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Horizontal Reference Planes in the Cephalometric Assessment of Upper Incisor Angulation



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Comparison of Three Horizontal Reference Planes in the Cephalometric Assessment of Upper Incisor Angulation in an Adult Nigerian Population.

Isiekwe IG, Akeredolu MO

Abstract

Background: The maxillary incisors play a very important role in the dentofacial aesthetics of an individual. Previous studies carried out in the Nigerian population to develop normative values for maxillary incisor angulation were conducted with the Frankfort plane as the only horizontal reference plane. This study sought to develop normative values for maxillary incisor angulation using three horizontal reference planes, namely: the sella-nasion, Frankfort, and palatal planes.

Methods: This was a cross-sectional study conducted using the lateral cephalometric radiographs of 74 young adults aged 18-25years, normal occlusion and balanced facial profiles. The lateral cephalometric radiographs were manually traced and the mean values for the upper incisor to the sella-nasion, Frankfort and mandibular planes were recorded. Twenty radiographs were randomly selected and retraced after one week.

Results: The mean age of the respondents was 21.12 $\pm$2.1 years, comprising 27 males (36.4%) and 47 females 63.4%. The mean values for the upper incisor angulation to the Sella-nasion, Frankfort and palatal planes recorded in this study were $116.38^0 \pm 3.84^0$, $122.29^0 \pm 5.9^0$ and 120.20 ± 5.9^0, respectively. There were no significant gender differences recorded. The upper incisor angulation to the palatal plane recorded the highest level of correlation ($r=0.88, p<.001$). after twenty radiographs were randomly retraced

Conclusion: The mean values for the upper incisor angulation to the Sella-nasion, Frankfort, and palatal planes for the young adult population studied were $116.38^0 \pm 3.84^0$, $122.29^0 \pm 5.9^0$ and 120.20 ± 5.9^0, respectively. These values will be of great value in orthodontic treatment planning for young adult Nigerians.

Key words: Incisor angulation, cephalometry, horizontal reference planes

Authors' Affiliation

Department of Child Dental Health,
Lagos University Teaching Hospital
Idi-Araba, Lagos.

Correspondence:

Dr I.G Isiekwe
Department of Child Dental Health
Faculty of Dental Science
College of Medicine, University of Lagos.
Email: iisiekwe@unilag.edu.ng

ORIGINAL ARTICLE

Introduction

Maxillary incisor angulation plays a very important role in facial aesthetics.[1] Thus, the measurement of incisor angulation is an important aspect of the cephalometric analysis in orthodontic diagnosis and treatment planning.[2] Indeed, the incisors are a key factor in dental occlusion and dentofacial aesthetics; therefore, the sagittal position and inclination of the incisors is a fundamental parameter in orthodontic diagnosis and treatment planning, particularly in dental extraction borderline cases.[3–5] An assessment of the maxillary incisor relationship is also very important in treatment planning for orthognathic surgery.[6]

Different authors have described different cephalometric analyses in the assessment of maxillary incisor angulation.[5] These authors ranging from Downs, Steiner, Tweed, Ricketts, and Riedel all present specific measures of incisor position.[6] In the assessment of incisor angulation, three horizontal reference planes are commonly used, and these are the sella-nasion plane, the Frankfort horizontal and the palatal plane.[6] Traditionally, maxillary incisor angulation is evaluated using cephalometric measurements of the long axis of the incisor (joining incisal tip to apex) and planes: sella-nasion (SN), the

Frankfort horizontal (FH) plane, the palatal plane (PP). [6,7]

With respect to the sella-nasion plane, Riedel,[8] Bishara,[9] and Drummond[10] described the U1/S-N angle, as the angle between the upper incisor and the sella-nasion plane. This angle also relates the maxillary incisors to the anterior cranial base.[6] For the Frankfort plane, Riedel,[8,11] described the U1/FH angle as the angle between the maxillary incisor and the Frankfort plane. This angle is also based on a superior reference plane, similar to the U1/S-N angle.[6] Burstone[12] described the U1/PP angle as the angle between the upper incisors and the palatal plane (the plane from the anterior nasal spine to the posterior nasal spine). This plane is an excellent indicator of orientation within the maxilla.[6]

Previous studies have been carried out to determine the incisor angulation of Nigerians.[13–15] Isiekwe[13] carried out a cephalometric study of incisor angulations in a Nigerian population. The upper and lower incisor angulations to the Frankfort and mandibular planes, recorded in that study, were 119^0-127^0 and 96^0 -104^0 respectively. These values have been used for over three decades in orthodontic diagnosis and treatment planning for adult Nigerians. Ajayi carried out a study to develop cephalometric norms for Nigerian children and similar values were recorded for the incisor angulation. In both studies,[13,14] the Frankfort plane was the only horizontal reference plane used in the assessment of maxillary incisor angulation. Thus, there are currently no established normative values for incisor angulations using the Sella-nasion or maxillary planes in Nigeria.

However, these two planes provide alternative means of assessing the maxillary incisor angulation. Indeed, it is argued that of the three planes, the palatal plane is the only plane that relates the upper incisors directly to the maxilla. Indeed, developing normative values for the upper incisor angulations to the Sella-nasion plane and maxillary plane will aid orthodontic treatment planning in adult Nigerians. Furthermore, these will also provide a basis of comparing the values obtained for Nigerians with those reported in other populations.

Thus, the aim of this study was to establish normative values for the maxillary incisor angulation to the palatal and sella-nasion planes in an adult Nigerian population. In addition, this study sought to compare the maxillary incisor angulation in an adult Nigerian population using the Frankfort, maxillary and sella-nasion planes.

Materials and Methods

The radiographs for this study had previously been used to assess the soft tissue profile of undergraduate students of the University of Lagos.[16,17] The subjects were made up of second year to final year medical, dental and pharmacy students of the College of Medicine, University of Lagos, Idi-araba, Lagos, Nigeria. The first step of the selection process involved clinical examinations and interviews to determine those who met the selection criteria: Nigerians with Nigerian grandparents; 18 to 25 years; symmetrical face and a harmonious facial profile, no previous orthodontic or prosthodontic treatment and no craniofacial deformities or history of trauma. Female subjects who were pregnant or likely to be pregnant were excluded from the study.

Seventy-four out of 100 radiographs used in the initial study were used in the current study. Ethical approval for the study had previously been obtained from the ethical committees of the College of Medicine, University of Lagos (CM/COM/08/VOL XX1) and the Lagos University Teaching Hospital, Idi-araba, Lagos. (ADM/DCST/221) In addition, informed written consent was obtained from each subject after the nature and purpose of the radiographs had been explained to them.

Lateral cephalometric radiographs had been taken of all subjects in natural head position with the eyes straight ahead, the teeth in centric occlusion and the lips in relaxed contact. The radiographs were taken using a Planmeca Publication Part Number 10014593 revision 7, digital Orthopantomograph/Cephalostat

machine (Planmeca OY, Helsinki, Finland 2009-06) at 68.0Kv, 5.0 mA for 17 secs at 18.5mGy/cm^2; at the Lagos University Teaching Hospital Dental Clinic, Idi-araba, Lagos, Nigeria. The same operator took all the radiographs.

The lateral cephalometric radiographs were manually traced on 0.003-mm matte acetate sheets with a 0.5mm lead pencil by one of the authors (MOA).

The three horizontal planes were defined as follows:

Definition of the landmarks and reference plane

- **Sella-nasion (S-N) plane:** A straight line running from the sella to the nasion.
  Sella is the mid-point of the sella-turcica
  Nasion is the most anterior point on the fronto-nasal suture.
- F**rankfort plane (FP):** A straight line running from the orbitale to the porion.
  Orbitale (O): The lowest point of the infra-orbital margin, where two orbitalia were visible, a point midway between the two was used.
  Porion (P): The uppermost point of the bony external auditory meatus.
- **Palatal plane (PP)**. A straight line passing from the anterior nasal spine to the posterior nasal spine.

The true long axis of the maxillary incisor was the line drawn from the Incision superius (Is) to the Incisor Apex superius (Isa) [18]

- **Incision superior (Is)** the incisal point of the most prominent maxillary central incisor
- **Apex superior (Isa):** the apex of the most prominent maxillary central incisor

The following three angles were drawn: (Figure 1)

1. U1/SN the angle between the true long axis of the maxillary incisor and the S-N plane.[8–10]
2. U1/FH the angle the true long axis of the maxillary incisor and the Frankfort plane[8,11]
3. U1/PP the angle between the true long axis of the maxillary incisor and the palatal plane.[12]

Statistical Analysis

The Statistical package for social sciences (SPSS) version 18, Chicago III, was used for analyzing data. Descriptive statistics of mean and standard deviation were obtained. Students' t-test was used to determine the gender differences at a significance level of $p<0.05$.

To assess errors in the cephalometric tracing, 20 randomly selected lateral cephalograms were retraced after an interval of 7 days. In addition, a paired t –test between the initial sample and twenty randomly selected radiographs showed no statistically significant difference between the first and second tracings ($p>0.05$). The correlation level between these measurements and the initial measurements were also recorded.

Results

A total of seventy-four cephalometric radiographs were assessed in this study comprising those of males 36.4% (27) and females 63.4% (47). The mean age of the study participants was 21.12$\pm$2.1 years. (Table 1)

Table 2 shows the mean values recorded for the maxillary incisor angulation with the three reference planes. It also shows an assessment for gender differences for each of the measurements. There were no significant gender differences recorded in the maxillary incisor angulation to the three planes.

Table 3 shows the correlation between the initial tracing and the second tracing and measurements carried out after one week interval. The highest level of correlation was recorded with the palatal plane, followed by the Frankfort plane and then the sella-nasion plane.

In Table 4, a comparison of the mean measurements recorded in this study is carried out with the values previously recorded for Caucasian (European-American) populations and a North-African population.

Table 1: Age and gender distribution of participants

Age group (Years)	Male (n=27)	Female (n=47)	Total
18-19	2(7.4)	14(29.8)	16(21.6)
20-21	13(48.1)	17(36.2)	30(40.5)
22-23	7(25.9)	11(23.4)	18(24.3)
24-25	5(18.5)	5(10.6)	10(13.5)
Mean±SD	21.63±1.9	20.83±2.2	21.12±2.1

Table 2: Mean values for maxillary incisor angulation with the three planes.

	Overall Mean±SD	Male (n=27) Mean±SD	Female (n=47) Mean±SD	t-value	p-value
U1/S-N	116.38±6.4	116.65±6.6	116.22±6.3	0.274	0.785
U1/FP	122.29±5.9	121.69±7.5	122.64±4.9	-0.664	0.509
U1/PP	120.20±5.9	119.04±6.7	120.86±5.3	-1.290	0.201

Table 3: Correlation between two measurements after one week interval

	Correlation coefficient	p-value
SN	.83	p< .001
FR	.86	p< .001
PP	.88	P< .001

Table 4: A comparison of the mean values recorded in this study with that recorded for European-American and other African populations.

Angle	Population	Value (sd) degrees
U1-SN	European-American	104.00
	Moroccan (North African)[19]	96.10 (3.87)
	African Brazilians	114.45 (5.38)
	Nigerian (This study)	116.38 (3.84)
U1-FP	European-American	
	Nigerian[13]	119.00-127.00
	Nigerian (This study)	122.29 (5.9)
U1-PP	European-American	109. 00
	Moroccan (North African)[19]	113.64 (6.04)
	African Brazillians[20]	115.85 (5.31)
	Nigerian (This study)	120.20 (5.9)

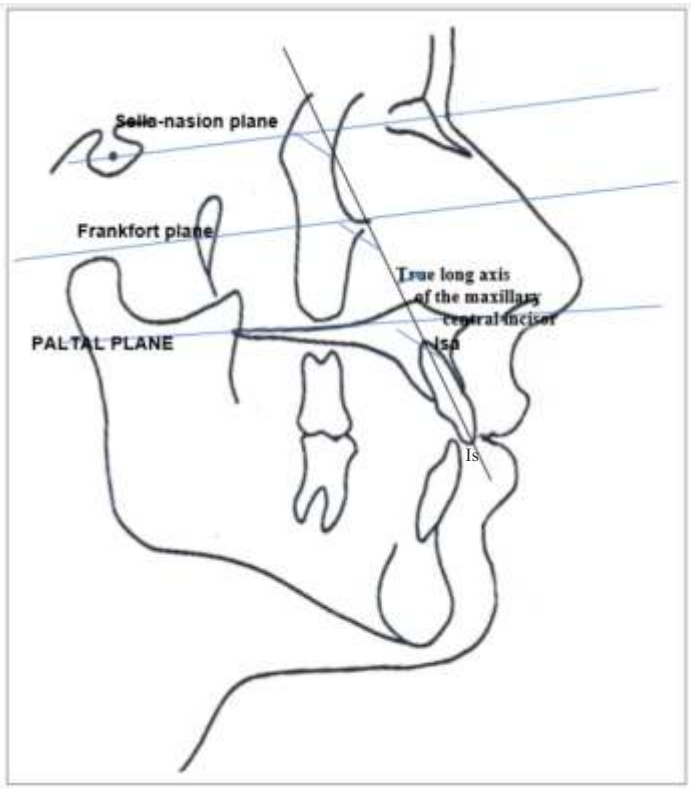


Figure 1

Diagram showing upper central incisor angulation to the sella-nasion, frankfort and palatal planes

Discussion

Cephalometric analysis is a key aspect of orthodontic treatment planning. The study carried out by Isiekwe[13]has served as a reference point till date for incisor angulations in Nigerians. These values have been very useful in diagnosis and treatment planning in adult Nigerians. However, there are currently no studies that have addressed maxillary incisor angulations, with respect to the palatal (maxillary) and the Sella-nasion plane, in the Nigerian population.

The importance of normative values using these planes as a reference is that they give the clinician a wide variety of options in the treatment planning process. Thus, a major outcome of this study is the development of normative values for the maxillary incisor relationship to the maxillary and sella-nasion planes which can be used for orthodontic treatment planning.

The sample size of this study is comparable to that in a similar study carried out among Saudi-Arabian adults

in which 70 adults[21] were studied, and larger than that used in a study among African-Brazillians, which sampled 43 people.[20] However, the sample in this study is also smaller than that used in related studies with sample sizes of 100 or more individuals.[13,16,19] Furthermore, the absence of significant gender differences observed in this study have also been reported in similar studies on maxillary incisor angulation carried out in Nigerian,[14] Morrocan,[19] and Saudi Arabian populations[19].

The intra-correlation coefficient recorded after the second measurement shows that the upper incisor to the palatal (maxillary) plane had the highest reliability of the three angles assessed. Thus, it may be argued that this angle should be consistently used in the assessment of incisor angulation, and may offer some advantages over the use of the two other planes. Furthermore, according to Ellis and MacNamara,[6] of the three horizontal reference planes, it is only the palatal plane that is located within the maxilla and not based on a superior skeletal reference plane. Indeed, because it is based on maxillary points, altering the position of the maxilla will not affect this measurement. They also argued that reference lines that are based on points far removed from the incisors may be affected by remote structures and not ideal for local descriptive applications. Thus, it may be argued that the palatal plane is an excellent indicator of incisor orientation within the maxilla.

In a study carried out to assess the impact of landmark identification on the validity of cephalometric assessment of maxillary incisor angulation using the palatal plane, it was observed that the greatest variability was in the location of the dental landmarks, as compared to the skeletal landmarks.[18] The greatest variability was recorded with locating the apex of the maxillary incisor, because of the poor contrast between the image of the root apex and the surrounding bone. [18]This increased variability associated with the location of the apex of the maxillary incisor is also likely to affect assessment of maxillary incisor inclination, with respect to both the Frankfort and Sella-nasion planes.

The upper incisor to SN plane theoretically links the maxillary incisor to the cranial base but this has also been shown to be affected by the position of the maxilla or the SNA angle, in addition to other factors apart from the earlier stated. This contrasts with the upper incisor to the Frankfort plane, which is not affected by the position of the maxilla, due to a difference in its horizontal relationship with the palatal plane.[6] However, the Frankfort plane that links the orbitale to the porion has also been reported to be subject to a high level of variability, due to the error in landmark identification associated with the porion and orbitale.[22,23] Thus, it may be argued that both the Sella-nasion and Frankfort planes have their limitations when used in the assessment of maxillary incisor angulation.

It is interesting to note that the normative values for the upper incisor to the Frankfort plane are very similar to the values reported by Isiekwe[13] and Ajayi,[14] who conducted similar studies among adults and children population, respectively. Furthermore, the relatively higher values for the maxillary incisor angulation in all three planes recorded for the Nigerian population, as compared to the Caucasian and North African (Moroccan) populations, further confirms the fact that Nigerians have a very protrusive incisal profile. Indeed, this confirms the bimaxillary proclination which had previously been reported in the Nigerian population. The close relationship between the values recorded for Nigerians and those recorded for the African-Brazillians further highlight the similarities between both populations and reinforce the bimaxillary protrusion that has been recorded in African populations.[13,16,20,24]

This study has a few limitations. One of these is that it was carried out in a young adult population and the

findings may not be representative of the entire population. In addition, the use of manual tracing may have contributed to some errors, but studies have shown that cephalometric measurements obtained from manual tracing compare favourably with those obtained from digital tracing.[23,25,26]

Conclusion

The findings of this study have contributed to the establishment of normative values for the upper incisor angulation to the Sella-Nasion, Frankfort, and palatal planes for the study's young adult population as 116.38^0 $\pm 3.84^0$, 122.29^0 $\pm 5.9^0$ and 120.20 ± 5.9^0 respectively. There were no significant gender differences in the values recorded. The upper incisor angulation to the palatal plane showed the highest level of reliability of the three angles measured and this was followed by the Frankfort and Sella-Nasion planes. The upper incisor angulation to the Frankfort plane obtained in this study is very similar to that previously reported for adult Nigerians, while the values reported for the Sella-Nasion and palatal planes are comparable to those which have been reported for black African populations.

Contribution of authors:

IG Isiekwe: Conceptualization, manuscript design and preparation

MO Akeredolu: Tracing of cephalometric radiographs, data analysis

Conflict of Interest: None declared

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Review Article

State-of-the-art review articles or systematic, critical assessments of literature are also published. Normally a review article on a subject already published in the West African Journal of Orthodontics is not accepted for a period of 3 years.

The typical length for review articles is 2000-3000 words, excluding tables, figures, and references.

Authors submitting review manuscripts should include a structured abstract of around 200 words describing the need and purpose of review, methods used for selection, extraction and synthesis of data, and main conclusions.

Clinical cases highlighting uncommon malocclusion condition, orthodontic treatment techniques are published as case reports. Single case reports are usually not accepted, unless some new or unusual aspect regarding aetiopathogenesis, diagnosis or management is brought out that adds to the existing body of knowledge. The text should not exceed 1000 words and is divided into sections, i.e., abstract, introduction, case report and discussion. The number of tables/figures should be limited to 2. Ten recent references are acceptable. A maximum of 3 or 1 author is permitted from the principle and each of the associated departments respectively. Thus, case reports from only one investigative department can have a maximum of 3 authors.

Letter to Editor(s)

Letters commenting upon a recent article in the West African Journal of Orthodontics are welcome.

Such letters should be received within 6 months of the article's publication. At the editorial board's discretion, a letter may be sent to authors! experts for comments and both letter and reply may be published together. Letters may also relate to other topics of interest to orthodontists and others, and/or useful clinical observations. Letters should not be more than 400 words. The number of authors should not exceed 2, including the authors' reply in response to a letter commenting upon an article published in this journal.

Images Section

A short text of about 150 words depicting the condition with color photographs (vide infra) is needed.

Normally only clinical photographs are accepted but accompanying skiagrams or pathological images could also be considered for publication.

Photographs should be of high quality, clearly identify the condition and preferably add to the existing knowledge.

Personal Viewpoint

Such articles are published on topical orthodontic issues including social aspects. It is expected that the authors have sufficient credible experience on the subject for giving viewpoints. These should not exceed 1500 words.

Notes, News and Events of Interest

Announcements for conferences, symposia, meetings or courses may be sent for publication in advance. The announcements should provide title, date(s) and place of the event and contact address, telephone, and email

occur for other reasons, such as personal relationships, academic competition and intellectual passion. If any of the authors have accepted reimbursement for attending symposium, a fee for speaking, fee for organizing educational reach, funds for a member of the staff of consultation fees from an organization that may in: way gain or lose financially from the result of the study, review, editorial or letter, a competing interest would be deemed to exist. If any of the authors had been employed by an organization that may in any way gain or lose financially from the publication, or if any of them hold stocks or shares in such an organization, competing interest would be deemed to exist. If competing interest exists, the author(s) must disclose them while submitting the manuscript.

Abstract and Key Words

The second page should carry an abstract in case of original article (250 words), review article (200 words), brief report (100-150 words), and case report (50 words), respectively. For original article and reviews, the abstract should be structured as detailed earlier. For brief reports, the abstract should state the purpose of the study, basic methodology, main findings (giving specific data and statistical significance) and key conclusion(s). Below the abstract, authors should provide 3-5 key words for indexing; terms from the Medical Subject Headings (MESH) list of Index Medicus should be used. The basic structure of a paper follows the well known acronym IMRAD, which stands for Introduction (what questions was asked), Methods (how was it studied), Results (what was found) and Discussion[4].

Introduction

The introduction must clearly state the question that the author(s) tried to answer in the study. It may be necessary to briefly review the relevant literature.

Only cite those references that are essential to justify the proposed study.

Materials and Methods

The methods section should describe, in a logical sequence, how the study was designed (e.g., how randomization was done), carried out (e.g., how subjects were chosen or excluded, ethical considerations, accurate details of materials used, exact drug dosage and form of treatment, etc.) and data were analyzed (e.g., an estimate of the power of the study, exact test used for statistical analysis, etc.).

For standard methods, appropriate references are sufficient, but if standard methods are modified these should be clearly brought out.

Authors should provide complete details of any new methods or apparatus used (manufacturer's name and address in parentheses).

Ethics

When reporting experiments on human subjects, authors should indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1964, as revised in 2000.

They should indicate whether the study was approved by the Institutions' Ethical Committee, and whether informed consent was obtained from the study participants. They should not use patients' names, initials, or hospital numbers, especially in illustrative material. This journal reserves the right to reject a manuscript on ethical grounds, on the basis of recommendations of its "Ethical Committee", even if the research has been cleared by the institutional ethical committee. Moreover, when reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.

Statistics

Authors should describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, they meet to quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Actual P values are provided rather than stating as just <0.05 or >0.05 etc. References for the design of the study and statistical methods should be to standard works when possible (with pages stated) rather than to papers in which the designs or methods were originally reported. Any general-use computer programs used should be specified and statistical terms, abbreviations, and most symbols be defined.

Results

This section should include only relevant, representative data and not all information collected during the study. Major findings should be presented clearly and concisely. Text, tables, and illustrations should be used sensibly while avoiding repeating in the text all the data depicted in the tables or illustrations and emphasizing or summarizing only important observations. Tables and figures should be restricted to those needed to explain the argument of the paper and to assess its support. It is necessary to cite the tables in the text and type them on separate sheets. It may also be useful to mention what the study did not find.

Discussion

Discussion ordinarily should not be more than one third of the total length of the manuscript. This section should include a summary of the major findings, their relationship to other similar studies, limitations of methods and implications of these findings in future research. Conclusions should be linked to the goals of the study. Unqualified statements and conclusions which are not completely supported by the data should be avoided. Authors should also refrain from making statements on economic benefits and costs unless their manuscript includes economic data and analyses.

Acknowledgements

In acknowledgements section, it is suitable to list all contributors who do not meet the criteria for authorship, such as a person who provided purely technical help, writing assistance, or a department head who provided only general support. Financial and material support should also be acknowledged.

Groups of persons who have contributed materially to the paper but whose contributions do not justify authorship may be listed under a heading such as "clinical investigators" or "participating investigators", and their function or contribution should be described, for example, "served as scientific advisers", "critically reviewed the study proposal", "collected data", or "provided and cared for study patients". A written consent is required from all the persons acknowledged, indicating their acceptance for the same.

Contributions to joint-authorship

In the case of multiple author-ship, authors are expected to state clearly their contributions to the paper being considered for publication in terms of study initiation, design including methodology, data collection, analysis and final write-up. The editorial board reserves the right to remove any author's name if the contribution is insignificant.

References

References should be numbered consecutively in the order in which they are first mentioned in the text.

References are identified in text, tables, and legends by Arabic numerals in parentheses. References cited only in tables or in legends to figures should be numbered in accordance with the sequence established by the first identification in the text of the particular table or figure.

The titles of journals should be abbreviated according to the style used in Index Medicus. Authors are required not to use abstracts, unpublished observations and personal communications as references. References to papers accepted but not yet published should be designated as "in press"; authors should obtain written permission to cite such papers as well as verification that they have been accepted for publication.

The references must be verified by the author against the original documents. The Uniform Requirements style (the Vancouver style) is based largely on an American National Standards Institute (ANSI) standard style adapted by the NLM for its databases.

Journal Article

List all authors when 6 or less. When 7 or more, list only first six and add et al. Ngan P, Yiu C, Hu A, Hagg U, Ei SHY, Gunel E. Cephalometric and occlusal changes following maxillary expansion and protraction. Eur J Orthod 1998; 20: 237-254.

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Tables

Each table should be typed in double-space on a separate sheet of paper. Tables not submitted as photographs must be numbered consecutively (Arabic numerals) in the order of their first citation in the text, with a brief but self explanatory title for each.
Each column should have a short or abbreviated heading.
Explanatory matters are placed in footnotes, not in the heading. In footnotes all nonstandard abbreviations that are used in each table should be explained adequately.
Statistical measures of variations should be identified such as standard deviation and standard error of the mean.
Be sure that each table is cited in the text. If data are used from another published or unpublished source, it is necessary to obtain permission and acknowledge them fully.

Figures and Instructions

Figures should be professionally drawn and photographed; freehand or typewritten lettering is unacceptable. Instead of original drawings, X-ray films, and other material, sharp, glossy, black-andwhite photographic prints of high quality are necessary, usually 127x 173 mm (5x7 in) but no larger than 203x254 mm (8x10 in) For color illustrations negatives or positive transparencies are provided, along with color prints. It is preferable to have the photograph in portrait form rather than in landscape form to fit easily into one column.
Letters, numbers and symbols in photographs should be clearly legible.
Each figure should have a label pasted on its back indicating the number of the figure, author's name, and an arrow to mark the top and left side of the figure.
It is unacceptable to write on the back of figures or scratch or mark them by using paper clips, and to bend figures or mount them on cardboard. If photographs of individual/people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph. It is advisable to cover the eyes unless specifically need to be shown. If a figure has been published, the original source should be acknowledged and written permission from the copyright holder be obtained to reproduce the material. Figures should be numbered consecutively (Arabic numerals) according to the order in which they have been first cited in the text.

Legends for Illustrations

Legends for illustrations should be typed or printed out in double-space, starting on a separate page, with Arabic numerals corresponding to the illustrations.
When symbols, arrows, numbers, or letters are used to identify parts of the illustrations, each of them must be identified and explained in the legend. The internal scale should be explained and the method of staining in photomicrographs be identified.

Units of Measurement

Measurements of length, height, weight, and volume should be reported in metric units, i.e., meter(m), gram(g), or liter(l) or their decimal multiples.
Milliliter or deciliter should be expressed as ml or dl.
Red and white blood cell counts are to be expressed as 63 x10 /mc l and x10/ mc respectively. Temperatures should be given in degrees Celsius and blood pressures in millimeters of mercury (mmHg). All hematological and clinical chemistry measurements should be reported in the conventional system or in terms of the International System of Units (SI).

Abbreviations and symbols

Only standard abbreviations are used in the text while avoiding abbreviations in the title and abstract.
The full term for which an abbreviation stands should precede its first use in the text unless it is a standard unit of measurement. Year, month, day, hour, minute and second should be abbreviated as yr, mon, d, h, mm, and s in tables respectively.

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Appendix 1:

Declaration of Originality and Transfer of Copyright

(Please download from Nigerian Association of Orthodontists (NAO) website https://www.nao-ng.org/)

This form is to be submitted with the initial copies of the manuscript to: West African Journal of Orthodontics, Department of Child Dental Health, Obafemi Awolowo University Ile-Ife, Osun State. Nigeria Manuscript No. (If known):

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