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Cranial base parameters in adults with skeletal class I and class II skeletal pattern

Soorya Dileep, Maimoona Abdul Khader[1], Hashim Ali[2], Denis Paul K[3], Milna Narayan[4] and Adarsh Jayan[5]

Department of Orthodontics and Dentofacial Orthopaedics, Rajas Dental College and Hospital, Tirunelveli, Tamil Nadu, [1]Department of Orthodontics and Dentofacial Orthopaedics, Educare Institute of Dental Sciences, Chattiparambu, Malappuram, Kerala, [2]Department of Orthodontics and Dentofacial Orthopaedics, Kannur Dental College, Anjarakkandy, Kerala, [3]Department of Pedodontics and Preventive Dentistry, Malabar Dental College and Research Center, Kerala, [4]Orthodontist, Private Practice, Kannur, Kerala, [5]Department of Conservative Dentistry and Endodontics, PMS College of Dental Science and Research, Vattapara, Trivandrum, Kerala, India

Address for correspondence:
Dr. Soorya Dileep, Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, Rajas Dental College and Hospital, Tirunelveli - 627 105, Tamil Nadu, India.
E-mail: soorya.dileep@gmail.com

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Abstract:

OBJECTIVE: Cranial base parameters exhibit wide variations. This study evaluated cranial base morphological characteristics of class II and class I malocclusions to identify risk factors for class II skeletal malocclusions.

METHODS: In this cross-sectional study, we recruited 30 class I adults and 30 class II adults and collected their lateral cephalograms. The cranial base length was calculated by measuring the base of the skull by determining the length of sella-to-nasion, basion to pterygomaxillary fissure, and pterygomaxillary fissure to point A. The cranial base angle was measured by the angle formed by the basion, sella, and nasion, and the base of the angle, which connects the basion and nasion, was measured.

RESULTS: The independent t-test for combined values showed no significant differences in one angular and five linear measures between groups. However, one angular measurement was positively correlated when men and women in class I and class II groups were analyzed separately.

CONCLUSION: Male patients with class II patterns exhibited larger cranial base angles than did those with class I patterns. Our study suggested that cranial base features have a minimal role in the development of class II malocclusions.

Keywords:

Cephalometric, cranial base, skeletal pattern

Introduction

Cranial base parameters exhibit wide variations. Cranial base changes alter the facial structures' growth and development, especially when the cranial base's shape and size increase rapidly.

The skull (cranial) base supports mandibular and maxillary segments. Thus, the disparity in this region leads to different articulation of mandibular and maxillary segments.

Linear and angular changes in skeletal parameters at the skull's base can change the position and development of maxillary segments attached to the cranial base's anterior segment and glenoid fossa and those of mandibular segments attached to the cranial base's posterior segment. Changes in the geometric relationship affect maxillary and mandibular positions with the cranial base and each other. These changes may affect an individual's skeletal patterns and dental occlusion types. The cranial base angle (also called the saddle angle) refers to angles between the sella-nasion and basion-sella points. The saddle angle is approximately 142° at birth; however, it decreases to 130° by 5 years of age.[1]

The sagittal jaw position relies on the cranial base. Those with class III patterns exhibit a

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small cranial base angle and short cranial base length.[2] However, no correlation of cranial base features with skeletal malocclusions has been discovered. Whether cranial base morphology differs between class II and class I patterns remains unclear.

Few studies have explored cranial base morphological features in skeletal class II malocclusion adults. No study has demonstrated an association of the lengths of posterior and anterior regions of the skull's base with skeletal patterns. This study compared cranial base morphological characteristics between class II and class I skeletal malocclusions to identify risk factors for class II patterns. Furthermore, this study determined the correlation of the lengths of posterior and anterior regions of the skull's base with class I and class II patterns.

Materials and Method

Radiographs used in the current study were collected from orthodontic patients' pretreatment records from the Department of Orthodontics, Kannur Dental College, Kerala, India. The Ethical Committee of Kannur Dental college approved this study (reference number 14 ORT 122).

Inclusion criteria

We included patients aged >16 years with confirmed skeletal malocclusion with an ANB angle of 2 °-(Point A- Nasion-Point B) (standard deviation [SD] = ±2°) and available lateral cephalograms patients whose ANB ranged from 0° to 4° and >4° were included in class I and class II groups, respectively.

Exclusion criteria

Patients with missing first molars, premolars, and poor-quality cephalograms were excluded.

The following landmarks were used:
1) Point A
2) Point-B
3) Basion (Ba)
4) Nasion, Na
5) Sella, S
6) Ptm (pterygomaxillary).

Procedure

In this cross-sectional study, we recruited 30 class I and 30 class II malocclusion patients and collected their lateral cephalograms. We used the Nemoceph software to assess skeletal parameters. Figure 1 shows cranial base linear measures obtained using the Nemoceph software.

Class I and class II patterns were confirmed according to the presence of ANB of 2° (SD = ±2°). The cranial base length was calculated by measuring the base of the skull as follows:

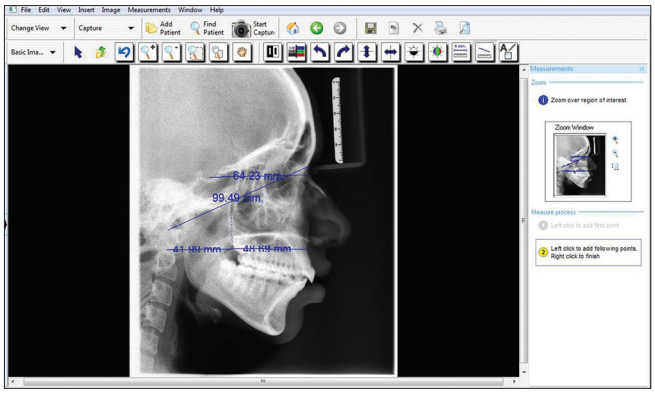

Figure 1: Cranial base linear measurements collected using the Nemoceph software

1. Measuring the sella-to-nasion length
2. Basion to pterygomaxillary fissure
3. The pterygomaxillary fissure to point A.
4. The cranial base angle is that formed by basion, sella, and nasion.
5. The base of the angle connecting the basion and nasion was measured.

Statistical analysis

Statistical analyses were performed using IBM SPSS statistics, 20.0 (IBM Corporation, USA). Descriptive statistics, namely the mean ± SD, median, minimum, and maximum, were employed to describe quantitative parameters. The independent t-test was adopted for comparing quantitative parameters between categories. For all statistical interpretations, *P* values of <0.05 were considered the threshold for statistical significance.

Results

This study included 60 patients (class I [n = 30] and class II [n = 30]). Of 30 in the class I group, 20 were women and 10 were men. Of 30 in the class II group, 13 were women and 17 were men.

The cranial base length (sella-nasion) between the groups showed a mean deviation of 68.4 (SD = 7.6; t = 0.24, and *P* = 0.808). The maximum deviation was 84 and the minimum deviation was 52 in the combined sample. In class II patients, the mean was 68 (SD = 6.1, t = 0.24, and *P* = 0.808). The maximum deviation was 80 and the minimum deviation was 56. No significant difference was discovered between these groups. Table 1 shows the cranial base length (sella-nasion) between the groups based on sex. The mean deviations were 66.2 and 65 and the SDs were 6.5 and 5.6 in all the female patients (t = 0.52 and *P* = 0.606). No significant between-group differences were noted.

Figure 2 shows the cranial base length (sella-nasion) between the two groups based on sex. The graph presents the mean deviation in the men and women. We examined the cranial base length (basion-pterygomaxillary fissure-point a) between two groups, and the combined means were 91 and 94.5 for groups I and II patients, respectively. Their SDs were 10 and 8.5, respectively (t = 1.46 and *P* = 0.149). No significant between-group differences were observed.

Table 2 shows the cranial base length (basion-pterygomaxillary fissure-point a) between these groups based on sex. We examined the cranial base length (basion-pterygomaxillary fissure) between these groups, and the combined means were 37.4 and 39.8 for groups I and II patients, respectively. The SDs were 4.7 and 5.2, respectively (t = 1.88 and *P* = 0.06). No significant between-group differences were noted.

Table 3 and Figure 3 show the cranial base length (basion-pterygomaxillary fissure) between these groups based on sex.

The cranial base length (pterygomaxillary fssure-point A) based on sex signifcantly showed no signifcant between-group differences [Table 4].

Table 1: Comparison of the cranial base length (sella-to-nasion) between class I and class II skeletal patterns based on sex

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	73.0	7.7	10	70.3	5.6	17	1.06	0.301
Female	66.2	6.5	20	65.0	5.6	13	0.52	0.606

Table 2: Comparison of the cranial base length (basion-pterygomaxillary fissure-point a) between class I and class II skeletal patterns based on sex

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	92.7	11.8	10	98.1	6.6	17	1.54	0.136
Female	90.2	9.2	20	89.8	8.6	13	0.11	0.912

Table 3: Comparison of the cranial base length (basion-pterygomaxillary fissure) between class I and class II skeletal patterns based on sex

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	38.6	5.8	10	41.5	4.5	17	1.46	0.156
Female	36.8	4.1	20	37.5	5.2	13	0.45	0.653

Table 5 shows the cranial base angle between these groups based on sex. Figure 4 depicts the diagrammatic

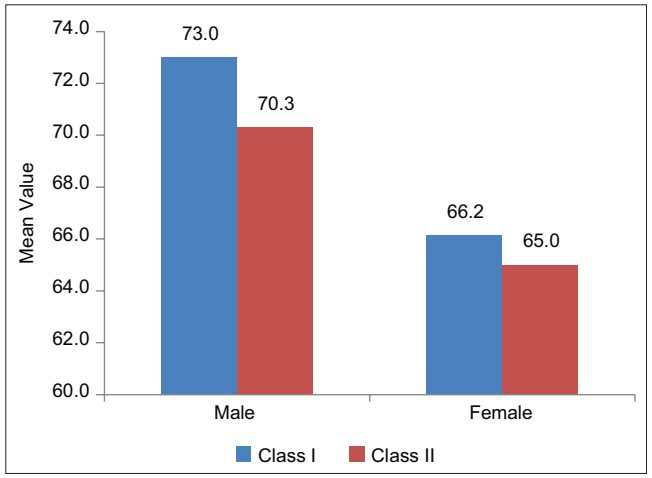

Figure 2: Comparison of cranial base length (sella- nasion) between skeletal pattern based on gender

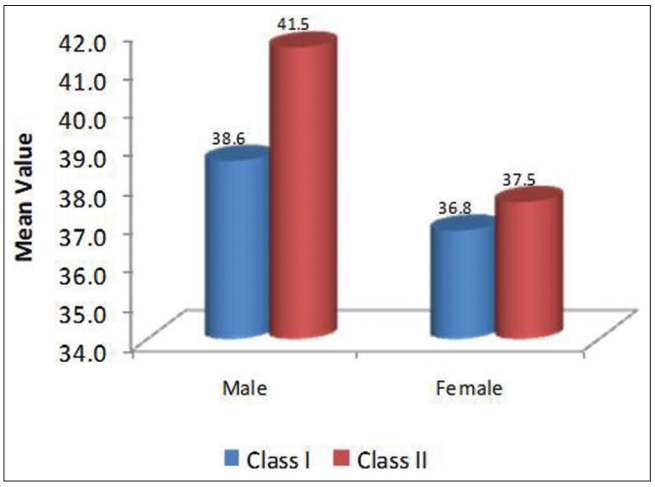

Figure 3: Comparison of the cranial base length (basion to pterygomaxillary fissure) between class I and class II groups based on sex

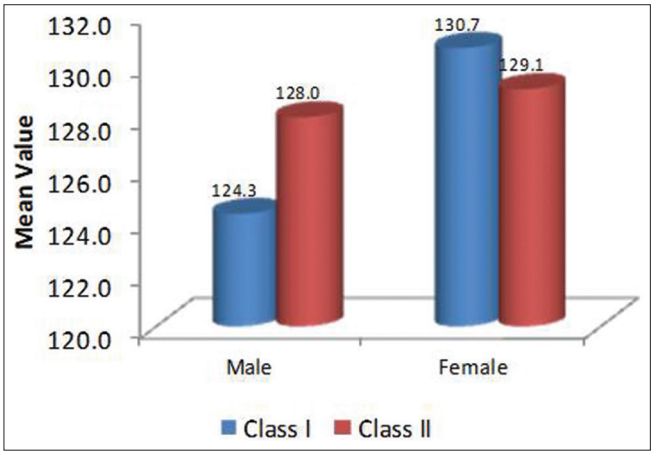

Figure 4: Diagrammatic representation of the mean of the cranial base angle between class I and class I groups based on sex

representation of the means of cranial-base angles between the groups based on sex. The mean (SD) value of the class I group was 124.3 (2.5).

Class I women presented a considerably higher mean value (130.7); however, their SD was 6.5. The class II men and women presented means of 128 and 129.1, respectively. The SDs were 4.4 in men and 5.6 in women in this group. The cranial base angle significantly differed between men and women, indicating that men with class II patterns had a larger cranial base angle.

Figure 5 depicts the diagrammatic representation of the mean values of the cranial base angle length between these groups based on sex.

The mean values of the cranial base angle length were 102.5 and 105.7 in groups I and II, respectively [t = 1.3 and *P* = 0.200; Figure 5]. No significant between-group differences were noted [Table 6].

Discussion

The cranial base supports mandibular and maxillary segments. Most cephalometric studies have evaluated only the association of the cranial base with mandibular and maxillary segments. Few studies have paid attention to cranial base morphological parameters in class II malocclusions.

This study compared cranial base morphological characteristics between class II and class I malocclusions. Because adults already have a developed skeletal pattern, examining adult patients can help investigate factors related to class II development.

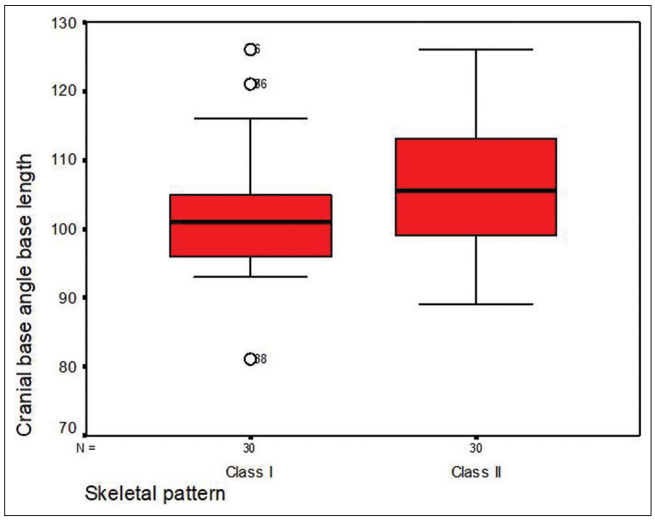

Figure 5: Box plot for the cranial base angle base length between class I and class II groups

The cranial base length is calculated by examining the lengths of sella-to-nasion, basion to pterygomaxillary fissure, and pterygomaxillary fissure to point A.

A cranial base angle is the angle formed by the basion, sella, and nasion, and the base of the angle connecting the basion and nasion.

Bjork recommended using articulare rather than basion due to its easier identification.[3] Some studies employed articulare to examine the cranial base's posterior limit.

Kerr and Adams used the basion to determine the cranial base angle.[4] Bhatia and Leighton[5] published figures for the N–S–Ba and N–S–Art angles and S– Ba and S–Art distances.

In this cross-sectional study, we recruited 30 class I (20 women and 10 men) and 30 class II adults (13 women and 17 men) and collected their lateral cephalograms.

Classes I and II patterns were confirmed according to ANB of 2° with SD of ±2°. The cranial base length was calculated by examining the length of sella-to-nasion, basion to pterygomaxillary fissure, and pterygomaxillary fissure to point.

The cranial base angle was examined as the angle developed by sella, basion, and nasion and the base of the angle connecting the basion and nasion was determined.

Table 4: Comparison of the cranial base length (pterygomaxillary fissure-point A) between class I and class II skeletal patterns based on sex

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	54.1	7.6	10	55.8	4.1	17	0.74	0.467
Female	53.4	7.0	20	52.3	4.1	13	0.51	0.614

Table 5: Comparison of the cranial base angle between class I and class II skeletal patterns based on sex (significant at the 0.05 level)

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	124.3	2.5	10	128.0	4.4	17	2.41*	0.024
Female	130.7	6.5	20	129.1	5.6	13	0.72	0.479

Table 6: Comparison of the cranial base angle length between class I and class II skeletal patterns based on sex

	Class I			Class II			*t*	*P*
	Mean	SD	*n*	Mean	SD	*n*		
Gender								
Male	107.1	11.1	10	110.2	8.2	17	0.84	0.409
Female	100.3	8.1	20	99.8	7.3	13	0.17	0.864

The independent t-test for combined values did not reveal significant differences in one angular and five linear measurements between these groups. However, the cranial base angle was larger in class II men. However, all linear measurements were not correlated between these groups.

Our results differed from those of previous studies. Some studies have reported wide fluctuations in cranial base angles.

The inconsistency between the results may be attributed to differences in case selection methods.

Our study differed from that of Sanggarnjanavanich *et al.*'s[6] in that they included adult females with class III patterns to examine the cranial base. They indicated that cranial base morphological features differed between classes III and I patterns.

Smaller cranial base angles and maxillary lengths were noted for class III patterns. In our study, class II women did not exhibit a correlation with the cranial base angle and length. However, class II men exhibited a larger cranial base angle.

All linear measurements exhibited no correlation between these groups.

Our study differed from that of Sayına *et al.*'s[7] who included 40 nongrowing females and reported increased cranial base angles in class II patients.

The inconsistencies in the results may be attributed to differences in case selection procedures. This study included skeletal malocclusion patients, whereas they recruited 40 women with dental and skeletal class II division 1 malocclusion. The results of our study are similar to those reported by Wilhelm *et al.*[2] who indicated no correlation between class II patterns and cranial base features except that adult male patients with class II patterns exhibited higher cranial base angles in the current study.

No significant correlation in linear and angular features was noted between groups I and II. However, larger cranial base angles were discovered in group II men.

In the current study, adult males and females with skeletal malocclusions were included. Those with dental malocclusion were not considered; this is a study limitation.

Patients with class II skeletal and dental malocclusions may have the same or different outcomes. Longitudinal studies should be performed to examine cranial base morphological features of skeletal class II malocclusions.

Conclusion

Cranial base features in group I did not present significant differences from those in group II. However, men with class II patterns exhibited larger cranial base angles. The results suggest the minimal role of cranial base features in class II malocclusions. Moreover, class II adult men have larger cranial base angles than do class I adult men.

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Conflicts of interest
There are no conflicts of interest.

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