British Journal of Medicine & Medical Research
4(16): 3092-3100, 2014

SCIENCEDOMAIN *international*
www.sciencedomain.org

An Update on Cephalometrics among Nigerians: Ascertaining Prevalent Jaw Patterns

Ifesanya Joy U.[1*]

[1]Department of Child Oral Health, University of Ibadan/University College Hospital Ibadan, Nigeria.

Author's contribution

This whole work was carried out by author IJU.

Original Research Article

Received 6th January 2014
Accepted 24th February 2014
Published 13th March 2014

ABSTRACT

Aims: Cephalometric norms vary between populations as well as among ethnicities within a known population. This study presents an update on cephalometric findings among Nigerians as well as the prevalent jaw patterns among subjects with malocclusion.
Study Design: A cross sectional study design was employed.
Place and Duration of Study: Orthodontic unit, University College Hospital, Ibadan, Nigeria between April 2008 and September 2011.
Methodology: One hundred and seven subjects were recruited (43 males, 64 females; overall mean age was 20.74±5.78 years). Thirty-six subjects had normal occlusion, 35 had skeletal pattern II and 36 had skeletal pattern III. Socio-demographic data, dental, occlusal and other orthodontic features were recorded on a data extraction form. Lateral cephalometric radiographs were taken for soft and hard tissue tracings. The ANB angle and Wits appraisal were used to assess skeletal pattern. Data was analysed using the Statistical Package for Social Sciences (SPSS) version 19. Frequency tables and measures of central tendency were generated. Variations in angular and linear variables were assessed using ANOVA and LSD post-hoc test. Significance was set at $P<.05$.
Results: A hundred and seven subjects were assessed. Mean age was 20.74±5.78 years. There was significant difference in mean values for SNB, ANB, SNMP, PP-MP, FMA, LI-MP and UI-LI angles between the three groups ($P<.05$). LSD post-hoc test showed significant reduction in SNB for class II ($P <.05$) but increase in SNB for class III subjects relative to the standards was not statistically significant ($P >.05$).
Conclusions: Mandibular deficiency appears to be the primary defect in class II malocclusion in this environment. On the other hand many factors are accountable for class III malocclusion.

**Corresponding author: Email: joyifesanya@yahoo.co.uk;*

Keywords: Cephalometry; Nigerians; malocclusion; jaw pattern.

1. INTRODUCTION

Since its advent by Broadbent and Hofrath in 1931 [1,2], radiographic cephalometry has become the most important tool in clinical and research orthodontics. Cephalometry has played a significant role in assessing the positioning of the maxilla and the mandible and is invaluable in estimating the aesthetic proportion of the face as well as the function of the dentition. Jaw discrepancies in the three planes of human existence are largely reported as contributory factors in many cases of malocclusion. Noting that a patient is type II or III skeletal pattern however, does not point out which jaw is defective with respect to established norms in a given population. Varying reports have been noted in different populations as to the prevalent jaw patterns responsible for sagittal skeletal discrepancies both in class II [3,4,5,6,7,8] and class III malocclusion [9]. Though having a population prevalence of the defective jaw in a particular class of malocclusion does not proffer a "one treatment suits all" approach in patient management, and it is established that each patient must be treated on individual merit, knowing the prevalent jaw anomaly is helpful in developing protocols geared toward early intervention and limitation of the abnormal trend in the implicated jaw. An example is presented in findings that show that Class II dento-skeletal disharmony does not exhibit significant growth change from late puberty through young adulthood [10], while the opposite has generally been reported in class III subjects [11,12].

Cephalometric findings in the Nigerian population are well documented [13,14,15]. However the prevalent jaw patterns for the different malocclusion groups have not been reported in Nigeria and the West African sub-region. The valuable information this knowledge may portend in terms of growth expectations in patients observed at an early developmental phase and in terms of treatment evaluation and outcomes in growing patients seen in this population is therefore missing.

1.1 Aims

This study presents an update on cephalometric findings among Nigerian subjects with normal occlusion as well as documents the prevalent jaw patterns in class II and III malocclusion in a cross section of Nigerians.

2. MATERIALS AND METHODS

Ethical approval was obtained from the University of Ibadan/ University College Hospital Ethical Reviews Board. After obtaining written informed consent from subjects or their parents/guardians if subjects were minors, a data extraction form was used to obtain socio-demographic information as well as dental, occlusal and other orthodontic findings. Lateral cephalometric radiographs were taken using the Pan-Blue-Oris machine (Blue-X Imaging S/no 2402kk0164 ASSAGO, ITALY). The Frankfort plane was parallel to the floor and subjects' teeth were in maximum contact. The distance from mid-sagittal plane of each individual to the source of radiation and the x-ray film was maintained at 150cm and 15cm respectively. Soft and hard tissue tracings were obtained by manual tracing using a 2H pencil on 0.003″ matted acetate tracing paper and over a viewing box in a dark room.

Linear cephalometric measurements including the length of sella-nasion (SN) plane: which defines the anterior cranial base, length of anterior nasal spine to posterior nasal spine:

(ANS-PNS) which represents the maxillary/palatal plane and the length of menton-gonion (Me-Go) outlining the mandibular plane. The Wits appraisal was also obtained using the maxillo-mandibular plane angle (MM°) bisector as the reference plane.

The following angular measurements were also recorded: sella-nasion-subspinale (SNA), sella-nasion-supramentale (SNB), subspinale-nasion-supramentale (ANB), anterior cranial base-mandibular plane (SN-MP), anterior cranial base-maxillary plane (SN-PP), Frankfort-mandibular plane (FMA), maxillary-mandibular plane (MMA), upper incisor to Frankfort plane angle (UI-FP), lower incisor to mandibular plane (LI-MP) and inter-incisal (UI-LI) angles (Fig. 1).

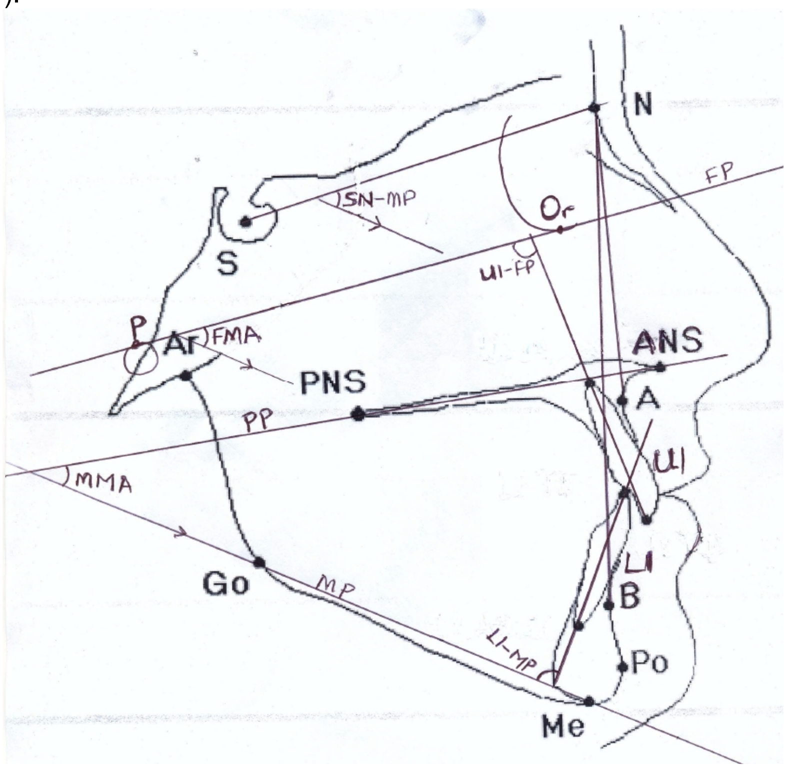

Fig. 1. Planes and angles assessed in the study
The ANB angle and Wits appraisal were used to assess skeletal pattern

Subjects were assigned as class I normal occlusion if these criteria were met:

- Molar relation was Angle's class I
- Skeletal pattern was class I using the ANB angle
- Skeletal pattern was class I using Wits appraisal
- Overjet was 2-4mm and overbite was half to a third overlap of the lower incisors
- Crowding or spacing did not exceed 2mm.

Subjects were assigned as class II or III malocclusion respectively if these criteria were met:

- Molar relation was class II or III
- Skeletal pattern was class II or III using the ANB angle

- Skeletal pattern was class II or III using the Wits appraisal

Subjects with class I malocclusion were excluded from the study as their skeletal relations were not expected to differ from those with normal skeletal relations. This way only class I normal occlusion as well as true class II and III subjects were included in the study. Subjects with developmental anomalies of the jaws and individuals with special health care needs were also excluded from the study. None of the subjects have had previous orthodontic treatment.

Intra examiner variability was assessed by retracing 5 (five) randomly selected radiographs at 2 (two) weeks interval. The paired t-test was used to analyse the readings and showed no significant variation as well as high correlation in readings at both times[SNA P=0.09; correlation .89 at P=.04: SNB P=.13; correlation 0.88 at P=.048; ANB P=.58; correlation 0.96 at P=.009] were obtained.

The data was entered into a computer spread sheet. Data was cleaned and analysed using the IBM Statistical Package for Social Sciences (SPSS) version 19. Descriptive statistics in form of frequency tables and measures of central tendency were generated. The students' independent t-test, the one-way analysis of variance (ANOVA) and Least Significant Difference(LSD) post-hoc test were used for analysis. Significance was set at P>.05.

3. RESULTS

Of the five hundred and fifty subjects seen between April 2008 and September 2011, a hundred and seven (19.5%) met the inclusion criteria and were recruited in the study. Overall mean age was 20.74±5.78 years: 21.94±4.07 years for subjects with normal occlusion and 20.14±6.40 years for subjects with malocclusion. Forty-three (40.2%) of the sample population were males, 64 (59.8%) were females. Thirty-six subjects (33.6%) were in the normal occlusion group, 35 (32.7%) were skeletal pattern II and 36 (33.6%) were skeletal pattern III. Reference values for angular measurements as obtained from the normal occlusion subjects is as presented in Table 1.

Table 1. Reference values for angular measurements in subjects with normal occlusion

Variable	Mean±S.D (°)
SNA	86.5±5.0
SNB	83.1±4.8
ANB	3.4±0.6
*SN-MP angle	30.9±6.0
*SN-PP angle	5.9±3.6
Fr-MP angle	24.1±4.2
MMP angle	26.0±4.5
UI-FP angle	120.7±4.8
LI-MP angle	102.5±6.1
UI-LI angle	112.0±6.3

**not previously documented for the Nigerian population*

The independent t-test showed no gender dichotomy in mean angular measurements among those with normal occlusion (*P*= .15 for SNA; *P* =.24 for SNB; *P* =.88 for ANB) and those with malocclusion (*P*=.06 for SNA; *P* =.51 for SNB; *P* =.25 for ANB) so findings were analysed jointly.

Among subjects with class II malocclusion, 8 (22.9%) had reduced SNA angle, 24 (68.6%) had normal, while only 3 (8.6%) had increased SNA. On the other hand, while 16 (65.6%) of them had normal SNB, 19 (54.3%) had SNB values less than one standard deviation of the expected norm.

With respect to class III subjects, SNA was normal in 22 (61%), increased in 3 (8.3%) and reduced in 11 (30.6%) of the subjects while SNB was normal in 16 (44.4%), increased in 15 (41.7%) and reduced in only 5 (13.9%).

Irrespective of the class of malocclusion, the most prevalent SNA/SNB combination were within normal values for class I occlusion. The pattern of jaw relations are as shown in Fig. 2.

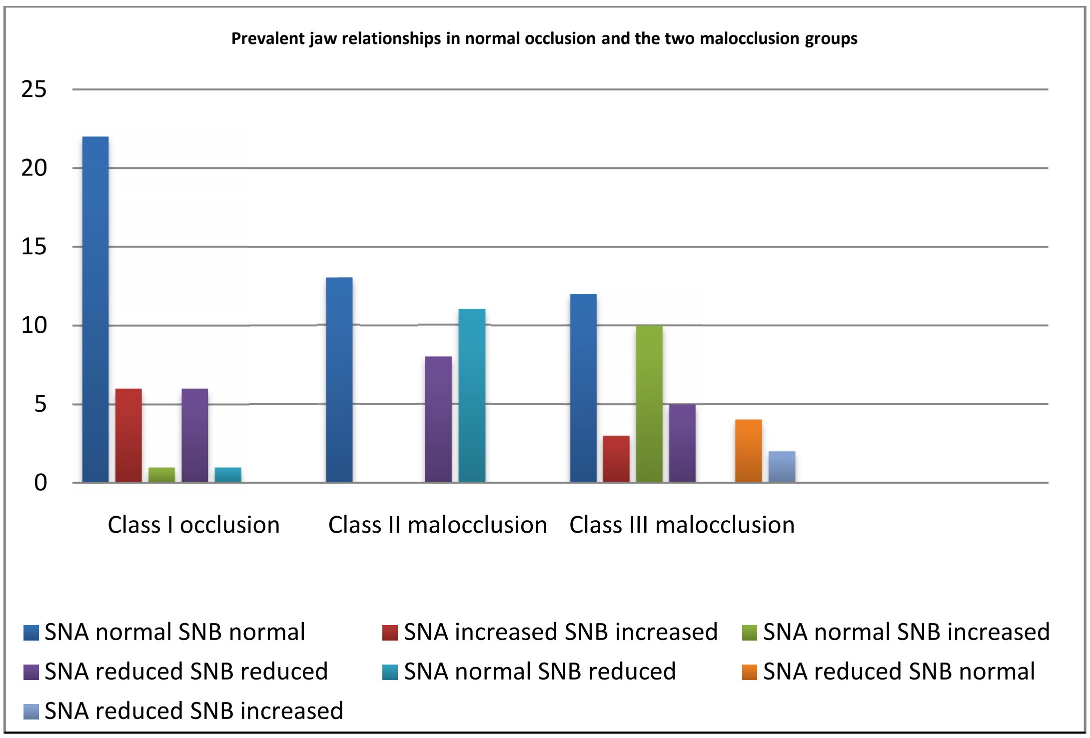

Fig. 2. Prevalent jaw relationships in normal occlusion and the two malocclusion groups

One-way ANOVA showed that there was no significant difference in mean values for SNA, SNPP and UI-FP angle between the three groups (*P*>.05). On the other hand there was significant difference in SNB, ANB, SNMP, PP-MP, FMA, LI-MP and UI-LI angles between the three groups (*P*<.05). LSD post-hoc test showed that there was significant reduction in SNB value among the class II subjects compared to the standard (*P*<.001). Although there was increase in mean SNB in class III subjects relative to the standards, it was not significant in this sample of Nigerians (*P*=.07). The trend observed with the other variables is presented in Table 2.

ANOVA of linear variables showed that there was no significant difference in the length of the palatal plane and anterior cranial base (*P*>.05), but the opposite was true for the mean length of the mandibular plane (*P*<.05) among the three groups assessed. The post-hoc test also indicated that the mandibular plane was significantly shorter in class II subjects when compared to subjects with normal occlusion (Table 3).

Table 2. Variations in angular measurements among the three types of skeletal pattern

Variable	ANOVA				LSD POST-HOC TEST		
		Mean±SD	F-Test	P-Value	I -J	Mean Difference	P-Value
SNA	Class I	86.5±5.0	1.49	.23	Class I vs. II	1.69	.16
	Class II	84.8± 4.9			Class I vs. III	1.82	.12
	Class III	84.7±5.0					
SNB	Class I	83.1±4.8	21.83	.001**	Class I vs. II	5.33	.001**
	Class II	77.8±4.8			Class I vs. III	-2.12	.07
	Class III	85.2±5.0					
SNMP	Class I	30.9±6.0	6.70	.002**	Class I vs. II	-5.84	.001**
	Class II	36.7±6.8			Class I vs. III	-1.92	.24
	Class III	32.8±7.6					
SNPP	Class I	5.9±3.6	0.80	.45	Class I vs. II	-1.07	.25
	Class II	7.0±3.7			Class I vs. III	-0.92	.32
	Class III	6.8±4.2					
FMA	Class I	24.1±4.2	3.11	.049*	Class I vs. II	-3.40	.02*
	Class II	27.5±6.4			Class I vs. III	-1.43	.29
	Class III	25.5±6.3					
PP-MP	Class I	26.0±4.5	10.19	.001**	Class I vs. II	-4.96	.001**
	Class II	31.0±5.8			Class I vs. III	-0.50	.68
	Class III	26.5±4.9					
UI-FP	Class I	120.7±4.8	2.54	.08	Class I vs. II	-3.60	.05
	Class II	124.3±10.0			Class I vs. III	-3.56	.06
	Class III	124.2±7.6					
LI-MP	Class I	102.5±6.1	6.70	.002**	Class I vs. II	0.30	.89
	Class II	102.2±13.0			Class I vs. III	7.06	.002**
	Class III	95.4±7.3					
UI-LI	Class I	112.0± 6.3	8.08	.001**	Class I vs. II	7.50	.004**
	Class II	104.5±14.8			Class I vs. III	-2.49	.33
	Class III	114.5±9.7					

** significant at P>.05,*
*** significant at p<0.01*

Table 3. Variations in linear measurements among the three types of skeletal pattern

	ANOVA				LSD POST-HOC TEST		
Variable	Class	Mean ± SD	F-Test	P–Value	I-J	Mean Difference	P-Value
Length SN plane	Class I	71.82±3.67	1.58	.21	Class I vs. II	-1.67	.08
	Class II	73.51±4.18			Class I vs. III	-0.67	.49
	Class III	72.49±4.27					
Length palatal plane	Class I	56.02± 3.96	1.00	.37	Class I vs. II	-0.35	.77
	Class II	55.67± 5.63			Class I vs. III	1.55	.18
	Class III	54.46± 4.98					
Length mandibu lar plane	Class I	85.13±5.56	5.89	.004**	Class I vs. II	3.05	.048*
	Class II	82.07±6.73			Class I vs. III	-2.17	.16
	Class III	87.29±6.93					

**significant at P<.05, **significant at P<.01*

4. DISCUSSIONS

This study has shown angular cephalometric values that are within acceptable limits of previously published values for Nigerians with normal occlusion [13,14,15]. Previously undocumented reference values for SN-MP and SN-PP angles obtained from this study show that this sample of Nigerians have mean values which are slightly less than but similar to those reported globally [16]. The dento-skeletal variables UI-FP and LI-MP though higher than for Caucasian populations are normal in this environment where some form of bi-maxillary proclination is common even in normal occlusion[13] a finding that has also been reported among African Americans [17].

Though the maxilla and mandible appear to be in positions acceptable as normal for most subjects even those with malocclusion, it is evident that the difference in spatial position is still contributory to the establishment of malocclusion. This is at least partly attributable to the wide range in standard deviate values for normal occlusion, as in fact, ANB of 10° has been reported in Nigerians with normal occlusion [14]. In addition, the diverse geometric orientations of the face for example the location of the nasion, which introduce various confounders into the antero-posterior relationship of the face is another factor to consider in this sample of Nigerians [18,19]. When those with malocclusion in spite of normal SNA and SNB values are excluded, mandibular retrognathism and prognathism in the presence of normal maxillary position are most implicated in class II and III malocclusion respectively. This highlights a possible role of the mandible in the aetiology of class II and III malocclusion in this environment. A report of combined prevalent maxillary prognathism and mandibular retrognathism has been reported in a Lithuanian study [3]. On the other hand, a similar report of prevalently mandibular deficiency has been reported among Iraqis with class II division I malocclusion compared with class I [20]. This Iraqi study also reported an increase in SN-MP and LI-MP angles as well as a stable SN plane length and the present study reports similar increase in SN-MP and SN plane length. Unlike the Iraqis however, Nigerians differ in that the LI-MP value did not change whether the subjects were class II or had normal occlusion in this study [20], again demonstrating the racial and possibly ethnic variation that malocclusions can present [3-9].

With respect to class III malocclusion, though a true difference in SNB and mandibular length values were observed, the post hoc test did not identify a particular jaw as prevalently responsible. So it appears that combinations of maxillary and mandibular base as well as dental orientations are responsible for class III malocclusion. This is highlighted by the significant increase in LI-MP angle in class III subjects.

The clinical value of these findings is that it underscores the need for early detection of and attention to the defective jaw. This way, interceptive regimens such as myofunctional appliance therapy and early use of facemasks and headgear can be instituted to mitigate against establishment of the respective malocclusion. More so, since opinions vary widely as to the different facial profiles, it is pertinent that the right treatment choice of the various available options known be made based on evidence both visual and radiographic.

5. CONCLUSION

In conclusion, mandibular deficiency appears to be the primary defect in class II malocclusion in this environment. On the other hand many factors are accountable for class III malocclusion, so it is important that individual cases be treated on evidence-based merit.

CONSENT AND ETHICAL APPROVAL

The research described in the submitted protocal, the consent forms and other participant information materials have been reviewed and given full approval by the UI/UCH Ethics Committee.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Broadbent BH. The face of the normal child. Angle Orthod. 1937;7:183–208.
2. Hofrath H. Die bedentung der roentgenfem der kiefer anomalien. Forschr Orthodont. 1931;1:232–248.
3. Sidlauskas A, Svalkauskiene V, Sidlauskas M. Assessment of Skeletal and Dental Pattern of Class II Division 1 Malocclusion with Relevance to Clinical Practice. Stomatologija Baltic Dent maxillofac J. 2006;8:3–8.
4. Mcnamara J. Components of Class II malocclusion in children 8-10 years of age. Angle Orthod. 1981;51:177–201.
5. Rothstein TL. Facial morphology and growth from 10 to 14 years of age in children presenting Class II Division 1, malocclusion: a comparative roentgenographic cephalometric study. Am J Orthod Dentofac Orthop. 1971;60:619–620.
6. Rosenblum ER. Class II malocclusion: mandibular retrusion or maxillary protusion? Angle Orthod. 1995;65:49–62.
7. Bishara SE. Mandibular changes in persons with untreated and treated Class II division 1 malocclusion. Am J Orthod Dentofac Orthop. 1998;113:661–673.
8. Henry RG. A classification of class II division I malocclusion. Angle Orthod. 1957;27:83–98.
9. Al-Lehaibi WKH, Al-Mothaffar N. The characteristic features of skeletal class III in Iraqi adult orthodontic patient. J Bagh Coll Dent. 2011;23:149–155.

10. Baccetti T, Stahl F, Mcnamara JA. Dentofacial growth changes in subjects with untreated Class II malocclusion from late puberty through young adulthood. Am J Orthod Dentofac Orthop. American Association of Orthodontists. 2009;135:148–154.
11. Baccetti T, Franchi L, Mcnamara JA. Growth in the Untreated Class III Subject. Seminars in Orthodontics. 2007;13:130–142.
12. Singh GD, McNamara J, Lozanoff S. Mandibular-morphology-in-subjects-with-Class-III-malocclusions finite element morphometry.pdf. Angle Orthod. 1998;68(5):409–418.
13. Isiekwe MC, Sowemimo GOA. Cephalometric findings in a normal Nigerian population sample and adults with unrepaired clefts. Cleft palate journal. 1984;21(4):323–328.
14. Utomi LI. A cephalometric study of antero-posterior skeletal jaw relationship in Nigerian Hausa-Fulani children. West Afr J Med. 2004;23:119–122.
15. Ajayi EO. Cephalometric norms of Nigerian children. Am J Orthod Dentofac Orthop. 2005;128:653–656.
16. Panagiotidis G, Witt E. Der individualisierte ANB-Winkel. Fortschr der kiefer orthopädie. 1977;51:309-317.
17. Alexander TL and Hitchcock HP. Cephalometric standards for American Negro children. Am J Orthod. 1978;74:298–304.
18. Hussels W, Nanda RS. Analysis of factors affecting angle ANB. Am J Orthod. 1984;85(5):411–423.
19. McNamara JA. A method of cephalometric evaluation. Am J Orthod. 1984;86:449–469.
20. Al-khafaji TJ, Sahib WW, Al-Azzawi AM. Assessment of skeletal and dental pattern of the mandible of class II division 1 malocclusion . [A comparative cephalometric study]. Kufa J Nusing Sci. 2011;1(1):17-48.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=461&id=12&aid=3986