An Analysis of 949 Cases of Condylar Process Fracture of the Mandible

Shiro Kubo 1) Akira Yamaguchi 2) Satoru Matsunaga 3)
1) Kubo Dental Clinic, Hokkaido, Japan
2) Oral Health Science Center, Tokyo Dental College, Japan
3) Dept of Oral Anatomy, Tokyo Dental College, Japan

Abstract: Condylar process fractures of the mandible (CPFM) are the most common type of mandibular fracture. However, the classification and management of CPFM is currently a subject of controversy. This retrospective study included an analysis of 949 cases of CPFM, which were categorized using Kubo’s classification (1983). This study proved that the most important prognostic factor for CPFM depends on the level and type (i.e. the position of the fractured segments) of the fracture. The indications for surgical and non-surgical treatment for condylar fractures, especially dislocated fractures in young adults require discussion.

Keywords: classification of condylar process fracture of mandible, retrospective analysis, non-surgical treatment, surgical treatment

I. Introduction

The incidence of condylar process fractures of the mandible (CPFM) is the highest among mandibular fractures (1). However, the treatment of CPFM remains controversial and is more widely discussed than any other type of maxillofacial fractures (2,3,4). In the past, as a rule, CPFM were treated with conservative methods (5). Functionally stable osteosynthesis and endoscopic-assisted reduction were recently introduced to the field of condylar traumatology (6). Spontaneous remodeling (regeneration) of the condylar head of the dislocated condylar process fracture can be observed generally among growing children (7,8,9). The age limit is an important factor, while choosing surgical or non-surgical treatment in children. However, its age is controversial and must be solved. Reliable comparisons between studies, including meta-analyses are difficult, owing to the difference in study protocols and lack of information on classification. Unambiguous and therapy-relevant classification is an important prerequisite for appropriate treatment of CPFM. We found that the level and type of fracture were the principal factors determining treatment selection.

II. Material and Methods

The data of patients examined at the departments of oral surgery of 11 university hospitals in Japan were collected retrospectively (7,10-19). The data of 949 cases of CPFM were extracted for synthesizing the results for the analysis. These cases had been analyzed with the classification of the CPFM presented by Kubo in 1983 (7). The prognosis of non-surgical treatment of CPFM was assessed by performing an analysis of the results of 403 cases from 6 university hospitals (7,12,14,15,17,19).

Figure 1: Classification of condylar process fracture of the mandible by Kubo 1983
The level of fracture was defined as follows:
1) Condylar head is elliptical in shape, partially including a part of the fovea pterygoidea.
2) The condylar neck is between the condylar head and bottom of the low neckline. The condylar neck region is divided into high neck and low neck by a line passing through the middle. The high neck area includes a part of the fovea pterygoidea.
3) The bottom of the low neckline runs through the deepest point of the sigmoid notch and is perpendicular to the posterior ramus line.
4) The base line runs through the deepest point of the sigmoid notch and imaginary line from the posterior border of the coronoid process.

**Figure 2: The types of fractures were classified as follows by MacLennan**

MacLennan’s (20) classification of condylar fractures, based on the degree, direction, and displacement of the fractured fragments, was used to determine the type of fracture:
1) Crack: no displacement of fragment
2) Deviation: The fragment is deviated and contact with the ramus of mandible is maintained, without any dislocation.
3) Displacement: The fragment is separated from the ramus of mandible and regard to the temporal fossa.
4) Deviation-dislocation: The condylar head is dislocated from the temporal fossa but contact with the ramus of mandible is maintained.
5) Displacement-dislocation: The condylar head is dislocated from the temporal fossa and separated from the ramus of mandible.

### III. Results

**Table 1: Result of the analysis of 949 cases of CPFM**

<table>
<thead>
<tr>
<th></th>
<th>Head</th>
<th>High neck</th>
<th>Low neck</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack</td>
<td>14</td>
<td>21</td>
<td>32</td>
<td>109</td>
</tr>
<tr>
<td>Deviation</td>
<td>24</td>
<td>46</td>
<td>54</td>
<td>83</td>
</tr>
<tr>
<td>Displacement</td>
<td>32</td>
<td>32</td>
<td>30</td>
<td>61</td>
</tr>
<tr>
<td>Deviation</td>
<td>19</td>
<td>42</td>
<td>39</td>
<td>26</td>
</tr>
<tr>
<td>Dislocation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement</td>
<td>59</td>
<td>128</td>
<td>48</td>
<td>50</td>
</tr>
</tbody>
</table>

|              | 148(15.6%) | 269(28.3%) | 203(21.4%) | 329(34.7%) |

1) Level of fracture
a) Head: 148 (15.6%) cases, high neck: 269 (28.3%) cases, low neck: 203 (21.4%) cases, base: 329 (34.7%) cases
b) Condylar neck showed a tendency to fracture in 472/949 (49.7%) cases.
An Analysis of 949 Cases of Condylar Process Fracture Of the Mandible

2) Type of fracture: The following types of fractures were observed:
   a) Crack: 176 (18.6%) cases, deviation: 207 (21.8%) cases, displacement: 155 (16.3%) cases; deviation-dislocation: 126 (13.3%) cases, displacement-dislocation: 285 (30.0%) cases.
   b) Dislocation: 411 (43.3%) cases, none-dislocation: 538 (56.7%) cases.

3) Correlation between the type and level of fracture
   a) Head and high condylar fracture showed a tendency to dislocate: 248/417 (59.5%) cases.
   b) Low neck and base fracture did not show a tendency to dislocate: 163/532 (30.6%) cases.
   c) High neck and displacement-dislocation was the most common level and type of fracture, respectively, observed in 128 (12.9%) cases.

Table 2: Result of non-surgical treatment of 403 cases of CPFM

<table>
<thead>
<tr>
<th>Type</th>
<th>Head</th>
<th>High neck</th>
<th>Low neck</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack</td>
<td>5/6</td>
<td>7/8</td>
<td>12/15</td>
<td>46/62</td>
</tr>
<tr>
<td>Deviation</td>
<td>9/10</td>
<td>14/19</td>
<td>11/16</td>
<td>21/38</td>
</tr>
<tr>
<td>Displacement</td>
<td>11/20</td>
<td>7/15</td>
<td>6/14</td>
<td>18/30</td>
</tr>
<tr>
<td>Deviation-dislocation</td>
<td>6/13</td>
<td>6/16</td>
<td>6/20</td>
<td>6/14</td>
</tr>
<tr>
<td>Displacement-dislocation</td>
<td>15/24</td>
<td>14/37</td>
<td>4/12</td>
<td>0/14</td>
</tr>
</tbody>
</table>

The prognosis of 403 cases of CPFM treated with non-surgical methods at 6 university hospitals in Japan was analyzed (7,12,14,15,17,19). Good prognosis was observed in 224/403 (55.6%) cases.
1) The prognoses of cracks and deviations in the head and high neck were fair in 35/43 (81.4%) cases.
2) The prognosis of displacement fractures was not good in 42/79 (53.2%) cases.
3) The prognosis of dislocation fractures was not satisfactory in 57/150 (38.0%) cases, especially at the level of low neck and base fracture was not good in 16/60 (26.7%) cases.

IV. Case Presentation

**Case 1:** A 9-year-old girl was referred for facial trauma to the Sapporo Medical University with the chief complaint of pain in the left temporomandibular joint (TMJ). Town projection X-ray image medial showed deviation-dislocation and high neck fracture. She was treated with non-surgical methods. Remodeling (regeneration) of condylar head was observed 1 year and 2 months later. The prognosis was extremely good. No facial deformation or dysfunction. (Figure 3A and B).

![Figure 3: A: Angle of deviation-dislocation fracture is 60 degrees (dotted line). B: 1 year 2 months later, remodeling (regeneration) of the condylar head was observed (arrow)](image)

**Case 2:** The left condylar head shows medial deviation-dislocation and the level of fracture is located at the low neck. The patient was a 16-year-old boy, who was treated by non-surgical methods. Unfortunately, remodeling of the condylar head was incomplete, leading to the formation of the so-called “double-headed condyle” 9 months later after conservative treatment. No oral dysfunction occurred. (Figure 4A and B).
Figure 4: A: Angle of deviation-dislocation fracture is 90 degrees (dotted line). B: After 9 months, remodeling (regeneration) of condylar head was incomplete, with the so-called “double-headed condyle “observed (allow).

Case 3: A 68-year-old woman stumbled on a rock and fell. She complained of severe pain and swelling in the left mandibular and bilateral condylar regions. Radiograph revealed bilateral condylar head displacement-dislocation and left mandibular body fracture with displacement. The body of the mandible showed atrophy. The left mandibular fragment was fixed with a screw and circumferential wiring under general anesthesia. The lower denture was held in place with circumferential wiring. The maximally denture was held in place with internal wire suspension from both zygomatic arches. Both arches were immobilized using splint wires for 1 month. After removal of fixation, rehabilitation of mandibular movement was performed for 3 months. Oral pantograph and CT scan were taken 21 years later (Figure 5 A and B). Both condylar head showed dislocation and deformities with uncomplete remodeling. However, no disorders of movement of the mandible, including those of mouth opening, jaw movement, mastication and speech were observed (Figure C). She alive to the age of 98 years.
V. Discussion:

There have been various attempts to classify CPFM in the past (21-25). The classification presented by Kubo (7) is simple, since it is easy to identify the four landmarks that divide the condylar process into four parts. These landmarks are the condyle head, sigmoid notch, posterior ramus line and the posterior border of the coronoid process. The diagnosis and management of CPFM are a topic of continued discourse at present (2). Reliable comparisons between studies, including meta-analyses are extremely difficult. Improvement in the standardization of data collection is needed (26). This analysis is reliable, since this retrospective report included 949 cases of CPFM from 11 university hospitals, which were categorized using the same classification(7,10-19). This analysis showed that CPFM showed a tendency to dislocate, especially head and high neck condylar fractures have a relatively high frequency of dislocation in 248/417 (59.5%) cases, since the lateral pterygoid muscle pulls the small fragment medially (27). Low neck and base fractures did not show a tendency to dislocate in 163/532 (30.6%) cases, since these fragments are larger than head and high neck, and less affected by the muscle.

Arch (5), an authority in oral surgery, states the following in his textbook (1975): “There is no indication for open reduction of subcondylar fracture, because it may cause problems of trismus, ankylosis, and/or sterile or suppurative resorption”. However, Blevins and Gores (28) performed conservative treatment in 140 patients and observed good prognosis in only 13% patients. Our analysis observed good prognosis in only 224/403 (55.60%) cases. The prognosis of dislocation fractures was not satisfactory in 57/150 (38.0%) cases, especially low neck and base fractures were not good in 16/60 (26.7%) cases. The results of the present analysis suggest that surgical treatment of dislocation fracture facilitates a better clinical outcome. Moreover, this investigation indicated that treating CPFM is beyond the scope of non-surgical methods. However, the prognosis depends on age of patient, the co-existence of other fractures, unilateral or bilateral condylar fracture, occlusal relationship, and time lag in consulting a physician.

Recently, surgery is being preferred for CPFM, which yields good prognosis owing to the progress in surgical methods and computed tomography scanning (2,4). The advent of functionally stable osteosynthesis in the field of condylar traumatology in the 1980s has gradually widened the indications for surgical treatment (2,6). “Should CPFM be treated with non-surgical or surgical methods?” The best approach is still under debate. In the past, CPFM was treated non-surgically, as a rule (5). However, in recent years, surgical treatment of CPFM with rigid internal fixation has become more common. The study by the 2nd International Bone Research Association Symposium for Condylar Fracture Osteosynthesis in 2012 found that most surgeons preferred surgical treatment with internal fixation (ORIF) for condylar base and neck fractures in adults and growing children (age ≥ 12-13 years), especially for displaced and dislocated fractures (2). ORIF may now be considered as the gold standard for both displaced and dislocated condylar base and neck fractures in adults (29).

There is consensus in the international literature regarding the treatment of both intracapsular and extracapsular condylar fractures in children, which must be treated with conservative treatment (1,30), since they retain considerable capacity for remodeling (regeneration) of the condylar area (7,8,9,31). The growth curves of girls and boys were published in 2000 by the Royal children’s Hospital Melbourne(http://www.cdc.gov/growthcharts). According to this statistical report, growth slows down from 13-14 years of age in girls and from 15-16 years of age in boys, respectively.
The remodeling (regeneration) of condylar head is associated with age-related distribution of blood markers, especially the serum bone metabolic marker, bone type alkaline phosphatase (BAP) (32,33). In children, these markers are released into the circulation during the processes of bone remodeling and modeling, and growth in length (33). Serum levels of BAP were lower in children older than 15 years compared with children younger than 15 years and significantly greater in boys than girls over 13 years (Figure 6). We expect that research on BAP and type I collagen cross-linked N-telopeptide (NTX) will make great progress. Hence, these markers can provide clear guideline on whether non-surgical treatment or surgical treatment should be opted. There is consensus in the world literature as regards the treatment of condylar fracture in children, which must be with non-surgical treatment. Case 1 showed complete remodeling (regeneration) of condyle. Case 2 showed incomplete regeneration of the condyle (so-called double-headed condyle). This case suggests a limit to conservative treatment. These cases indicated that the non-surgical treatment is an effective management for dislocated condylar fractures in children. After reviewing the various reports published over the previous years, we estimated that surgical treatment should be avoided in young patients (girls: age <13 years, boys: age <15 years). We must consider that there is the difference in growth individual variation, such as nation, an intellectual environment, girl or boy etc.

The prognosis of head and displacement-dislocation condylar fractures was observed in 15/24 (62.5%) cases. There is no consensus as regards the treatment of condylar fractures in adults. Case 3 was a 68-year-old woman, whose left sided mandibular body fracture was treated surgically, but the bilateral displaced-dislocated condylar fractures were treated non-surgically. Three-dimensional imaging revealed deformities in the dislocated condylar head and so called double headed condyle 21 years later. It is speculated that the old woman lived well until 98 years old because of she was able to take sufficient oral intake without disorders. Even with a head and displacement-dislocation fracture, good prognosis could be obtained. An adaptive change in centric occlusion (which depicts the relationship of the condyle to the articular fossa) was observed in this patient, after an event has altered the structures, and thus, the prognosis was satisfactory. The TMJ is the most anatomically and functionally complex joint in the body. The mandible can characteristically perform three-dimensional movement. Therefore, the main aim of treatment is restoration of function and not anatomic restoration of the fragments of the condylar process. Rehabilitation and long-term follow-up are most important factors that ensure satisfactory prognosis following non-surgical treatment.

VI. Conclusion

This analysis attempted to elucidate the criteria for determining (surgical or non-surgical) the treatment of CPFM. We found that the level and type of fracture were the principal factors determining treatment selection. The patient’s age is an important criterion for selecting the treatment method, especially in children. The indication of surgical and non-surgical treatment of condylar head fractures, especially fractures in young adults, requires further discussion and study. It also showed that surgical treatment was necessary for most of dislocated fracture to ensure good prognosis.

References

An Analysis of 949 Cases of Condylar Process Fracture Of the Mandible


