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# Cranial base angulation and linear dimensions in Class I, II and III sagittal jaw relationships in a Nigerian population: A cephalometric study

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## Abstract

**Background:** Controversies still exist on the role of cranial base in the classification of jaw discrepancies. This present study was conducted to determine the role of cranial base in the classification of jaw discrepancies among a Nigerian population.
**Materials and method:** This cross-sectional descriptive study involved 209 pre-treatment lateral cephalographs comprising of 79 males and 130 females (aged 7 to 55 years). The A-point- nasion-B point angle (ANB) was used to categorize the sagittal jaw relationship into skeletal patterns I, II and III. One-way ANOVA was applied to test if cranial base angulation and length differ significantly among the skeletal patterns. Pearson's correlation coefficient was used to test for association between some independent variables. Statistical significance was determined only when p value was < 0 .05
**Result:** There were no statistically significant differences in the cranial base angle and cranial base lengths in the different skeletal patterns. Negative significant correlations were noted between the cranial base angle and the sella nasion-A point angle (SNA; r= - 0.483; p<0.001) and the sella nasion-B point angle (SNB; r= - 0.439, p<0.001) angles in the different skeletal malocclusion but not with cranial base angle and ANB angle (r= -0.021, P=0.758). In addition, the cranial base length showed positive significant correlation with the effective maxillary length (r= 0.759, p=<0.001) and effective mandibular length in the different skeletal malocclusion morphology (r= 0.718, p<0.001)
**Conclusion:** This study has shown that cranial base angulation and linear dimensions do not play primary aetiological roles in determining the outcome of the sagittal jaw relationships in the different skeletal malocclusion.

Keywords: Cranial base angulation, Linear dimensions, sagittal jaw relationships.

## Introduction

The cranial base or basicranium has been a key area of interest in orthodontics due to its influence on the growth and development of the craniofacial structures. It provides support for the brain tissue and serves as a structural platform for the complex naso-maxillary structure.[1] The basicranium is majorly a midline structure comprising of the basi-occipital, sphenoid, ethmoid and the frontal bone but it also has the temporal bone laterally. These bones are formed from early cartilaginous pre-cursors known as the chondrocranium joined together by the cartilaginous joint referred to as the synchondroses. The three major synchondroses in the midline are: the mid-sphenoidal which fuses peri-natally, the sphenoid-ethmoidal which fuses in the adolescent period and the spheno-occipital that closes during the eruption of the third molars.[2] This makes the spheno-occipital

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synchondrosis a major contributory factor to the post-natal growth of the cranial base since the growth of the anterior cranial base reaches it maximum length around 7-8 years.[3] The saddle-shaped structure called the sella turcica divides the cranial base into two parts: the anterior and the posterior limbs with an angle in the mid-sagittal plane called the saddle angle or the cranial base angle. Several investigators have reported varying cranial base angles in different populations and has been observed to be stable around 5-15 years.[4] The naso-maxillary complex is supported by the anterior cranial base while the posterior cranial base is related to the mandible. The flexion or angulation of the cranial base has been linked to the rearrangement of the skull to adapt to the increase in brain size[5,6] and also to the increase in the pace of the growth of the brain tissue relative to the basicranium itself.[7] In addition, the cranial base is a growth center that has its own genetically controlled mechanism of growth.

Whatever the mechanism of angulation of the cranial base is, there is a consequential effect on the dimension and orientations of the underlying craniofacial structures.[8] Because the mandible and the maxilla articulate with different parts of the cranial base, it is inferred that differential growth of the cranial base would also result in relative positioning of the jaws and does ultimately affects the outcome of the occlusion. Hence, the association between the angulation of the cranial base with jaw position and the categorization of malocclusion has received extensive attention in the field of orthodontics.[9-14] Some authors have supported the notion that the cranial base dimension and orientation is an aetiological factor to be considered in the development of malocclusion[9,10,13] On the contrary, some other researchers reported different findings.[11,12,14] An increase in the cranial base angle is reported to be related to retrusive effect on the mandible which increases the tendency towards the development of Class II sagittal jaw relationship while a more acute angle would supposedly predispose to mandibular prognathic in Class III relationship.[10] Three-dimensional images have been recommended for future studies following a significant influence between the lateral portion of the cranial base and the facial skeleton.[15] It is worth noting that there has been a report of differential effects of the length of posterior cranial base (sella–basion) and its flexion in different vertical face pattern. Knowledge of the growth and stability of the cranial is considered pivotal for diagnosis and treatment planning in orthodontics due to its effect on the position, sizes, angulation of the underlying facial structures.[16] It is therefore obvious from the literature that researchers are far from reaching an agreeable conclusion on the aetiological role of cranial base dimension and flexion on sagittal jaw discrepancy in malocclusion.

Therefore, the aim of the present study was to test the following null hypotheses on the effect of cranial base dimensions and flexion of the different sagittal jaw relation of malocclusion among a sample of Nigerian orthodontic patients.

- That the cranial base angulation does not play a statistically significant role in determining the outcome of the sagittal jaw relationship
- That the cranial base lengths do not play significant roles in determining the outcome of the sagittal jaw relationship
- That the cranial base lengths do not have statistically significant correlation with the effective length of the mandible and maxilla in the different sagittal jaw relationship.

## Materials and methods.

In this cross sectional study, the pre-treatment lateral cephalometric radiographs of two hundred and nine (209) orthodontic patients who sort orthodontic treatment clinic at Edo State Specialist Hospital and from a private orthodontic clinic in Benin City, Edo State, between January 2021 to December 2023 were selected. The study was conducted between December 2023 to August 2024.

### Selection criteria

The inclusion criteria include participants with undistorted and clear radiographs, individuals without a history or features of congenital anomaly. Participants with records of previous orthodontic treatment were excluded. Ethical approval to carry out the research was obtained from the Research and Ethics Committee of the Hospital Management Agency (A732/8).

**Data collection and description of landmarks** (Table 1).

All selected lateral cephalographs were manually traced on a well illuminated box using a single matte acetate tracing paper and a 3H lead pencil. Linear measurements were taken using a transparent plastic

Table 1: Description of lateral cephalometric landmarks

| Landmarks | Description |
|---|---|
| S | Sella: The center of the hypophyseal fossa (sella tursica). |
| N | Nasion: The most anterior point of nasofrontal suture in the midsagittal plane, |
| Ba | Basion: The midpoint of the curvature between upper and lower surfaces of the basilar portion of the occipital bone. |
| A | Point A: The deepest point in the midsagittal plane between the anterior nasal spine and prosthion. |
| B | Point B: The deepest point in the midsagittal plane between infradentale and pogonion. |
| Gn | Gnathion: The most outward and everted point on the profile curvature of the symphysis of the mandible, located midway between pogonion and menton. |
| Co | Condylion: The most superior posterior point on the outline of the mandibular condyle. |
| SN | Anterior cranial base length: a line connecting S to Na. |
| SB | Posterior cranial base length: a line connecting S to Ba. |
| BaN | Total cranial base length: a line connecting Ba to N. |
| CoA | Effective maxillary length a line connecting Ba to |
| CoGn | Effective mandibular length a line connecting Ba to |
| BaSN | Cranial base angle |
| SNA | Sagittal relationship of the maxilla to the anterior cranial base |
| SNB | Sagittal relationship of the mandible to the anterior cranial base |
| ANB | Sagittal relationship of the mandible to the maxilla (skeletal pattern). |

Table 2: Intra-rater reliability test

| Variable | Intra-class coefficient | P-value |
|---|---|---|
| BaSN(⁰) | 0.764 | 0.027 |
| S-N(mm) | 0.965 | 0.000 |
| S-Ba(mm) | 0.842 | 0.002 |
| Ba-N(mm) | 0.978 | 0.000 |
| SNA(⁰) | 0.859 | 0.002 |
| SNB(⁰) | 0.878 | 0.001 |
| ANB(⁰) | 0.966 | 0.000 |
| Co-A(mm) | 0.976 | 0.000 |
| Co-Gn(mm) | 0.892 | 0.000 |
| MMD(mm) | 0.885 | 0.000 |

ICC values: < 0.5 (Poor); 0.5-0.75 (Moderate); 0.75-0.9 (Good); > 0.9 (Excellent).

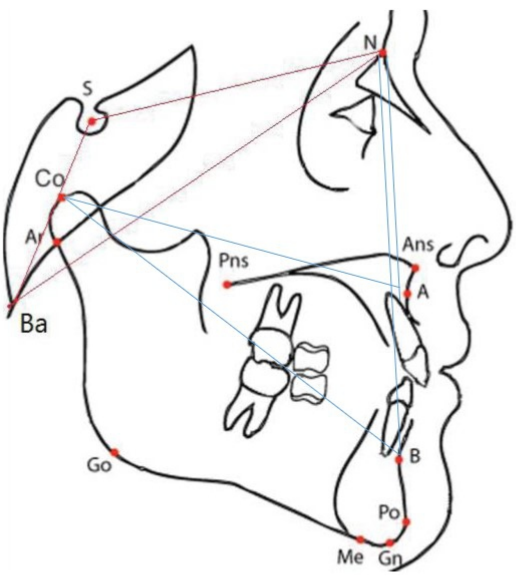


Figure 1: Cephalometric landmarks

meter rule while the angular measurements were read using the standard protractor. In order to guide against exhaustion by the investigator, a maximum of 7 lateral cephalographs were traced per day. All 209 lateral cephalographs were traced by the same investigator over a period of 5 weeks.

**Reliability test**

To determine the intra-rater reliability, 20 lateral cephalographs were traced twice at one-week interval. Intra-class correlation coefficient (ICC) was used to determine the intra-rater reliability by the investigator. The two-way mixed-effect model with absolute agreement definition was applied and the intra-rater reliability ranged from good to excellent (Table 2).

All participants were categorized into the different sagittal jaw relationships according to the reference value of ANB angle reported in a Nigerian population.[17] This include: Class I: ANB range of (2° to 4°); Class II: ANB angle more than 4° and Class III: ANB angle less than 2°.

**Statistical analysis**

The data collected were entered into and analyzed using Statistical Package for the Social Sciences (SPSS) version 22. Mean and standard deviation were used to summarize numeric data while categorical data were summarized as frequencies and percentages. One-way analysis of variance (ANOVA) was applied to test if the independent variables (cranial base angulation and length) differ significantly among the dependent variables (skeletal patterns). When there was a significant difference among the different jaw relationship, a Tukey post hoc test was used to determine the specific group where the significant difference may have occurred. In addition, Pearson's correlation coefficient was used to test the association between some independent variables in the different sagittal jaw relationships. Significance was determined only when the confidence level (p value) was < 0 .05.

Table 3. Mean age distribution in the different skeletal patterns according to gender

| Variables | Skeletal pattern I | Skeletal pattern II | Skeletal pattern III | P value (ANOVA) | Total |
|---|---|---|---|---|---|
| **No. of respondents** | **64(30.6)** | **103(49.3)** | **42(20.1)** | | **209(100.0)** |
| **Age in years (mean standard deviation)** | 19.59(8.08) | 18.84 (8.68) | 20.24(10.21) | 0.663 | 19.35(8.81) |
| Male | | | | | |
| n(%) | 20 (25.3) | 45 (57.00) | 14 (17.7) | | 79 (37.8) |
| (M-SD) | 17.45(6.76) | 14.84 (6.22) | 23.50(11.88) | 0.002 | 17.04(8.26) |
| | | Post hoc Tukey | | P value | |
| SPI-SPII | | | | 0.424 | |
| SPI-SPII | | | | 0.069 | |
| SPII-SPIII | | | | 0.001 | |
| Female | | | | | |
| n(%) | 44 (33.9) | 58 (44.6) | 28 (21.5) | 0.263 | 130 (62.2) |
| (M-SD) | 20.57(8.50) | 21.93(8.98) | 18.61(9.06) | | 20.75(8.86) |

Key: (M-SD)- Mean (standard deviation); SP-Skeletal pattern

Table 4: Cephalometric presentation of the cranial base and the jaw bases in the different skeletal patterns

| Variables N(%) | **SK-PAT I** 64(30.6) | **SK-PAT-** II 103 (49.3) | **SK-PAT-** III 42 (20.1) | P value (ANOVA) |
|---|---|---|---|---|
| BaSN$(^0)$ -M(SD) | 132.64(5.28) | 131.96(6.25) | 132.52(7.95) | 0.769 |
| S-N(mm) -M(SD) | 61.47(5.49) | 60.58(6.35) | 60.91(5.53) | 0.645 |
| S-Ba(mm) -M(SD) | 39.72(4.80) | 39.79(4.24) | 39.76(4.42) | 0.994 |
| Ba-N(mm) -M(SD) | 93.52(8.99) | 91.78(8.40) | 93.00(8.85) | 0.424 |
| SNA$(^0)$-M(SD) | 84.66(4.07) | 86.28(4.70) | 83.98(4.49) | 0.008 |
| SNB$(^0)$ -M(SD) | 81.66(4.33) | 78.54(4.75) | 83.69(9.44) | <0.001 |
| ANB$(^0)$ -M(SD) | 3.14(1.10) | 7.81(2.38) | -0.86(2.14) | <0.001 |
| Co-A(mm) -M(SD) | 77.59(7.23) | 77.69(7.32) | 75.79(7.53) | 0.338 |
| Co-Gn(mm) -M(SD) | 101.52(11.10) | 97.23(9.74) | 102.91(8.87) | 0.002 |
| MMD(mm) -M(SD) | 24.09(5.96) | 19.61(5.40) | 27.12(4.06) | <0.001 |

Table 5: Tukey Post hoc analysis for significant variables

| Variables | SNA$(^0)$ | SNB$(^0)$ | ANB$(^0)$ | Co-Gn(mm) | MMD(mm) |
|---|---|---|---|---|---|
| SPI VS SP II | 0.060 | 0.003 | *0.000 | 0.021 | *0.000 |
| SPI VS SP III | 0.724 | 0.193 | *0.000 | 0.765 | 0.013 |
| SPII VS SPIII | 0.015 | *0.000 | *0.000 | 0.006 | *0.000 |

SP-skeletal pattern, * - p<0.001.

statistically significant difference was noted among the sagittal jaw relationships, hence no post hoc test was conducted among the females, (table 3).

Table 4 shows that the cranial base angle (BaSN), anterior cranial base (S-N), posterior cranial base (S-Ba) and total cranial base (BaN) lengths were not statistically different in the three different sagittal jaw relationships. However, the sagittal relationship of the jaw bases: the maxilla (SNA) and the mandible (SNB) to the anterior cranial base in the various sagittal jaw relationships differ significantly in the three sagittal jaw pattern, P =0.008 and P<0.001 respectively. Similar observation was noted with the effective mandibular lengths (Co-Gn) and the mandibulo-maxillary differential (MMD) with p values of 0.002 and <0.001 respectively. The table shows that class II jaw relationship had the smallest cranial base angle of 131.96(6.25) degree and the smallest effective length of the mandible of 97.23(9.74) millimeters.

## Results

There were 79 males and 130 females (ages 7 to 55 years) and the mean age of the study participants was 19.35 ± 8.81 years.

The average mean age of the study participants was 19.35 ± 8.81 years. There was no statistically significant difference in the mean age among the different sagittal jaw relationships. The mean age of the male participants was 17.04 ± 8.26 years, with statistically significant difference observed in the various sagittal jaw relationships, p=0.002. Post hoc Tukey shows that the statistical significant difference among the male participants was between skeletal pattern II and skeletal III, p=0.001. The mean age of the female participants was 20.75± 8.86 years and no

In Table 6, the cranial base angle (BaSN) had a moderate, negative correlation with SNA and SNB in skeletal pattern I and also with SNB in skeletal pattern III, which were statistically significant. There were however, negative, weak correlations between cranial base angle and SNA and also between cranial base angle and SNB in skeletal pattern II. A strong, negative correlation was noted between BaSN and SNA in skeletal pattern III, (p<0.0001). In total, there were no statistically significant correlations between BaSN/ANB, BaSN/Co-A, BaSN/Co-Gn and BaSN/MMD.

Table 7 shows that the anterior cranial base length (SN) and the posterior cranial base length (SBa) did

Table 6: Pearson's correlation between cranial base angle and facial parameters in the different sagittal jaw relationships

| Variables | SK-PAT I N(%) 64(30.6) | SK-PAT II N(%) 103 (49.3) | SK-PAT III N(%) 42 (20.1) | TOTAL 209 (100) |
|---|---|---|---|---|
| | r(P value) | r(P value) | r(P value) | r(P value) |
| BaSN-SNA | -0.513 (<0.0001) | -0.369(<0.0001) | -0.711(<0.0001) | -0.483(<0.0001) |
| BaSN-SNB | -0.531(<0.0001) | -0.332(0.001) | -0.633(<0.0001) | -0.439(<0.0001) |
| BaSN-ANB | 0.083(0.515) | -0.066(0.510) | 0.218(0.165) | -0.021(0.758) |
| BaSN/Co-A | 0.148(0.242) | 0.090(0.368) | -0.215(0.172) | 0.023(0.736) |
| BaSN/Co-Gn | 0.057(0.655) | 0.027(0.789) | -0.320(0.039) | -0.029(0.677) |
| BaSN/MMD | -0.088(0.490) | -0.126(0.205) | -0.300(0.054) | -0.102(0.141) |

SK-PAT- Skeletal pattern; r-Pearson's correlation coefficient

Table 7: Pearson's Correlation between cranial base lengths and facial parameters in the different sagittal jaw relationships

| Variables | SK-PAT I N(%) 64(30.6) | SK-PAT II N(%) 103 (49.3) | SK-PAT III N(%) 42 (20.1) | TOTAL 209 (100) |
|---|---|---|---|---|
| | r(p value) | r(p value) | r(p value) | r(p value) |
| SN-SNA | 0.090(0.478) | -0.108(0.276) | 0.254(0.105) | 0.000(0.999) |
| SN-SNB | -0.140(0.268) | -0.079(0.429) | 0.331(0.032) | 0.102(0.141) |
| SN-ANB | -0.151(0.234) | -0.044(0.662) | -0.024(0.882) | -0.060(0.386) |
| SBa-SNA | 0.018(0.890) | -0.082(0.413) | 0.193(0.221) | 0.005(0.945) |
| SBa-SNB | 0.080(0.530) | -0.080(0.424) | 0.246(0.116) | 0.062(0.372) |
| SBa-ANB | -0.224(0.075) | 0.013(0.897) | 0.052(0.752) | -0.007(0.915) |
| BaN-SNA | 0.010(0.939) | -0.238(0.015) | 0.051(0.748) | -0.121(0.080) |
| BaN-SNB | 0.054(0.672) | -0.183(0.064) | 0.153(0.332) | 0.018(0.798) |
| BaN-ANB | -0.161(0.205) | -0.090(0.367) | 0.043(0.789) | -0.097(0.160) |

SK-PAT- Skeletal pattern; r-Pearson's correlation coefficient

Table 8: Pearson's correlation between cranial base length and jaw base length according to sagittal jaw relationship

| Variables | SK-PAT I N(%) 64(30.6) | SK-PAT II N(%) 103 (49.3) | SK-PAT III N(%) 42 (20.1) | TOTAL 209 (100) |
|---|---|---|---|---|
| | r(p value) | r(p value) | r(p value) | r(p value) |
| SN/CoA | 0.796(0.000) | 0.732(0.000) | 0.820(0.000) | 0.759(0.000) |
| SN/CoGn | 0.742(0.000) | 0.695(0.000) | 0.849(0.000) | 0.718(0.000) |
| SBa/CoA | 0.528(0.000) | 0.504(0.000) | 0.516(0.000) | 0.511(0.000) |
| SBa/CoGn | 0.501(0.000) | 0.504(0.000) | 0.517(0.000) | 0.488(0.000) |
| BaN/CoA | 0.789(0.000) | 0.773(0.000) | 0.712(0.000) | 0.755(0.000) |
| BaN/CoGn | 0.733(0.000) | 0.726(0.000) | 0.715(0.000) | 0.720(0.000) |

SK-PAT- Skeletal pattern; r-Pearson's correlation coefficient

not show statistical significant correlations with SNA and SNB in the different skeletal patterns except in skeletal pattern III where the anterior cranial base length showed a weak, positive statistical significant correlation with SNB, r=0.331; p=0.032. A weak, negative correlation between the total cranial base length (BaN) and SNA was observed in class II skeletal pattern, which was statistical significant, p=0.015. On the other hand, the anterior (SN), posterior (SBa) and the total (BaN) cranial base lengths did not show significant correlation with ANB in the different skeletal patterns.

Table 8 shows moderate to strong positive correlation between the anterior (S-N), and the total (Ba-N) cranial base and the effective maxillary (Co-A) and effective mandibular (Co-Gn) lengths in the different skeletal jaw relationships, which were statistically significant. On the other hand, the posterior cranial base length had weak and moderate positive correlation with the effective mandibular (Co-Gn) lengths and the effective maxillary (Co-A) length respectively, p<0.0001.

## Discussion

The methods utilized in this study is similar to that described by a previous author, who described the cranial base angle by utilizing the basion as the posterior limit of the posterior cranial base.[14] Although the articulare appears easy to locate on the lateral cephalograph[8] but its distance from the actual anatomic landmark of the cranial base has particularly not made it a favorable landmark by researchers.[18] Despite the difficulty encountered in locating the basion, researchers have insisted on it due to its anatomic significance.[18] The basion was chosen as the posterior limit of the cranial base in this study due to its anatomic importance considering that the parameters obtained from using either of landmarks are closely related.[8,19]

The findings of this present study did not reveal any significant difference in the cranial base angle among the three groups of skeletal jaw relationship. This observation is similar to the findings made by previous authors.[11,16,20,21] On the other hand, this study is contrary to the observations made by some other researchers.[13,22-24] In 2022, Klocke et al conducted a longitudinal study and reported only minimal changes in the cranial base flexure from 5 to 1 2 years of age.[25] The author reported that the relationship between cranial base angle and the skeletal pattern appeared to have been established before 5 years and that it only has limited influence on the development of the skeletal pattern.[25] The differences observed in cranial base angles between skeletal pattern I and II has been noted not to be sufficient enough to decisively distinguish between them.[22,23,26] Hence, in order to maintain constant relationship between the mandible and the anterior cranial base, some form of compensatory mechanism tends to occur.[27] In a more obtuse cranial base angle, there is a resultant closure of the angle between the ramus of the mandible and the posterior cranial base; causing the mandible to rotate downward and forward, thereby obviating the tendency toward a class II skeletal pattern.[27] Also, an acute posterior cranial limb (S-Ba) flexure that could predispose to mandibular prognathism (in class III) could be compensated for by an increase in the length of the posterior limb.[12] Therefore, the classification of malocclusion on the basis of the cranial base does appears controversial because the growth of the cranial base is controlled genetically as against the malocclusion traits that are largely influenced by acquired factors such as: habit, breathing and mastication.[28] Therefore, apart from cranial base flexure, individual variation and differential growth pattern could also be considered as possible aetiological factors in the classification of skeletal malocclusion.[29]

In this current study, the mean of the anterior cranial base, posterior cranial base and the total cranial base lengths were not statistically different in the different skeletal jaw patterns. These findings corroborate an earlier finding reported among a Sudanese population.[14] This present study showed fairly constant anterior cranial base lengths but slightly higher in skeletal pattern I. Also in this study, the anterior and the total cranial base lengths appeared slightly lower in skeletal pattern II compared to skeletal pattern I and III. This pattern is similar to the findings in a Saudi population however, no significant findings were observed in this current study as against the findings of the author.[22] The dimensions of anterior cranial base, posterior cranial base and the total cranial base lengths observed among a Sudanese population appear to be generally higher than what is presented in the study.[14] On the other hand, the mean difference in the posterior cranial base length in this current study was reported to be significantly lower in skeletal pattern III in a study conducted among a Brazilian population.[16] Racial difference could be a major contributory factor in the differences observed. This current study also revealed a statistical significant difference in the effective mandibular lengths among the different skeletal pattern. The effective mandibular length was significantly higher in skeletal pattern I compared to skeletal II. This also corroborates the observation made by a previous author.[14]

Statically significant negative correlations between the cranial base angle and SNA and SNB were observed in this current study. That is, an increase in the cranial base angle would results in a decrease in the SNA and SNB and vice versa. This finding is comparable to the observations made by previous authors.[14,31] Therefore, the assessment of the sagittal relationship of the maxilla with the cranial base using SNA should be with caution since its value could be influenced by the angulation of the cranial base.[32] There was however no significant correlation between cranial base flexure and ANB in the various skeletal patterns. This further consolidates the results in this study that shows no differences in the cranial base angels in the three jaw relationships especially as ANB was used to classify the skeletal pattern in this study, which is in agreement with the findings of previous authors.[14,25]

In this current study, the anterior cranial base length only showed a significant positive correlation with SNB in skeletal pattern III morphology while the total cranial base length had a negative significant correlation with SNA in skeletal pattern II morphology. This finding is at variance with the observation made by Ahmed and Abuaffan among Sudanese.[14] A significant positive correlation between posterior cranial base length with SNA and SNB skeletal pattern III morphologies was only observed by the author.[14] This study also showed a positive significant correlation between the anterior, posterior and total cranial base lengths and the effective length of the maxilla and mandible. The correlation coefficients were reportedly higher with the anterior and total cranial base lengths compared to the posterior cranial base length. Although the posterior cranial base length showed the least correlation coefficient with the effective mandibular length in the different skeletal morphologies, the literature still records it as having more significant effect on the post-natal growth of the mandible.[16] Therefore, should the basion be used as the reference point in the cranial base for the mandible instead of the nasion?

The controversy surrounding the influence of the cranial base flexure in the classification of the morphologies of skeletal malocclusion is far from over. This current study disagrees that the cranial base angulation plays a significant role in the development of the skeletal malocclusion of the jaw.

**Conclusion**

This current study has shown that the cranial base angulation does not play a statistically significant role in determining the outcome of the sagittal jaw relationship in various malocclusion. Also, there were no significant difference in the anterior, posterior and total cranial base length in the various malocclusion. Furthermore, negative significant correlations were noted between the cranial base angle and the SNA and SNB angles in the different skeletal malocclusion with no significant correlation observed between the cranial base angle and ANB. The correlation between the cranial base lengths and the SNA, SNB and ANB were largely not statistically significant except between SN and SNB in class III and also between total cranial base (BaN) and SNA in skeletal pattern II . In addition, the cranial base length showed positive significant correlation with the effective maxillary and effective mandibular length in the different skeletal malocclusion morphology.

**Study limitation**

This study was a descriptive cross-sectional research and it was not impossible to determine the initial skeletal pattern of the participants in their early developmental stages prior to this study.

**Recommendation**

The authors therefore suggest that a longitudinal survey be conducted to determine the exact role of cranial base angulation in developing anterior-posterior jaw discrepancies.

**Conflict of interest**

The authors declare no conflict of interest.

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