment of subcondylar fractures can be divided into two major treatment methods: closed treatment or closed reduction (CR) and open reduction and internal fixation (ORIF). CR requires a period of maxillomandibular fixation (MMF), followed by active physiotherapy. ORIF allows good anatomical repositioning and immediate functional movement of the jaw. This study compares the clinical and radiological outcomes after CR and ORIF management of subcondylar fractures.

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## II. Materials and Methods

Forty-eight patients presenting with subcondylar fracture between January 2010 and March 2013 at the Department of Oral and Maxillofacial Surgery, Gachon University Gil Medical Center were included in this retrospective study. The treatment methods were decided according to the surgeons' preferences and experiences. Fifteen patients (14 males and 1 female) with an age range of 6 to 52 years (mean, 42 years) were treated with CR, and 33 patients (28 males and 5 females) with an age range of 17 to 62 years (mean, 34 years) underwent an ORIF operation. Patients with CR were followed-up for an average of 10.7 months (range, 3 to 36 months). Those with ORIF were followed-up for an average of 3.8 months (range, 3 to 24 months). All patients included in this study had more than three months of follow-up. A telephone survey was performed for the 6 CR patients who did not visit the clinic for three months after the first visit.

Chart review was performed, and occlusion, maximal mouth opening, deviation on mouth opening, and nerve injury were evaluated. Radiologic assessment was also performed to



**Fig. 1.** Illustration showing the method by which loss of ramus height was measured on the panoramic view. A reference line was drawn through both gonial angles. A perpendicular line between the most superior point of the condyle and the reference line was drawn on the panoramic radiograph. The difference between the non-fractured and fractured side was used as a measure of difference in ramus length.

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**Fig. 2.** Illustration showing the method by which tangential displacement was quantified on the panoramic view. A reference line was drawn through both gonial angles, and another line was drawn tangential to the posterior border of the condylar process on each side. The angle between the intersection of the tangent and the condylar process was calculated. The difference in this angle between the non-fractured and fractured sides was used as a measurement of tangential angulation.

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evaluate the tangential angulation of the displaced fragment and loss of ramus height, as described in Palmieri et al.<sup>3</sup>. The amount of condyle fragment displacement (tangential angulation and loss of ramus height) was evaluated on panoramic radiographs at the first visit and three months later.(Figs. 1, 2)

The data were analyzed using IBM SPSS Statistics for Windows, version 19.0 (IBM Co., Armonk, NY, USA). Measurements are given as the mean±standard deviation. Comparisons between the two groups were performed using the Mann-Whitney U test.

### III. Results

#### 1. Patient data

In the CR group, 2 condylar fragments were displaced medially, 7 laterally, and 6 were non-displaced. In the ORIF group, 2 condylar fragments were displaced medially, 24 laterally, and 7 were non-displaced. The average period of MMF was 5.47 days in the CR group and 6.33 days in the ORIF group. Associated mandibular fractures occurred in 68.75% of cases, especially symphysis fractures (64.58%). Twelve patients (11 symphysis, 1 body) from the CR group and 21 patients (20 symphysis, 1 body) from the ORIF group had concomitant mandibular fractures. All concomitant fractures were treated with ORIF.(Table 1)

#### 2. Radiologic results

In the CR group, the average loss of ramus height was 2.44

**Table 1.** Patient's data

Parameter	Closed reduction (n=15)	Open reduction and internal fixation (n=33)
Gender (male/female)	14/1	28/5
Age at injury (yr)	42 (6-52)	34 (17-62)
Concomitant fracture		
Symphysis	11	20
Body	1	1
Angle	0	0
None	3	12
Displacement of fractured fragment		
Medial overlap type	2	2
Lateral overlap type	7	24
Non-displaced	6	7

Values are presented as number or mean (range).

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±2.18 mm, and tangential angulation was 3.67°±2.53° at the first visit. Three months after CR, the average loss of ramus height was 1.99±0.99 mm, and tangential angulation was 2.35°±2.23°. The difference between the first visit and the three-month follow-up was 1.25±1.61 mm in loss of ramus height and 0.32°±1.56° in tangential angulation.

In the ORIF group, the average loss of ramus height was 3.61±2.33 mm, and tangential angulation was 8.66°±5.12° at the first visit. Three months after ORIF, the average loss of ramus height was 1.01±1.19 mm, and tangential angulation was 1.74°±0.89°. The difference between the first visit and three-month follow-up was 2.60±2.02 mm in loss of ramus height and 6.92°±4.86° in tangential angulation.

There was a statistically significant difference between the

groups in the loss of ramus height ( $P=0.008$ ) and tangential angulation ( $P=0.000$ ). (Tables 2, 3) There was also a statistically significant difference between the groups in preoperative tangential angulation ( $P=0.002$ ). (Table 3)

### 3. Clinical results

The clinical parameters were observed three months after treatment or by telephone survey. Neither group had any patients with post-treatment malocclusion or permanent nerve injury. The mouth opening of all patients was greater than 40 mm. However, 6 of 15 patients (40%) in the CR group showed deviation on mouth opening. Similarly, 11 of 33 patients (33%) in the ORIF group showed deviation on mouth opening. (Table 4)

**Table 2.** Radiologic parameters for loss of ramus height (mm)

Parameter	Closed reduction	Open reduction and internal fixation	<i>P</i> -value <sup>1</sup>
Preoperative	2.44±2.18	3.61±2.33	0.079
Postoperative	1.99±0.99	1.01±1.19	0.301
Difference	1.25±1.61	2.60±2.02	0.008

<sup>1</sup>Mann-Whitney U test.

Values are presented as mean±standard deviation.

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**Table 3.** Radiologic parameters for tangential angulation of the fractured fragment (°)

Parameter	Closed reduction	Open reduction and internal fixation	<i>P</i> -value <sup>1</sup>
Preoperative	3.67±2.53	8.66±5.12	0.002
Postoperative	2.35±2.23	1.74±0.89	0.586
Difference	0.32±1.56	6.92±4.86	0.000

<sup>1</sup>Mann-Whitney U test.

Values are presented as mean±standard deviation.

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**Table 4.** Clinical parameters

Parameter	Closed reduction (n=15)	Open reduction and internal fixation (n=33)
Malocclusion	0	0
Mouth opening limitation	0	0
Deviation on opening	6	11
Nerve injury	0	0

Values are presented as number.

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## IV. Discussion

Despite a plethora of treatment guidelines, management of subcondylar fracture of the mandible remains controversial. During the past few decades, CR has been the preferred treatment<sup>4</sup>; however, closed treatment requires a period of MMF, followed by active physiotherapy<sup>5</sup>. Also, long-term complications such as pain, arthritis, open bite, deviation of the mandible on opening, inadequate restoration of vertical height of the ramus leading to malocclusion, and ankylosis can result from the CR method<sup>6</sup>. However, we found no significant differences between groups in the average period of MMF (5.47 days in CR group and 6.33 days in ORIF group) and no serious complications.

Surgical treatment allows proper anatomical repositioning and immediate functional movement of the jaw<sup>7</sup>. There is consensus that correct anatomical repositioning of the mandibular condyle process is an important prerequisite for re-establishing function<sup>8</sup>. In cases of severe displacement or dislocation, surgical management is preferred<sup>6,9</sup>. In our study, all treatment methods were decided by the treating surgeons. In our clinics, doctors tend to provide CR for patients with less displaced fractures and ORIF to those with more displaced fractures. The preoperative tangential angulation in the CR group ( $3.67^\circ \pm 2.53^\circ$ ) was significantly less ( $P=0.002$ ) than that in ORIF group ( $8.66^\circ \pm 5.12^\circ$ ). However, the difference between the groups in preoperative loss of ramus height was not significant.

Palmieri et al.<sup>3</sup> reported that open reduction might produce functional benefits for patients with severely dislocated condylar process fractures, and Undt et al.<sup>7</sup> reported that ORIF allows appropriate anatomical repositioning and immediate functional movement of the mandible. Similarly, in our study, the difference between preoperative and postoperative loss of ramus height in the ORIF group ( $2.60 \pm 2.02$  mm) was statistically greater than that in the CR group ( $1.25 \pm 1.61$  mm;  $P=0.008$ ). The difference between preoperative and postoperative tangential angulation in the ORIF group ( $6.92^\circ \pm 4.86^\circ$ ) was statistically greater than that in the CR group ( $0.32^\circ \pm 1.56^\circ$ ;  $P=0.000$ ).

Haug and Assael<sup>10</sup> showed no differences for maximum interincisal opening, deviation on opening, and occlusion between closed and open management groups after treatment. Likewise, we found no clinical differences, such as occlusion or interincisal mouth opening, between the CR and ORIF groups. However, 6 patients (40%) in the CR group and 11 patients (33%) in the ORIF group showed deviation on maxi-

mal opening of the lower jaw three months after treatment. Our study used only 48 patients and a relatively short follow-up period. Future research should compare the outcomes of many more cases with long-term follow-up.

## V. Conclusion

In conclusion, CR had clinically satisfactory results, although ORIF produced more accurate reduction of fractured fragments. In the absence of distinct displacement of a fractured fragment, therefore, CR should be selected over ORIF to prevent the need for an operation.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

## References

1. Lee SC, Kim YG, Ryu DM, Lee BS, Yoon OB, Jin TH. A clinical and statistical study of condylar fracture of mandible. *J Korean Assoc Oral Maxillofac Surg* 1998;24:326-9.
2. Lindahl L. Condylar fractures of the mandible. I. Classification and relation to age, occlusion, and concomitant injuries of teeth and teeth-supporting structures, and fractures of the mandibular body. *Int J Oral Surg* 1977;6:12-21.
3. Palmieri C, Ellis E 3rd, Throckmorton G. Mandibular motion after closed and open treatment of unilateral mandibular condylar process fractures. *J Oral Maxillofac Surg* 1999;57:764-75.
4. Brandt MT, Haug RH. Open versus closed reduction of adult mandibular condyle fractures: a review of the literature regarding the evolution of current thoughts on management. *J Oral Maxillofac Surg* 2003;61:1324-32.
5. Suzuki T, Kawamura H, Kasahara T, Nagasaka H. Resorbable poly-L-lactide plates and screws for the treatment of mandibular condylar process fractures: a clinical and radiologic follow-up study. *J Oral Maxillofac Surg* 2004;62:919-24.
6. Iizuka T, Ladrach K, Geering AH, Raveh J. Open reduction without fixation of dislocated condylar process fractures: long-term clinical and radiologic analysis. *J Oral Maxillofac Surg* 1998;56:553-61.
7. Undt G, Kermer C, Rasse M, Sinko K, Ewers R. Transoral miniplate osteosynthesis of condylar neck fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1999;88:534-43.
8. Baker AW, McMahon J, Moos KF. Current consensus on the management of fractures of the mandibular condyle. A method by questionnaire. *Int J Oral Maxillofac Surg* 1998;27:258-66.
9. Sugiura T, Yamamoto K, Murakami K, Sugimura M. A comparative evaluation of osteosynthesis with lag screws, miniplates, or Kirschner wires for mandibular condylar process fractures. *J Oral Maxillofac Surg* 2001;59:1161-8.
10. Haug RH, Assael LA. Outcomes of open versus closed treatment of mandibular subcondylar fractures. *J Oral Maxillofac Surg* 2001;59:370-5.