Selected cephalometric angular norms in Kikuyu children

By Sunil Kapila, BDS, MS

An accurate diagnostic evaluation of any orthodontic patient involves a comparison of the individual's cephalometric findings with the norms for his or her ethnic group. This is because cephalometric standards vary widely between different ethnic groups.[1-14] Drummond[5] reported a greater mandibular inclination relative to the Frankfort horizontal plane and more prognathic relation of the maxilla to the anterior cranial base and the mandible in black American children as compared to white children. The investigator also noted more procumbent and protrusive maxillary and mandibular incisors in black American children. Other investigators[2,9,12,13] have demonstrated similar findings on the craniofacial patterns in black Americans.

Herkovits[15] stated that American blacks are a racial admixture of African blacks, West European whites and Mongoloids. He noted that only about 20 percent of American blacks are of a wholly African descent. This entails that cephalometric norms for black Americans may differ from those of black Africans as demonstrated by Jacobson[10] and Bacon and Mathis.[14] Jacobson[10] found that South African blacks had less proclined maxillary incisors than black Americans. Similarly, Bacon and Mathis[14] noted that Senegalese and Cameroonians have a smaller Frankfort — mandibular plane angle than blacks in America[3,5] and South Africa.[10]

Although a large number of studies have been conducted to determine craniofacial dimensions for whites, black Americans as well as other ethnic groups, only limited information on cephalometric standards of African blacks is presently available. Furthermore, the continent of Africa is populated by diverse ethnic entities which demonstrate variations in facial patterns even between closely related ethnic groups.[14] These factors negate the use of cephalometric norms defined for other black populations for appropriate orthodontic evaluation and treatment of Kenyan blacks. As no cephalometric guidelines

Abstract

Fifty-six standardized lateral head radiographs of Kikuyu children, represented equally by sex and aged nine to 15 years, were evaluated to determine norms for six dentoskeletal angles. The mean values obtained for the measured variables in the two sexes were: SNA = 84.4° (±4.0°); SNB = 79.3° (±4.1°); ANB = +5.1° (±2.0°); FMA = 34.0° (±5.1°); IMPA = 96.2° (±5.0°) and 1/1 = 111.6° (±7.7°). Angle SNB was found to be significantly larger in females. A comparison of the means of the cephalometric angles for the Kikuyu children with those of black American children demonstrated a steeper Frankfort-mandibular plane angle and a more acute lower incisor to mandibular plane angle in Kikuyu children. The Kikuyu children were also noted to have a more prognathic maxilla relative to the cranial base and mandible, a greater inclination of the lower incisors to mandibular plane and a more acute interincisal angle when compared to white children. The study emphasizes the need for use of group specific norms for orthodontic diagnosis and treatment planning.

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Key Words

Cephalometric angular norms • Kikuyu children • Black American children • White children

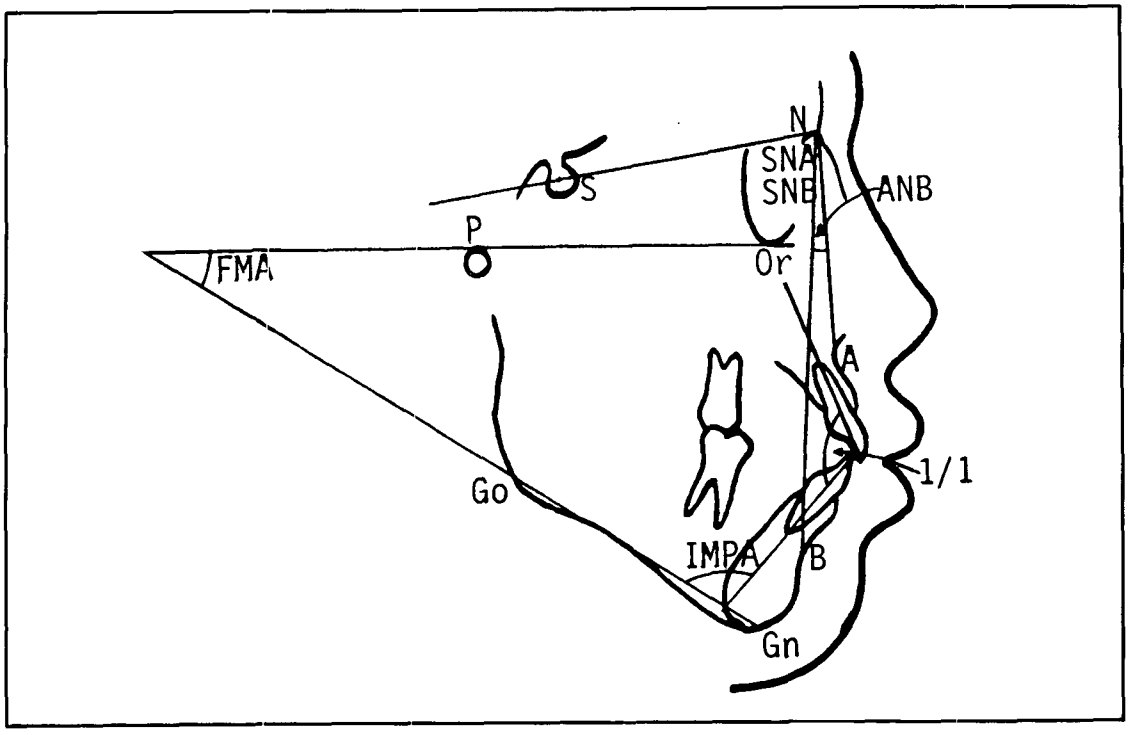

Figure 1
Landmarks, planes and variables measured in Kikuyu children. The angles determined were: a) sella-nasion-subspinale (SNA); b) sella-nasion-supramentale (SNB); c) subspinale-nasion-supramentale (ANB); d) Frankfort-mandibular plane (FMA); e) lower incisor to mandibular plane (IMPA) and f) interincisal (1/1).

have previously been defined for any ethnic group in Kenya, the present study was conducted to evaluate six dentoskeletal angles for Kenyan children of Kikuyu descent. The Kikuyu, who are the predominant tribe in Kenya, are of Bantu origin. This investigation also compared the cephalometric findings for the Kikuyu children with those of white and black American children.

Material and methods

Two hundred and fifty-six standardized lateral head radiographs available at the Department of Dental Surgery of the University of Nairobi, Kenya were examined. Although most of these radiographs were taken for patients presenting for orthodontic treatment, only those individuals displaying a pleasing facial profile, mild crowding of less than five millimeters in one or both arches as well as Class I molars and canines were selected for the investigation. Figure 1 depicts a facial profile which was considered typical for this sample. From the radiographs evaluated, only 28 males and 28 females satisfied the criteria and were included in this study.

Tracings were done on matte finish acetate paper and measurements made with a large protractor to the nearest 0.5 degrees. The radiographs were traced twice and a mean of the measurements taken if the difference between two consecutive tracings was one degree or less. When the error between two tracings exceeded one degree, the tracings were repeated until a measurement error within the acceptable range was obtained.

Cephalometric landmarks were determined according to the definitions proposed by Salzmann[16] and included sella (S), nasion (N), subspinale (A), supramentale (B), orbitale (Or), anatomical porion (P), gnathion (Gn) and Gonion (Go) (Fig. 1). Six clinically relevant and commonly used skeletal and dental angles were measured. These were sella-nasion-subspinale (SNA), sella-nasion-supramentale (SNB), subspinale-nasion-supramentale (ANB), Frankfort-mandibular plane (FMA), lower incisor-mandibular plane (IMPA) and interincisal (1/1) angles.

In order to compare the craniofacial dimensions of Kikuyu children with those of white and black American children, it was desirable to obtain cephalometric data for these children from studies with similar sampling criteria as used in the present investigation. Studies by Taylor and Hitchcock[4] on white children and Drummond[5] on black American children were found to be suitable for this purpose.

Statistical analysis

The data for all measurements was first plotted as frequency distribution graphs. As this procedure revealed an almost normal distribution for all angles, the students *t*-test was used to assess sex differences in the measured values. The students *t*-test was also used to evaluate any differences between the facial dimensions of Kikuyu children and those of white and black American children. Differences in the mean values for the angles were regarded to be significant if $p < 0.05$.

Table 1

Means, standard deviations (SD) and ranges for cephalometric angles in 28 male and 28 female Kikuyu children. The probability values (p) for any sex differences are also provided.

Angle	Males			Females			p
	Mean	(±SD)	Min Max	Mean	(±SD)	Min Max	
SNA	83.5	(4.3)	80.0 - 95.0	85.3	(3.6)	77.5 - 91.0	NS
SNB	78.2	(4.5)	70.5 - 89.0	80.4	(3.4)	73.5 - 85.0	0.05
ANB	+5.3	(2.6)	+2.0 - +9.5	+4.9	(1.4)	+3.0 - +7.0	NS
FMA	34.4	(5.0)	27.0 - 42.0	33.7	(5.3)	24.0 - 43.0	NS
IMPA	96.8	(5.0)	89.0 - 108.5	95.6	(5.1)	85.5 - 106.0	NS
1/1	111.4	(6.9)	94.0 - 123.0	111.9	(8.5)	94.0 - 125.5	NS

NS: non significant difference

Table 1
Means, standard deviations (SD) and ranges for cephalometric angles in 28 male and 28 female Kikuyu children. The probability values (p) for any sex differences are also provided.

Results

A total of 56 standardized lateral head radiographs were analyzed. The age range of the subjects was nine to 15 years ($\bar{x}$=11.30 years). The mean ages for the 28 males and 28 females were 11.75 years and 10.85 years respectively. The differences in the mean ages of the two sexes was statistically insignificant.

The cephalometric findings for males and females are listed in Table I. With the exception of SNB angle, no other variable was found to be significantly different between the two sexes. Angle SNB was found to be larger in females ($p < 0.05$). The male-female difference in the means for this angle was 2.2°.

The mean angular dimensions for the five variables that displayed no sex differences were: SNA = 84.4° (±4.0°); ANB = +5.1° (±2.0°); FMA = 34.0° (±5.1°); IMPA = 96.2° (±5.0°) and 1/1 = 111.6° (±7.7°). The means for angle SNB were 78.2° (±4.5°) in males and 80.4° (±3.4°) in females. These values indicate a relatively large sagittal difference between the maxilla and mandible, a steep mandibular plane and proclined relationship of the incisors. The combined male and female means and standard deviations for these angles are presented in Table 2.

Discussion

A subjective assessment of the Kikuyu face in profile demonstrates protrusive and everted full lips, a convex facial profile with a prominent dentoalveolar area and a hyperdivergent skeletal pattern. The numerical values for the dental and skeletal variables determined in this investigation lend support to these observations. The measurements made reveal prognathism of the maxilla relative to the mandible, protrusive dentoalveolar relationships as well as a steep mandibular plane.

This study revealed that only one variable, namely the SNB angle differed significantly between the two sexes (Table 1). This angle was 2.2° greater on the average in females than in males. The sex difference in this variable may be attributed to the earlier general and facial pubertal growth in females.[17,18] It is also probable that detection of differences between the two sexes for some variables in this study as well as previous investigations[7,13] may have been masked by the relatively wide age range of the samples.

A comparison of the findings of this investigation with those of Drummond[5] on black American children revealed two statistically significant differences. Thus, while the FMA angle was larger in Kikuyu children, IMPA was greater in black American children (Table 2). These differences indicate a greater inclination of the mandibular plane to the Frankfort horizontal plane and less proclined mandibular incisors in Kikuyu as compared to black American children. The combination of a steeper mandibular plane with relatively upright lower incisors would be expected to be accompanied by structural compensations in the facial morphology of the Kikuyu children. Such compensations may be present in the cranial base, maxilla or mandible and should be determined by further detailed cephalometric analysis.

Table 2
Comparison of means for craniofacial angles in Kikuyu children with cephalometric norms for white and black American children.

Table 2
Comparison of means for craniofacial angles in Kikuyu children with cephalometric norms for white and black American children.

Angle	Black American* N = 40 Mean (±SD)	p	Kikuyu N = 56 Mean (±SD)	p	Caucasian** N = 40 Mean (±SD)
SNA	84.7 (4.4)	NS	84.4 (4.0)	0.05	81.0 (3.2)
SNB	79.2 (4.2)	NS	79.3 (4.1)	NS	78.2 (2.9)
ANB	+5.5 (3.1)	NS	+5.1 (2.0)	0.01	+2.8 (2.0)
FMA	30.6 (4.7)	0.01	34.0 (5.1)	0.01	26.4 (4.6)
IMPA	100.0 (5.0)	0.01	96.2 (5.0)	NS	97.3 (6.3)
1/1	113.8 (6.9)	NS	111.6 (7.7)	0.01	126.8 (8.4)

NS: non significant difference

* Data from Drummond (1968)
** Data from Taylor and Hitchcock (1966)

Several statistically significant differences were noted on comparing the cephalometric means for the Kikuyu children with norms suggested for white children.[4] The Kikuyu children demonstrated larger SNA, ANB and FMA angles as well as a more acute interincisal angle in comparison to white children. These differences indicate that, in contrast to white children, Kikuyu children have a more prognathic maxilla relative to the cranial base and mandible, a relatively hyperdivergent mandible and a more proclined relationship between the maxillary and mandibular incisors. Drummond[5] as well as other investigators[2,3,9,12,13] report similar differences in the facial patterns of the black Americans and whites, although these differences are not of the same magnitude as those found between Kikuyu and white children. These findings, therefore, indicate greater dissimilarities between the facial morphologies of Kikuyu and white children than differences between Kikuyu and black American children.

The angular norms determined in this investigation have several important clinical implications. For example, an ANB angle ranging from about three degrees to seven degrees in a child of Kikuyu extraction signifies that the individual is likely to have a Class I skeletal relationship. In contrast, an ANB angle in the higher magnitudes of this range in a white child is often associated with a Class II skeletal pattern. Furthermore, the proclined mandibular incisors and the acute relationship between the maxillary and mandibular incisors indicate that relative uprighting of these teeth during orthodontic treatment may be unstable due to an imbalance created between the dentition and its muscular soft tissue environment. The steep Frankfort-mandibular plane angle will also often result in rapid closure of extraction spaces. Thus, demands on anchorage may be increased substantially during treatment of these children.

The mandibular incisor to Frankfort horizontal plane angle was not determined in this study. However, the calculated mean for this angle in the 56 Kikuyu children was 49.8°. This signifies that, in addition to other variables which differ between the Kikuyu and white children, the standards for the Tweed triangle used for white children do not apply to Kikuyu children. It is probable that relative uprighting of mandibular incisors in these individuals will position the teeth in an unbalanced relationship to the soft tissue environment with subsequent unstable results.

Certain limitations are imposed by the method of sample selection commonly used in cephalometric studies. Although data from such selected groups provides information on cephalometric values of individuals with acceptable facial profiles, the selection is subjective and introduces a degree of personal bias. Nevertheless, such data is valuable in orthodontic diagnosis and treatment planning.

Summary

Fifty-six standardized lateral head radiographs of Kikuyu children, represented equally by sex and aged nine to 15 years, were evaluated in order to determine norms for six craniofacial

angles. Only children with Class I occlusions and pleasing facial profiles were investigated. The mean values obtained for skeletal angles were: SNA = 84.4° (±4.0°); SNB = 79.3° (±4.1°); ANB = +5.1° (±2.0°) and FMA = 34.0° (±5.1°). The means derived for the dental angles IMPA and 1/1 were 96.2° (±5.0°) and 111.6° (±7.7°) respectively. Angle SNB was found to be significantly larger in females than in males.

The findings of this study were compared with norms suggested for black American and white children and some statistically significant differences were noted. The Kikuyu children demonstrated a greater mandibular inclination relative to the Frankfort horizontal plane and less proclined mandibular incisors in comparison with black American children. In contrast to white children, the Kikuyu children were noted to have a more prognathic maxilla relative to the cranial base and mandible, a greater mandibular incisor inclination and a more acute interincisal angle. These findings signify that the use of group specific norms is an essential prerequisite for an accurate evaluation of orthodontic patients. Cephalometric norms, in this context, imply a range of values rather than a single number represented by the mean for the variable. This investigation also defines areas of further research including the need for a detailed evaluation of craniofacial dimensions and the determination of age specific cephalometric standards for Kikuyu children.

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