

“A Suggestion: Effective Use of Bone-Specific Alkaline Phosphatase as a Clinical Marker to Determine the Treatment of Condylar Process Dislocated Fracture of Mandible? A case series”

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Abstract

This study aimed to suggest a factor of indicating the age limiting in which regeneration of the condylar process fracture of mandible (CPFM) with total dislocation of the condylar head is possible, especially in patients of a growing age, for which the treatment of CPFM is based on the clinical experiences and has no scientific background. This article focused on the deciding operative or non-operative methods to treat patients of a growing age.

Key words: *Condylar process fracture of mandible, Regeneration of condylar head, Bone-specific alkaline phosphatase, Child*

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I. Introduction

CPFM is the most prevalent fracture of the mandible^{1,2)}, 43.3% of these fractures are caused by dislocation which was analyzed in 949 cases of CPFM³⁾. The treatment methods are broadly divided into surgical and non-surgical treatments. Accordingly, open reduction with internal fixation (ORIF) was recommended to be considered for severely displaced and dislocated condylar base and lower neck fractures, especially in children and adolescents (>12-13 years), rather than non-surgical treatment in base and lower neck fractures¹⁾. However, this conclusion is based on the clinical experience of many surgeons and has no scientific background. It is questionable to conclude the age of 12-13 years as binding definition the boundary age between surgical and non-surgical treatment. Since bone regeneration involves the participation of bone-specific alkaline phosphatase (BAP), which is considered to be a highly specific marker of osteogenesis in the osteoblast⁴⁾, the measurement of serum BAP level in each case may be a useful tool to determine operative or non-operative treatment of patients in a growing age. This article evaluates this possibility by presentation of our experiences gained with clinical cases and a bibliographic review of the relationship between BAP and regeneration of dislocated CPFM with a special focus on fractures of the condylar head of the mandible.

II. Case Presentation

These three patients were referred for facial trauma to the university hospital. These town projection X-ray images showed left side deviation-dislocation and high neck fracture. They had the same diagnosis and were treated with the same non-surgical methods. Fig. 1, 2, 3 show result of conservative treatment of neck fractures with dislocation of the condylar head out of the glenoid fossa. Case 1: The first patient was an 8-year-old girl. After conservative treatment almost normal form of regenerated condylar head was observed 1 year 2 months later (**Fig. 1**). The outcome was extremely good. No facial deformation or dysfunction. Case 2: The second case was 16-year-old boy. Regeneration and resorption of condylar head was incomplete, leading to the bifid mandibular condyle 9 months later after conservative treatment (**Fig. 2**). The mouth opening was the width of two fingers. Case 3: The third patient was 19-year-old girl. No regeneration and resorption of the condylar head was observed at the fracture site 3 year later (**Fig. 3**). She complained of trismus and dislocation of mandible.



Fig. 1: Above: Angle of deviation-dislocation fracture is 60 degrees (dotted line). Below: 1 year 2 months later, regeneration of condylar head was observed (arrow).

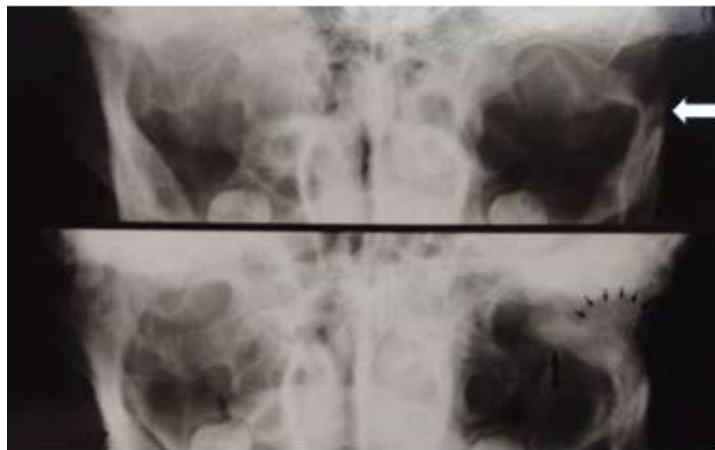


Fig. 2: Above: Angle of deviation-dislocation fracture is 90 degrees. Below: After 9 months, regeneration of condylar head was incomplete (small arrow): bifid mandibular condyle.

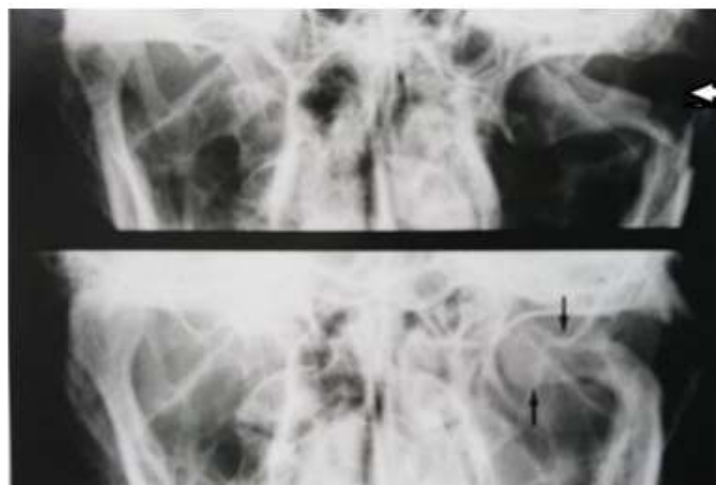


Fig. 3: Above: Angle of deviation-dislocation fracture is 90 degrees. Below: After 3 years, no regeneration and resorption of condylar head (arrow).

Case 4: The fourth patient was a 12-year-old boy. He fell off his bicycle and bruised his chin. He visited

department of otolaryngology with trismus and occusal dysfunction. He was advised to have surgery but refused. Finally he visited my clinic and was treated non-surgically (**Fig. 4**). The X-ray image showed left side displacement-dislocation and head fracture. 1 year later, the outcome was extremely good. He got normal occlusion and none of trismus (**Fig. 5**).

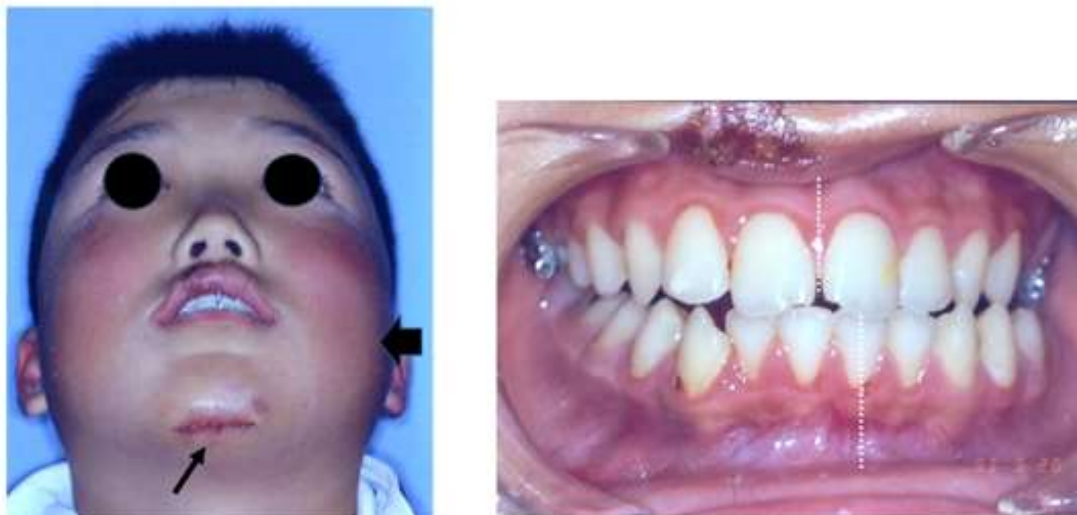


Fig. 4: Lacerated wound of chin was sutured and displaced mandible to left



Fig. 5: 1 year later, no trismus and normal occlusion

III. Clinical Procedures and Outcomes

Two of CPFM, 8- and 12-year-old, successfully cured by non-surgical treatment, but other two patients, 16- and 19-year-old, exhibited incomplete cure. Bibliographic review suggested that the values for BAP are one of the possible factors to assess whether surgical or non-surgical treatment for CPFM should be performed.

IV. Discussion

CPFM treatment methods are basically divided into surgical and non-surgical treatments. Until around 1980, CPFM was predominantly treated using conservative methods, as described by Archer (1975)⁵. Some postoperative adverse events such as trismus, ankylosis, and resorption of condylar head have been reported previously. The introduction of computed tomography (CT) and magnetic resonance imaging (MRI) have made diagnosis easier and improved the surgical methods. Owing to recent advances in diagnostic and surgical technique, treatment now has even been performed for condylar head fractures in adults^{6,7,8}, which was previously a contraindication.

At present, CPFMs are a topic of continuous controversial discussion regarding management in children. It has been reported that in pediatric dislocation fractures, the fragments are absorbed and regeneration of the condylar head takes place^{9,10,11,12,13,14,15,16,17}. This study aimed at determining the age of limits in which regeneration of the CPFM with total dislocation of the condyle from the glenoid fossa is possible, especially in patients of a growing age. According to a recent consensus conference, most surgeons preferred to perform ORIF for condylar base and neck fracture in both adult and growing patients (age>12-13 years), especially in severely displaced and dislocated fractures¹. Because the craniofacial skeleton becomes more adult-like in its form at about 12 years of age, so the indication of ORIF increases with age¹⁸. The 2012 position paper from the International Bone Research Association stated that patients of a growing age (>12-13 years old) may be indicated for surgery because after this age, a comprehensive regeneration of the condylar head cannot be expected any longer, however, depending on sex (i.e., girls earlier than boys) and biological rather than chronological age. Accordingly, ORIF was recommended for severely displaced or dislocated fractures, especially in children and adolescents (>12-13 years), rather than non-surgical treatment¹. However, this conclusion is based on clinical experience of many surgeons and no evidence-based scientific background.

The case 2 showed incomplete resorption and regeneration from the fracture stump, resulting in a bifid mandibular condyle¹⁹. This case suggested us possibility of regeneration of dislocated condyle head until 16 years of age²⁰. The case 1 and 4 support that conservative treatment is sufficient in pediatric patients, but treatment results worsen with age like in case 2, 3. Management of CPFM in children differs somewhat from that in adults^{21,22}. The growth period of young people differs depending on the respective country, and factors such as sex, race, living environment, and nutritional status. Therefore, it is questionable to conclude uniformly the chronological age of 12-13 years as binding definition of the boundary age between surgery and non-surgical treatments.

Bone remodeling is an ongoing dynamic process consisting of bone resorption and bone formation. Normally, these processes are balanced, resulting in 10 % replacement of the skeleton, each year. There are many bone markers and characteristics of the skeleton. BAP is considered to be a highly specific marker of the bone-forming activity of osteoblasts. Serum levels of BAP and TRAP5b were significantly higher in adolescent boys compared with girls (p<0.001)²³. Serum levels of BAP were lower in children older than 15 year compared with children younger than 15 years (p<0.001) and significantly greater in boys than girls over 13 years (P<0.001)^{23,24}.

As with other marker, the values for BAP in children are elevated over normal premenopausal controls⁶. The values for BAP in children (**Table1**) implies that regeneration of a dislocated condyle head cannot be expected in females over ≥12 years and males age ≥ 16 years of age⁴.

Table 1: Values for BAP in children

Children, female(U/L)				Children, male (U/L)			
Age (years)	N	Mean	Percentile Rangea (3rd-97th %)	Age (years)	N	Mean	Percentile Rangea (3rd-97th %)
<1	3	135	79-178	<1	1	126	77-168
2-4	20	129	77-180	2-4	18	115	68-157
5-11	48	118	70-200	5-11	74	114	59-165
★ 12-15	58	67	36-146	12-15	34	114	46-192
16-19	38	26	11-56	★ 16-19	44	57	22-112

Boundary age between surgical and non-surgical treatment

Modified from Reference

23)

The prognosis of dislocated fractures after non-surgical treatment was shown to be not satisfactory in 57/150 of the cases (38.0%)³. This suggests that most of dislocated CPFM should undergo operation, but children are an exception^{9,10,11,12,13,14,15,16,20,21,22}. The values for BAP are one of the decisive factors indicating whether surgical or non-surgical treatments for CPFM should be performed (**Fig. 6**). Further reserches are necessary to clarify the factors for decision-making in the future.

Fig. 6: Serum levels of BAP is distinguishing marks for treatment?



V. Conclusion

This article suggests that a definition of the age limit in which regeneration of the CPFM with total dislocation of the condylar process of the mandible is possible, especially in patients of growing age. The result of the BAP-level implies that a comprehensive repair of a dislocated condyle fracture cannot be expected in females aged over ≥ 12 years and males aged ≥ 16 years. The measurement of serum BAP in each case may be a useful approach to determine operative or non-operative methods to treat patients of a growing age.

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