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Original article

Influence of posterior cranial base growth on the therapeutic effect of bite jumping appliance

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ABSTRACT

Objective: Aim of this study was to examine influence of posterior cranial base (PCB) growth on the effect of bite jumping appliances in skeletal Class II malocclusion.
Material and methods: Cephalograms at pretreatment (T1) and completion of functional therapy (T2) of twenty-eight skeletal Class II Japanese patients treated with bite jumping appliances were used in this study. All subjects were divided into two groups according to reduction of ANB angle and establishment of Angle Class I molar relationship: improved and non- improved groups.
Results: There was a wide range of individual differences in the PCB growth during the treatment period. The changes of Ba(x) and Ba(y) in the PCB growth were highly correlated to the positional changes of Ar respectively, though there were no correlations between Ba(x) and Ba(y), and Ar(x) and Ar(y). The change of Ba(x) between T1 and T2 in improved group was significantly less than that in non-improved group. The change of Ar(x) in the improved group was significant less than that in the non-improved group. Discriminant analysis demonstrated that the change of Ar(x) was the most important factor that influenced the ANB angle (intermaxillary relationship).
Conclusion: The results in this study suggest that PCB growth, especially anteroposterior growth evidently influences the effect of bite jumping appliance.

1. Introduction

Many types of functional appliances have been used for orthodontic treatment; the bite jumping appliance (BJA) is one of the typical functional appliance. Therapy using a BJA forces the mandible of the patient into a forward position and induces mandibular growth, especially condylar growth [1–3]. Therefore, the appliance can be applied in cases of skeletal class II malocclusion to correct skeletal discrepancy.

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The effect of functional therapies, including BJA therapy, is controversial. Some studies demonstrated that the improvement of intermaxillary relationship in cephalometric analyses resulted from mandibular growth [4–11]. Others reported negative results on the effect of functional therapies [12–15].

There are few conclusive explanations of the effect of functional appliance (FA). This might be due to the influence of growth of the cranial base, especially the posterior cranial base growth (PCB), which has not been taken into consideration in the evaluation of functional therapies.

Many studies on the growth of the PCB have described that anteroposterior growth of the PCB evidently influences the position of the glenoid fossa and mandible, especially the posterior part of mandible during the growth period [16–21]. Growth of the PCB varies widely among individuals during the growth period [22–24]. Therefore, it is reasonable to assume that growth of the PCB influences the effect of functional therapy. In this study, we hypothesized that the extensive growth of PCB would worsen the treatment results of BJA therapy due to the posterior movement of the condyle.

We examined the influence of growth of the PCB on the effects of BJA therapy. First, we determined the relationship between growth of the PCB and the position of the posterior part of mandible. Then we divided the subjects into two groups (improved and non- improved groups) on the basis of improvement of intermaxillary relationship, and compared their data.

2. Material and methods

The subjects consisted of patients who had been treated with a bite jumping appliance at a private orthodontic dental clinic. Male participants were selected based on the following criteria: (1) Hellman's dental age IIIA or IIIB at pretreatment (T1) and IVA at posttreatment (T2), (2) ANB angle greater than 5° with overjet greater than 6mm, (3) without congenital anomaly, (4) clear craniomaxillofacial outline seen on lateral cephalogram, and (5) healthy with no history of orthodontic treatment. The selected subjects were divided into two groups based on improvement of intermaxillary relationship: improved group, and non-improved group. The division criteria were as follows: (1) The reduction of ANB angle was over 2.0°, (2) Angle Class I molar relationship.

Twenty-eight skeletal Class II div. 1 male participants participated in this study, fourteen in the improved (IMP) group and fourteen in the non-improved (NON) group.

Cephalometric radiographs, taken at pretreatment in mixed dentition (T1) and posttreatment (T2), were used in this study. The treatment started at an average age of 9 years 7 months ± 1 year 5 months (8y1m–12y5m: T1) and finished at an average age of 14 years 6 months ± 1 year 3 months (11y9m–16y9m: T2).

The study protocol was approved by the institutional review board of the School of Dental Medicine, Tsurumi University.

Each lateral cephalogram was traced on 0.003-inch frosted acetate by one investigator (T.N.) and checked for accuracy by another investigator (T.S.).

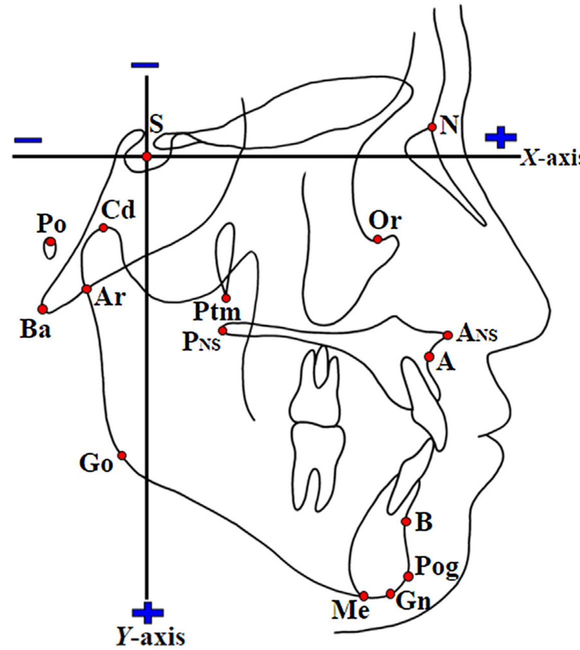

Fig. 1 – Coordinate axes and cephalometric landmarks.
A: the deepest point on the midsaggital plane between supradentale and the anterior nasal spine.
ANS: the most anterior point on the maxilla at the level of the palate in the midsagittal plane.
Ar: the point of intersection between the anterior surface of the sphenoid bone and the posterior contour of the mandibular ramous.
B: the deepest point on the midsagittal plane between infradentale and pogonion.
Ba: the most posteroinferior point of the anterior margin of the foramen magnum in the midsagittal plane.
Cd: the most posterior superior point on the condyle of the mandible.
Gn: the most downward and forward point on the symphysis at the intersection of the facial and mandible planes.
Go: the most posterior inferior point at the angle of the mandible.
Me: the most inferior midpoint of the symphysis.
N: the most anterior point of the frontonasal suture in the midsagittal plane.
Or: the deepest point on the infraorbital margin.
PNS: the most posterior point on the palatine bone in the midsagittal plane.
Po: the most superior point of the external auditory meatus.
Pog: the most anterior midpoint of the symphysis.
Ptm: the contour of the pterygomaxillary fissure formed anteriorly by the retromolar tuberosity of the maxilla and posterioely by the anterior curve of the pterygoid process of the sphenoid bone.
S: the center of the hypophyseal fossa in the midsagittal plane.

Definition of the landmarks were illustrated and presented (Fig. 1). The position of the landmarks were recorded in Cartesian coordinates (X and Y-axes) with sella (S) as the origin of axes (x.y=0.0). The horizontal reference plane (X-axis) was parallel to the Frankfort horizontal plane (FH plane) passing S.