Radiographic Evaluation into the Relationship of Different Cephalometric Values and Malocclusion

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Background: There is an abundance of contradictory data regarding the relationship between the value of the cranial base angle, the type of malocclusion and the degree of mandibular prognathism.
The **aim** of our study was to identify craniofacial differences between the classes of malocclusion, to evaluate the relationship between the cranial base angle and lengths, the skeletal and dento-alveolar pattern.
Methods: A retrospective cephalometric study was carried out on 44 cephalometric radiographs to examine the contribution of cranial base angle and different linear and angular values in the four groups of malocclusion as classified by Angle. We measured the cranial base flexure, jaw position angles, the maxillary mandibular planes angle, the cranial base lengths and jaw lengths.
Results showed that the cranial base angle was significantly larger in class II division 1 subjects than in the class I group, mandibular length was found to be similar in class I and class II subjects, although it was significantly larger in the class III group and the cranial base angle was correlated inversely with maxillar and mandibular plane angles.
Conclusions: We found no correlation between the anterior cranial base length and maxillary and mandibulary prognathism.

Keywords: cephalometric, cranial base angle, malocclusion

Introduction

A number of authors have suggested that there is a relationship between the degree of cranial base flexion and the type of malocclusion. One group contends that the cranial base flexure has no effect on the class of malocclusion or mandibular prognathism [1], whereas others contend that the cranial base flexure is a determining factor [2]. For cephalometric measurement purposes, the maxilla is attached to the anterior leg that extends from the sella turcica (S) to the frontal-nasal suture (N). The mandible is attached to the posterior leg extending from the sella turcica (S) to the anterior border of the foramen magnum, defined as basion (Ba). Therefore, geometric logic would dictate, that any change in flexure could affect the relationship of the maxilla and mandible and influence the type of malocclusion.

The cranial base angle, or saddle angle, is usually measured radiographically as the angle between the Basion-Sellea-Nasion points, although the Articulare and Bolton points have also been used to describe the posterior limit, making it difficult to compare the results of different studies.

The angle at birth is approximately 142°, but then reduces to 130° at 5 years of age. From 5 to 15 years the cranial base angle is relatively stable. Therefore, the cranial base angle at age 5 can be an accurate predictor of the eventual occlusal type of the patient at age 15 in approximately 73% of the patients.

A number of studies have attempted to identify craniofacial differences between the classes of malocclusion, and have found a linear relationship between the cranial base angle and prognathism with the angle systematically reducing from class II, via class I, to class III individuals.

Other authors have presented contradictory evidence, that there is no correlation between the cranial base angle and Angle's class I or class III.

Clearly the cranial base angle is not the only factor involved in determining malocclusion. Some authors suggested that a number of factors determine or influence static jaw position and the degree of prognathism in individual cases.

In view of the conflicting evidence, the aim of this cephalometric study was to explore further the role of the cranial base angle and certain linear and angular measurements in the various groups of malocclusion.

Materials and methods

A total of 44 cephalometric radiographs were selected on the basis of molar occlusion and ANB angle, taken in centric relation, they were surveyed and classified by the size of ANB angles into the four categories of Angle's molar classification (11 radiographs for each malocclusion group, with an age range between 8–12 years).

- Class I – ANB angle between 2°–4°;
- Class II – ANB angle larger than 4°;
  - division 1 – interincisal angle smaller than 135°;
  - division 2 – interincisal angle larger than 135°;
- Class III – ANB angle smaller than 2°.

Each group contained approximately similar numbers of male and female patients.

The cephalometric records were digitized and with the CorelDRAW X5 Graphic Suite software 22 landmarks have been marked on each radiograph. A number of linear and angular variables were calculated:

- cranial base flexure (N-S-Ba, N-S-Art);

Fig. 1. Cranial base flexure (N-S-Ba), maxillar lenghts (SNA-SNP) and mandibular lenghts (Me-Go) measurements using the CorelDRAW X5 Graphic Suite software

- jaw position (SNA, SNB angles);
- skeletal pattern (ANB angle, maxillary mandibular planes angle);
- dento-alveolar pattern (upper incisors to maxillary plane angle, lower incisor to mandibular plane angle, interincisal angle);
- cranial base lengths (N-S, S-Ba);
- jaw lengths (Cd-SNA, Cd-Pog, Art-SNA, Art-Pog, SNA-SNP, Me-Go).

The error of the method was estimated by using the Dahlberg formula. Variability between the groups was investigated using one-way analysis of variance (ANOVA). The group variable means for the class II and class III groups were compared with the class I group by means of an independent t-test.

Results

First it was necessary to demonstrate that the data for each variable showed significant variance in the four malocclusion groups so as not to invalidate comparisons between individual malocclusion groups.

The cranial base angle was found to be significantly larger in class II division 1 subjects than in the class I group. This difference was not seen between class I subjects and the other two malocclusion groups.

The cranial base lengths, N-S and S-Ba, were significantly larger in both divisions of class II malocclusion than in class I subjects, but measurements were similar in class I and class III.

Angle SNA showed no significant variation between class I subjects and the other groups. SNA-SNP was significantly increased above class I values in class II division1 and class II division 2 groups. No significant differences were found for these lengths between class I and class III subjects.

Table I. Statistical analysis of the measured values using the one-way ANOVA test

	N-S-Art	N-S-Ba	N-S	SNA	SNB
SNA	-0.53**	-0.54**	-0.17**	–	–
SNB	-0.55**	-0.48**	-0.18**	–	–
ANB	0.06	0.03	0.33	–	–
SNA-SNP	0.07	0.04	0.51**	0,26**	0.02
Me-Go	0.02	0.003	0.42**	0.19	0.41**

*Significant correlation at p >0.05 **Significant correlation at p >0.01

Table II. Correlation coefficients in Angle class I malocclusions

	N-S-Art	N-S-Ba	N-S	SNA	SNB
SNA	-0.48**	0.54**	-0.24	–	–
SNB	-0.45**	-0.56**	-0.22	–	–
ANB	-0.06	-0.08	-0.07	–	–
SNA-SNP	0.02	-0.20	0.42**	0.10	0.03
Me-Go	-0.02	-0.07	0.48**	0.18	0.31**

*Significant correlation at p >0.05 **Significant correlation at p >0.01

Table III. Correlation coefficients in Angle class II division 1 malocclusions

	N-S-Art	N-S-Ba	N-S	SNA	SNB
SNA	-0.51**	-0.58**	-0.31*	–	–
SNB	-0,50**	-0.55**	-0.19	–	–
ANB	-0.15	-0.22	0.22*	–	–
SNA-SNP	-0.05	-0.09	0.39*	0.22	0.29*
Me-Go	0.14	0.09	0.39*	0.13	0.24

*Significant correlation at p >0.05 **Significant correlation at p >0.01

Table IV. Correlation coefficients in Angle class II division 2 malocclusions

	N-S-Art	N-S-Ba	N-S	SNA	SNB
SNA	-0.71**	-0.65**	-0.22	–	–
SNB	-0.69**	-0.65**	-0.16	–	–
ANB	-0.26	-0.22	-0.17	–	–
SNA-SNP	-0.06	-0.11	0.57**	0.34*	0.27
Me-Go	-0.03	-0.10	0.53**	0.22	0.39*

*Significant correlation at p >0.05 **Significant correlation at p >0.01

Table V. Correlation coefficients in Angle class III malocclusions

	N-S-Art	N-S-Ba	N-S	SNA	SNB
SNA	-0.55**	-0.47**	0.01	–	–
SNB	-0.46**	-0.42**	0.17	–	–
ANB	-0.09	-0.03	-0.18	–	–
SNA-SNP	0.23	0.35*	0.53**	0.28*	0.09
Me-Go	0.01	0.07	0.49**	0.34	0.55**

*Significant correlation at p >0.05 **Significant correlation at p >0.01

Mandibular length measurement Gn-Go was found similar in class I and class II subjects, although it was significantly larger in the class III group. This finding that mandibular prognathism was greatest in class III subjects, also reflected in angle SNB, which was largest in the class III group.

The cranial base angle was correlated inversely with SNA and SNB angles. The correlation between cranial base angle and jaw lenghts was nearly zero. The correlation between maxillary length and SNA angle was small, but statistically significant. Correlation between mandibular length and SNB angle was somewhat stronger. There was no apparent link between cranial base angle and skeletal base pattern as indicated by variable ANB. Posterior cranial base length (S-Ba) showed no relationship with mandibular prognathism as measured by the SNB angle. There was no association between the anterior cranial base length (N-S) with maxillary and mandibulary prognathism as measured by the SNA and SNB angles.

Discussion

The sample consisted of 44 cephalometric radiographs, selected on the basis of molar occlusion and classified into the four categories of Angle's molar classification. The class I sample showed good agreement with published cephalometric norms for both dental and skeletal cephalometric relationships. Data for the other malocclusion groups showed the expected variations in terms of dentoalveolar and skeletal base patterns for each group and the obtained values were the same we found in the literature [4].

The present results, using both measures of the posterior cranial base, do not support the concept that the cranial base angle, by providing a variation in the antero-posterior position of the mandibular articulation, is a major determinant in establishing the main classes of malocclusion. Only the class II division 1 group showed a significant difference in parameters N-S-Ba and N-S-Art in comparison to class I. A recent study consisting in the evaluation of 200 cephalometric radiographs of Caucasian patients showed that the cranial base angle, calculated according to both N–S–Ba and N–S–Art, was found to be significantly larger in class II division 1 subjects than in the class I group. This difference was not seen between class I subjects and the other two malocclusion groups [5].

The finding from the pooled sample that cranial base angle was correlated to the angles SNA and SNB is in agreement with published cephalometric norms, which demonstrated a relationship between the cranial base angle and facial prognathism.

The correlation analysis also suggests a relationship between mandibular position and the magnitude of cranial base flexure. The smaller the cranial base angle, more forward the mandibular position, as indicated by angle SNB.

Only a little correlation was evident between the ANB angle and cranial base parameters. The positive and significant correlations between S-Ba and N-S distances with maxillary and mandibular lengths are likely to be topographical and of little biological significance.

Conclusions

1. The cranial base angle alone does not appear to be an important factor in the prediction and establishment of malocclusion.
2. Jaw lengths are significantly different between the malocclusion groups we examined. The maxillary length is increased in class II malocclusions and the mandibular length is greater in class III.

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