



# Anatomical and Functional Recovery of Intracapsular Fractures of the Mandibular Condyle: Analysis of 124 Cases after Closed Treatment

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## Abstract

**Purpose:** The purpose of this study is to evaluate the influence of intracapsular fracture lines of the mandibular condyle on the anatomical and functional recovery after non-surgical closed treatment.

**Methods:** Clinical and radiological follow-up of 124 patients with intracapsular fractures of the mandibular condyle was performed after closed treatment between 2005 and 2012. The intracapsular fractures were classified into three categories: type A (medial condylar pole fracture), type B (lateral condylar pole fracture with loss of vertical height) and type M (multiple fragments or comminuted fracture).

**Results:** By radiological finding, fracture types B and M lost up to 24% vertical height of the mandibular condyle compared to the height on the opposite side. In Type M, moderate to severe dysfunction was observed in 33% of the cases. Bilateral fractures were significantly associated with the risk of temporomandibular joint (TMJ) dysfunction in fracture types A and B. Bilateral fracture and TMJ dysfunction were not statistically significantly associated in type M fractures.

**Conclusion:** Most of the mandibular intracapsular condylar fractures recovered acceptably after conservative non-surgical treatment with functional rehabilitation, even with some anatomical shortening of the condylar height. The poor functional recovery encountered in type M fractures, especially in cases with additional fracture sites and bilateral fractures, points up the limitation of closed treatment in such cases.

**Key words:** Temporomandibular joint disorders, Mandibular fracture, Mandibular condyle

## Introduction

Among facial bone fractures, mandible and nasal bone fractures are most common, and condylar fractures are one of the most common fractures in the mandible[1]. Condylar fractures account for 29% to 40% of facial bone fractures

and 9% to 62% of all mandible fractures[2-8]. Intracapsular condylar fractures, however, are relatively rare[9].

The ideal approach for diagnosis and treatment of mandibular condylar fractures is an open question. Many studies have investigated treatment methods and physical therapy based on condylar fracture classification[10-12]. The

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indications for closed versus open treatment are also a matter of debate[13-16], with various methods of conservative treatment reported[17]. The typical closed treatment is intermaxillary fixation for one or two weeks to correct occlusion and stretch the jaw to prevent ankylosis[18]. Conservative treatments are preferred to avoid facial nerve injury, scar formation during surgery, and the difficulty of reducing small fragments[19]. However, several studies observed unpredictable results after conservative treatment, including deviation of the mandible[17], growth disturbance of the jaw, and ankylosis[19-21].

The purpose of this retrospective study is to evaluate the influence of intracapsular fracture lines of the mandibular condyle on the anatomical and functional recovery after non-surgical closed treatment.

## Materials and Methods

### 1. Patients

In the period from 2005 to 2012, 180 patients with intracapsular fractures of the mandibular condyle were treated at our institution. In the current study, 124 of these patients (90 male and 34 female patients; average age, 35.4 years; range, five to 71 years) were examined two to 90 months after treatment (mean, 31.2 months). The condylar fractures were caused by slips (n=58), traffic accidents (n=30), falls (n=24), motorcycle accidents (n=20), syncope (n=6), bicycle accidents (n=11), drunkenness (n=9), work accidents (n=6), sports (n=3), and assaults (n=1). The fractures

were classified based on radiographs including a panoramic and a postero-anterior radiogram, coronal computed tomography.

The current study adopted Hlawitschka classification system[22,23], which groups intracapsular fractures into three categories: type A (medial condylar pole fracture), type B (lateral condylar pole fracture with loss of vertical height) and type M (multiple fragments or comminuted fracture) (Fig. 1). Based upon Hlawitschka classification, 29 type A intracapsular fractures, 56 type B intracapsular fractures and 39 type M intracapsular fractures were diagnosed in the present study. Concomitant fractures at other sites of the mandible were treated by osteosynthesis, allowing the initiation of mouth-opening exercises as soon as possible. Closed treatment included one week of intermaxillary fixation and functional observation for four to eight weeks. This study was approved by the institutional review board of Kyungpook National University Hospital (IRB No. 2014-01-002-003).

### 2. Post-treatment examinations

The clinical findings are summarized using the dysfunction index provided by Helkimo[24], composed of five criteria: mandibular mobility, temporomandibular joint (TMJ) function, pain in masticatory muscle, TMJ pain, and pain during movement (Table 1). The radiologic examination included orthopantomograph. The distances measured are shown in Fig. 2. Reductions in the height of the ramus and condyle on panoramic radiographs after unilateral condyle fracture were determined by comparison with the height on the non-fractured contralateral side.

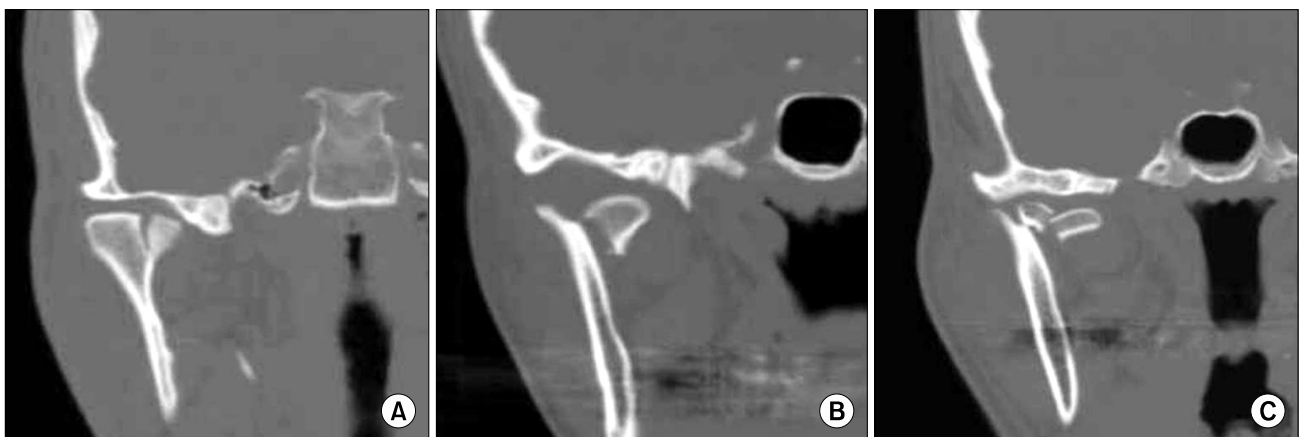
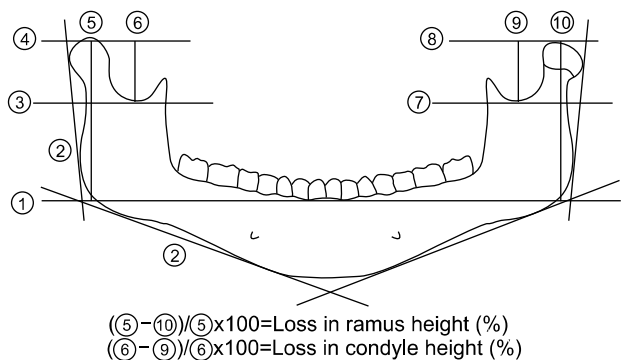


Fig. 1. Type of intracapsular fracture in coronal view. (A) Medial condylar pole fracture. (B) Lateral condylar pole fracture with loss of vertical height. (C) Multiple fragments or comminuted fracture.

**Table 1.** TMJ clinical dysfunction index (Di) by Helkimo categories[24]

Symptom	Criteria (point)
Impaired range of movement/mobility index	Normal range of movement (0) Slightly impaired mobility (1) Severely impaired mobility (5)
Impaired TMJ function	Smooth movement without TMJ sounds and/or deviation of $\leq 2$ mm on opening or closing (0) TMJ sounds in one or both joints and/or deviation of $\geq 2$ mm on opening or closing (1) Locking and/or luxation of the TMJ (5)
Muscle pain	No tenderness on palpation of the masticatory muscles (0) Tenderness on palpation of 1~3 palpation sites (1) Tenderness on palpation of 4 or more palpation sites (5)
TMJ pain	No tenderness on palpation (0) Tenderness on palpation laterally (1) Tenderness on palpation posteriorly (5)
Pain on movement of the mandible	No pain on movement (0) Pain on 1 type of movement (1) Pain on 2 or more types of movements (5)

Dysfunction score: sum of 5 symptoms (0~25 points), Di0: clinically symptom free (0 point), DiI: mild dysfunction (1~4 points), DiII: moderate dysfunction (5~9 points), DiIII: severe dysfunction (10~25 points). TMJ, temporomandibular joint.



**Fig. 2.** Distances in the panoramic radiogram according to Hlawitschka and Eckelt[23]. ①: horizontal line of mandibular angle, ②: tangents line of mandibular angle, ③: horizontal line of subcondylar notch in non-fractured side, ④: horizontal line of condyle in non-fractured side, ⑤: ramus height in non-fractured side (mm), ⑥: condyle height in non-fractured side (mm), ⑦: horizontal line of subcondylar notch in fractured side, ⑧: horizontal line of condyle in fractured side, ⑨: condyle height in fractured side (mm), ⑩: ramus height in fractured side (mm).

### 3. Statistical analysis

The average values and standard deviations were determined using the program Microsoft Excel 2010 (Microsoft, Redmond, WA, USA). Fisher exact test and Cochran-Mantel-Haenszel test were used to determine the significance of differences between types of intracapsular fracture and the presence of additional mandibular fractures. Null hypotheses of no difference were rejected if *P*-values were less than 0.05, or equivalently, if the 95% confidence intervals of risk point estimates excluded 1.

**Table 2.** Distribution of loss in ramus and condyle height by fracture type

Type	No. of patients	Loss in vertical ramus height (%)	Loss in condylar height (%)
Type A	19	2.7±2.5	8.3±7.0
Type B	41	9.3±4.5	23.7±13.5
Type M	19	7.7±5.0	24.0±7.7

Values are presented as number or mean±standard deviation. Type A, medial condylar pole fracture; Type B, lateral condylar pole fracture with loss of vertical height; Type M, multiple fragments or comminuted fracture.

## Results

### 1. Radiological findings

Radiological evaluation showed a reduction of 24% in the condylar height for intracapsular fracture types B and M and a reduction of 8% for type A fractures, in comparison with the heights on the non-fractured contralateral side. The mandibular ramus height was reduced by an average of 9% for type B, 8% for type M, and 3% for type A (Table 2).

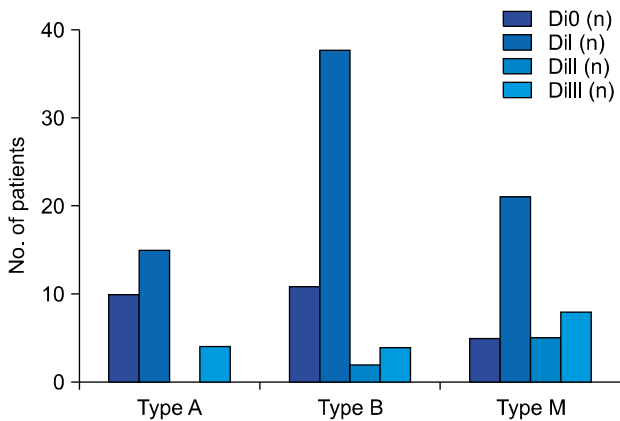
### 2. Clinical findings

Moderate-to-severe dysfunction was observed in 13 out of 39 type M cases (33.3%), four out of 29 type A cases (13.8%), and six out of 56 type B cases (10.7%). The differences in the risk of moderate-to-severe dysfunction among the three groups were statistically significant (Table 3, Fig. 3; Fisher exact test, *P*=0.019). Bilateral fractures were significantly associated with the risk of TMJ dysfunction in types A and B fractures. No statistically significant differ-

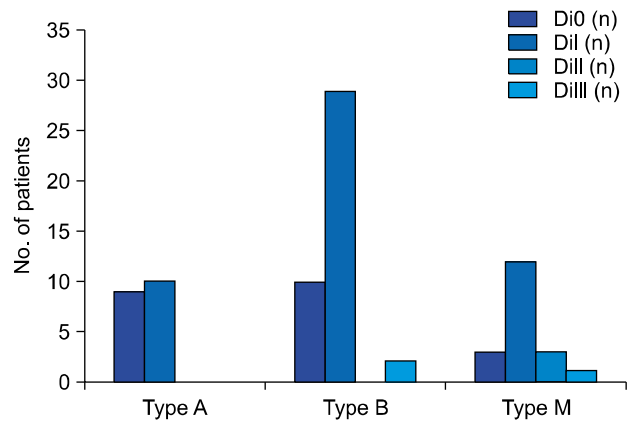
**Table 3.** Distribution of clinical dysfunction by fracture type

Type	Uni/Bi	No. of patients	Helkimo clinical dysfunction index					Odds ratio	P-value
			Di0 (n)	Dil (n)	Di0+Dil (n)	Dill (n)	Dill+Dilll (n)		
Type A	Uni	19	9	10	19	0	0	Inf*	<0.01
	Bi	10	1	5	6	4	4		
	Sub	29	10	15	25	0	4		
Type B	Uni	41	10	29	39	0	2	6.78*	0.0382
	Bi	15	1	10	11	2	4		
	Sub	56	11	39	50	2	4		
Type M	Uni	19	3	12	15	3	1	2.979*	0.176
	Bi	20	2	9	11	2	7		
	Sub	39	5	21	26	5	8		
Total		124	26	75	101	7	16	5.83 <sup>†</sup>	<0.01

Dysfunction score: sum of 5 symptoms (0~25 points), Di0: clinically symptom free (0 point), Dil: mild dysfunction (1~4 points), Dill: moderate dysfunction (5~9 points), Dilll: severe dysfunction (10~25 points). Type A, medial condylar pole fracture; Type B, lateral condylar pole fracture with loss of vertical height; Type M, multiple fragments or comminuted fracture; Uni, unilateral fracture; Bi, bilateral fracture; Sub, subtotal; Inf, infinity. \*Fisher's exact test. <sup>†</sup>Cochran-Mantel-Haenszel test.



**Fig. 3.** Distribution of clinical dysfunction by fracture type. Dysfunction score: sum of 5 symptoms (0~25 points), Di0: clinically symptom free (0 point), Dil: mild dysfunction (1~4 points), Dill: moderate dysfunction (5~9 points), Dilll: severe dysfunction (10~25 points). Type A, medial condylar pole fracture; Type B, lateral condylar pole fracture with loss of vertical height; Type M, multiple fragments or comminuted fracture.



**Fig. 4.** Distribution of clinical dysfunction by fracture type in unilateral fracture. Dysfunction score: sum of 5 symptoms (0~25 points), Di0: clinically symptom free (0 point), Dil: mild dysfunction (1~4 points), Dill: moderate dysfunction (5~9 points), Dilll: severe dysfunction (10~25 points). Type A, medial condylar pole fracture; Type B, lateral condylar pole fracture with loss of vertical height; Type M, multiple fragments or comminuted fracture.

**Table 4.** Distribution of clinical dysfunction by unilateral/bilateral fracture

Type	No. of patients	Helkimo dysfunction index			
		Symptom-free: Di0 (n)	Mild: Dil (n)	Moderate: Dill (n)	Severe: Dilll (n)
Unilateral	79	22	51	3	3
Bilateral	45	4	24	4	13
Total	124	26	77	7	16

ence was observed in the association between bilateral fractures and TMJ dysfunction in type M cases (Table 3).

Moderate-to-severe dysfunction was observed in 17 out of 45 bilateral fracture cases (37.8%), and in six out of 79 unilateral fracture cases (7.6%). The difference in the number of cases of moderate-to-severe dysfunction be-

tween the groups was statistically significant (Table 4, Fig. 3, 4; Fisher exact test,  $P < 0.0001$ ). Moderate-to-severe dysfunction was observed in 20 out of 75 cases with additional fractures (26.7%), and in three out of 49 cases without additional fractures (6.1%). The difference between groups was statistically significant (Table 5; Fisher exact test,

$P=0.0028$ ). No statistically significant difference was found among the three additional fracture site groups (Fig. 5).

## Discussion

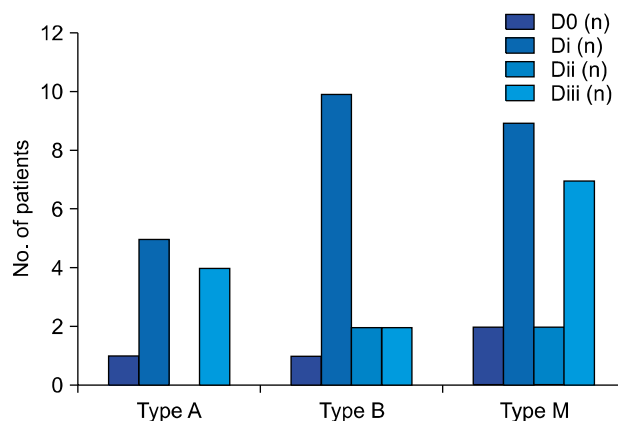
The most common causes of condyle fractures cited in the literature are traffic accidents, followed by falls and assaults[25]. Condylar fractures can be caused by indirect forces delivered to the condyle from the direct trauma site[26]. In the present study, the most common cause of an intracapsular condyle fracture was a slip. Condylar fractures may lead to severe problems such as malocclusion, facial growth disturbance, or disorders of the TMJ[27].

Zachariades *et al.*[26] reported that choice of treatment for condylar fractures depends on factors such as co-morbidity with other facial fractures, the location of condylar fractures, the level of displacement, the state of dentition and dental occlusion, and general condition.

Treatment for condyle fractures includes closed treatment and surgical intervention. Closed treatment includes intermaxillary mobilization and functional therapy. Surgical intervention is used to reposition and stabilize the frag-

ments[8].

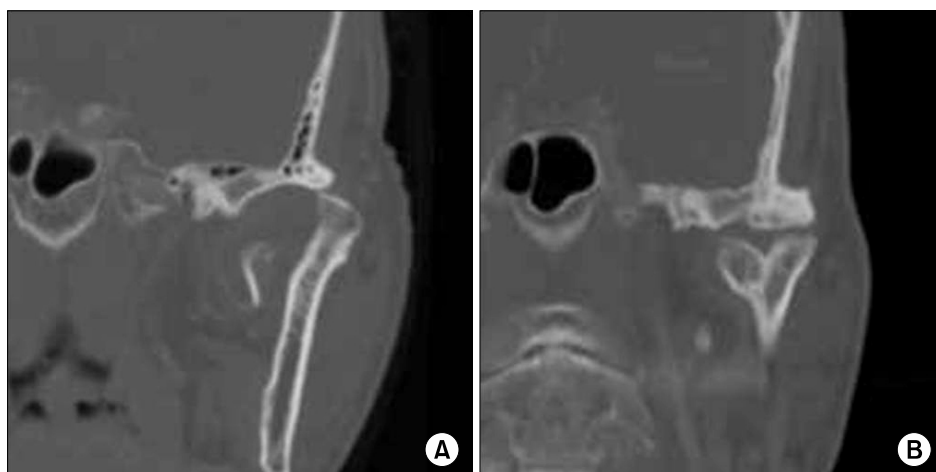
Closed treatment is indicated in almost all condylar fractures occurring in childhood[28], because it achieves early mobilization and adequate functional stimulation of con-



**Fig. 5.** Distribution of clinical dysfunction by fracture type in bilateral fracture. Dysfunction score: sum of 5 symptoms (0~25 points), Di0: clinically symptom free (0 point), Di1: mild dysfunction (1~4 points), Di2: moderate dysfunction (5~9 points), Di3: severe dysfunction (10~25 points). Type A, medial condylar pole fracture; Type B, lateral condylar pole fracture with loss of vertical height; Type M, multiple fragments or comminuted fracture.

**Table 5.** Distribution of clinical dysfunction by additional fracture sites

Fracture site	No. of patients	Helkimo dysfunction index			
		Symptom-free: Di0 (n)	Mild: Di1 (n)	Moderate: Di2 (n)	Severe: Di3 (n)
<b>Additional fracture site</b>					
Symphysis	60	13	31	6	10
Body or angle	19	6	8	1	4
Subcondylar neck	6	2	3	1	0
<b>Total</b>	<b>75</b>	<b>17</b>	<b>38</b>	<b>7</b>	<b>13</b>
None	49	9	37	0	3



**Fig. 6.** Radiologic findings of patient with bilateral and additional fracture who had severe dysfunction. (A) First visit. (B) Four years later.

dylar growth[8,28]. Conversely, surgical intervention is indicated when the condylar head is severely displaced or dislocated, especially in adults[26,28].

In childhood, remodeling of the mandibular condyle can often recover normal to near-normal morphology and function, since the remodeling center is the mandibular condyle and it responds to changes in the relationship of surrounding structures during growth[29-31].

Conservative treatment may be regarded as the first choice of treatment for fractures of mandibular condyle to avoid nerve injury and scar formation[19]. Nevertheless, contraindications for closed treatment for condylar fractures should be considered carefully. Ellis *et al.*[32] reported that more severe problems can occur, for example malocclusion and open bite, or deviation on mouth opening, when condylar fractures are treated by closed treatment. Dahlström *et al.*[29] reported that mild clinical dysfunction can occur after moderate displacement of the condylar head, and moderate clinical dysfunction may occur after condylar head dislocation. Silvennoinen *et al.*[27] reported that injuries were more often severe after bilateral condylar fractures, compared with unilateral condylar fracture cases.

In this study, type M cases involving bilateral fractures and additional fractures often developed moderate-to-severe dysfunction and deranged condylar morphology (Fig. 6). Bilateral fractures developed more severe functional disturbance than unilateral fractures (odds ratio=5.83,  $P<0.01$ ; Table 3), although the frequency of dysfunction did not differ between bilateral and unilateral fractures in type M cases. This means that a type M presentation leads to significantly more dysfunction. Type M cases frequently developed severe functional problems even in unilateral cases.

## Conclusion

Most mandibular intracapsular condylar fractures showed clinically acceptable recovery with conservative non-surgical treatment and functional rehabilitation even with some anatomical shortening of the condylar height. The poor functional recovery encountered in type M fractures, especially in cases with additional fracture sites and bilateral fractures, point up the limitations of closed treatment for such cases.

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