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Tooth Movement in the resolution of Crowding



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Orthodontic Management of Anterior Crowding



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Rate of Tooth Movement in the Resolution of Anterior Segment Crowding

Nkwocha FG[a], Temisanren OT[a], daCosta OO[b], Denloye OO[a]

Abstract

Background: Dental crowding presents the displacement of the contact points of teeth, impaired facial aesthetics, compromised oral health and function, and psychological impacts. Orthodontic treatment for crowding is commenced with thin, flexible arch wires such as; Nickel Titanium (NiTi) and Copper Nickel Titanium (CuNiTi) arch wires. This study aimed to present the rate of tooth movement as a means of assessing resolution of crowding and to compare this rate when using NiTi and CuNiTi archwires in the alignment phase of treatment of anterior segment crowding.

Methods: A randomized control trial among participants with a Little's Irregularity Index score (LII) of at least 4mm, randomly allocated into 2 groups -according to wire types. Archwires of 0.014; 0.016 sequence were used for alignment; the participants reviewed every six weeks till alignment. The rate was calculated by plotting a regression curve for the LII scores over the review period using the Grapher™ Golden Software.

Results: The rate of alignment was similar between the arches treated with CuNiTi arch wires (0.94mm/week) and those treated with NiTi arch wires (0.91mm/week) with no statistically significant difference. p-value =0.19.

Conclusion: Rate of tooth movement / reduction in irregularity index over time has been presented as a means of assessment of resolution of anterior segment crowding.

Keywords: anterior crowding, tooth movement, Little's Irregularity Index.

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ORIGINAL ARTICLE

Introduction

Dental crowding is a malocclusion characterized by insufficient space to accommodate all the teeth present in the dental arch thus, the teeth are too close together presenting abnormal positions such as overlapping, protrusion of teeth, displacement of teeth in different directions[1]. The prevalence of anterior segment crowding in Nigeria is put at 15.1% - 43%[2–6]. Anterior segment crowding occurs within the region of the incisors and canines, while posterior segment crowding occurs in the region of the premolars and molars. Excessively large teeth or excessively small jaw bases and a combination of the two have are some of the factors responsible for the space deficit noted in crowded jaw[7].

Anterior segment crowding is one of the most common forms of malocclusion and a frequent reason for presenting to the orthodontic clinic[8]. This is because of the oral health, esthetic and psychological problems associated with the malocclusion. The highly visible anterior dentition contributes largely to the appearance of the face with

a pleasing dental appearance impacting positively on an individual's self-esteem and quality of life[9,10], while the converse is the case with an unattractive dental appearance such as occurs in crowding. Bullying, discrimination, taunting and name calling amongst others have been reported to have been meted out on children with anterior crowding, with negative consequences on their social interactions and academic performance[11–15]

Crowding is associated with oral health problems such as poor oral hygiene, tooth decay, and periodontal problems[16,17]. This is because crowded arches present stagnation areas, which attract plaque and calculus. The tight contact areas are also difficult to clean or floss properly. These factors predispose to dental cavities, gum disease, and periodontal problems.[18] All these problems are known to improve following orthodontic treatment of the crowding and straightening of the teeth, which involves the use of braces - (brackets and wires).

The initial phase of orthodontic treatment involves the use of small-diameter flexible archwires made of different alloys such as the Nickel Titanium (NiTi) archwire and the newer, costlier Copper Nickel Titanium (CuNiTi) archwires. The duration of orthodontic treatment, which ranges from eighteen months to twenty-four months, is usually the major complaints of patients concerning this treatment. Several authors have presented techniques and products, including archwires, which are said to reduce the length of time for orthodontic treatment. Some other studies present the amount of time taken for alignment of malocclusion[19–23], however, few studies have quantified the amount of tooth movement vis-a-vis the time involved in the alignment stages of anterior segment crowding, which would be the true rate of alignment-the rate of reduction of tooth irregularity.[24]

The aim of this study was to present the rate of tooth movement/reduction in irregularity index over time, as a means of assessing the resolution of crowding in the initial alignment phase of orthodontic treatment, and to compare this rate when using NiTi and CuNiTi archwires for the treatment of anterior segment crowding.

Materials and Methods

A randomized control trial was conducted at the orthodontic clinic of the University College Hospital, Ibadan. Patients aged 10-18 years were asked to participate in the study if they had all anterior permanent teeth fully erupted (i.e., incisors and canines) in either upper or lower arch or both arches; Little's Irregularity Index (LII) of 4mm and above (moderate, severe, and very severe crowding) and no history of previous orthodontic treatment. Patients were excluded from participating in the study if any of the following was present; Mild anterior segment crowding defined by Little's Irregularity index of less than 4mm; history of the use of medications known to affect the rate of tooth movement e.g., bisphosphonates. Others include; the need for only a segmental fixed appliance; impacted teeth that may need to be exposed; craniofacial syndromes such as cleft lip and palate; morphological anomalies of teeth such as peg shaped laterals; a lingually/palatally displaced tooth that cannot be bonded on the initial bonding visit; systemic disorders such as sickle cell disease; or refusal to participate in the study.

Little's Irregularity Index (LII) is a quantitative index proposed for the assessment of lower anterior segment alignment.[25] It quantitatively measures the severity of anterior segment mal-alignment by measuring the actual linear distances between the displaced adjacent contact points. The numeric value obtained represents the labio lingual deviation of the teeth, relative to the anterior arch forms. It is used to classify the degree of irregularity into 5 categories as

follows: Perfect Alignment = 0-0.9mm; Mild Crowding = 1.0 - 3.9mm; Moderate Crowding = 4.0-6.9mm; Severe Crowding = 7.0-9.9mm, and Very Severe Crowding =10mm and above.[25] This measurement represents the distance that the anatomic contact points must be moved, in order to gain proper anterior tooth alignment. Thus, Little's Irregularity Index (LII) is a good tool for quantitatively assessing alignment and treatment progress and has been applied in several field and clinical studies.[26–30]

The sample size calculated was 32 arches in each group, thus for the 2 groups, sixty four arches were included in the study. Participants were expected to present with at least one arch that met the inclusion criteria, either maxillary arch or mandibular arch, or both. Where there was need for orthodontic treatment in both arches but only one arch met the inclusion criteria, both arches were treated with the same type of archwire for uniformity.

Randomization into the archwire groups (NiTi group and CuNiTi group) was performed by means of simple balloting. Ethical clearance for this study was sought for and obtained from the UI/UCH Ethical Committee with approval number UI/EC/14/0275. Written informed consent was obtained from the patient or guardian, a verbal explanation of the procedure was also given to the patients and a verbal assent was obtained from patients less than 18 years old.

The participants' biodata was obtained and recorded, pretreatment study models were also obtained, on which pretreatment Little's Irregularity Index- LII0 (Fig 2) was measured using a fine beaked digital caliper (CB Calipers, Brown and Sharpe, U.S.A. Accuracy +/- 0.02 per 150mm. Resolution 0.01mm) and recorded. The participants' orthodontic treatment was then commenced by placement of the brackets, using the standard acid etch direct bonding technique and Roth 0.022 prescription attachments (Redi-Pak Prescription kit, Lancer Orthodontics Inc.,2330 Cousteau Court, C.A, U.S.A). The allotted archwires- NiTi (G4™ nickel titanium archwire , G&H wire company U.S.A) or CuNiTi (Damon optimal force copper NiTi®, Ormco Corporation, Glendora, C.A, U.S.A) were then placed and ligated using elastic ligatures. The 0.014" diameter arch wire was used first, followed by 0.016" diameter archwire in both NiTi and CuNiTi groups. The participants were given post-operative instructions –verbal and written.

Each participating arch was reviewed every 6 weeks, following the bonding of brackets and placement of wires for a maximum of 24 weeks (4 visits). At each review visit, study models were obtained, and LII was measured on the models until the LII reduced to 3.0mm or less. The casts produced at pre-treatment, 6 weeks, 12 weeks, 18 weeks and 24 weeks were labeled serially as LII 0, LII 1, LII 2, LII 3 and LII 4 respectively. For arches whose LII reduced to 3.0mm or less before the end of the twenty-four-week review period, their orthodontic treatment progressed to the next stage with stiffer archwires as the arch had reached the set endpoint and thus, exit the study. Also, arches that did not achieve alignment by the end of the twenty-four-week review period had their orthodontic treatment continued as appropriate while the study also ended for such arches at that time and are exited from the study.

The rate of reduction of irregularity index (alignment) for each arch was calculated by computing the irregularity index scores from the arch over the contributed review period and plotting a regression curve for the arch. The curve was plotted with LII on the vertical axis (Y-axis) and time on the horizontal (X-axis). The Grapher™ Version 8, Golden Software LLC. was used to plot the curve and the slope of the regression curve was imputed as the

rate of alignment for each arch. The results were analyzed using the Statistical Package for Social Sciences (SPSS) Chicago Inc. V. 21.0 statistical software.

Results

A total of 60 participants were involved in the study. There were 21 (35%) males and 39 (65%) females whose ages ranged from 11 to 18 years with a mean age of 15.43 ± 2.46 years. The majority 46 (76.7%) of participants had Angle's class I malocclusion. Twenty-nine (48.3%) of them had normal overjet of 1-3mm, while 9 (15.0%) had overjet of 7-13mm. Concerning their overbite, 24(40%) participants had normal overbite and 16 (26.7%) had increased overbite.

From these participants, 64 arches were treated; thirty-seven maxillary arches (57.8%) and 27 (42.2%) mandibular arches. According to Little's Irregularity Index (LII), moderate crowding was present in 22 (34.3%) arches, severe crowding was noted in 25 (39.1%) arches and very severe crowding in 17 (26.6%) arches.

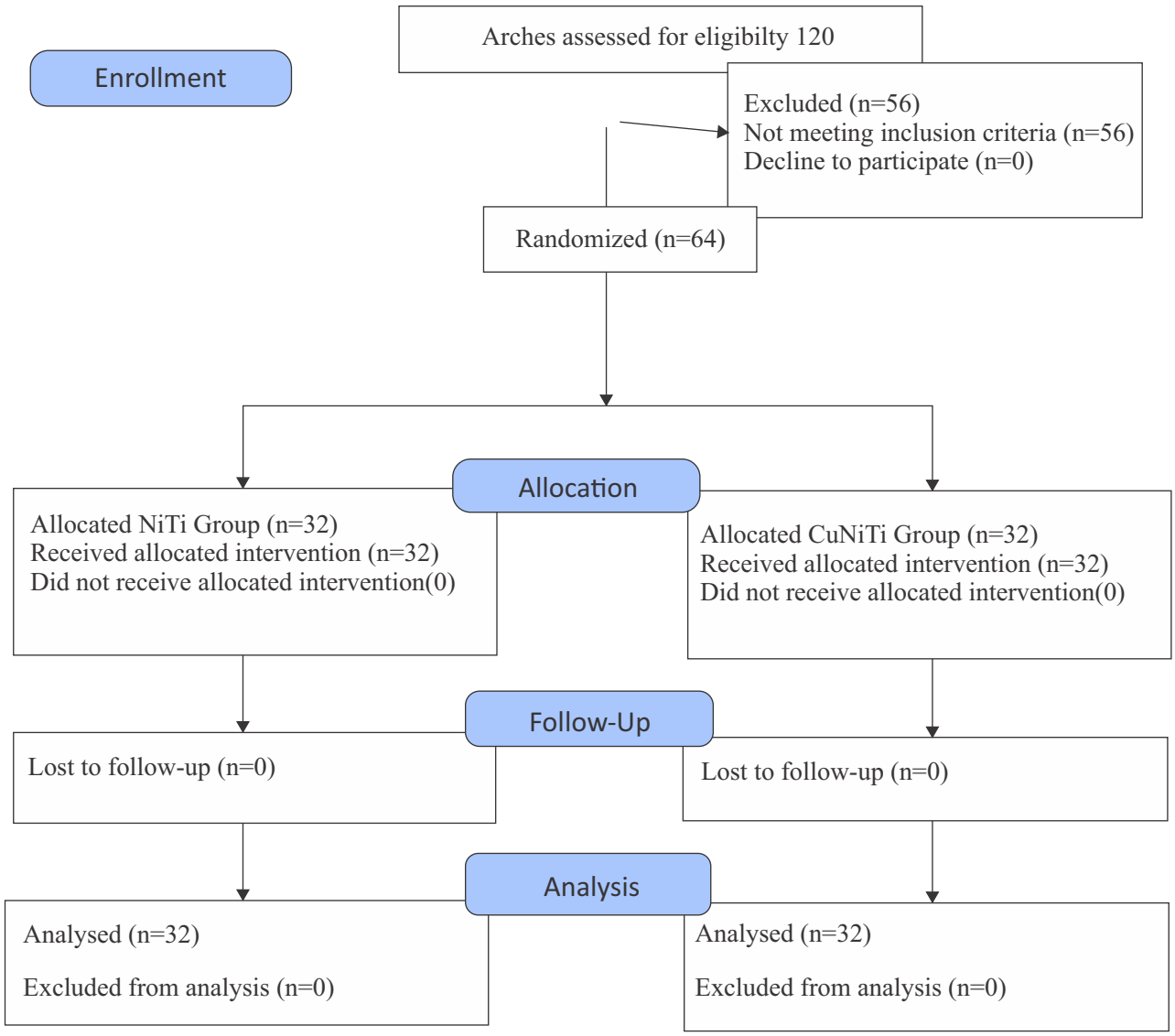
At the end of the 24-week study period, the mean irregularity index was 0.00 ±0.00mm for arches treated with CuNiTi archwires while it was 0.16 ±0.89mm for arches treated with NiTi archwires. At the points of review, the mean irregularity index was consistently lower in arches treated with CuNiTi compared to arches treated with NiTi archwires. However, when subjected to the Mann-Whitney U test, this difference was not statistically significant at the review times. This is shown in figure 3- a diagrammatic representation of the reduction of the LII of the arch wire groups.

Arches treated with NiTi archwires had a minimum rate of 0.79mm per week, a maximum rate of 1.04mm per week and a median rate of alignment of 0.90mm/week (IQR = 0.11). Likewise, the arches treated with CuNiTi arch wires had a minimum rate of 0.84mm/week, maximum rate of 1.04 mm/week and a median rate of alignment of 0.94mm/week (IQR= 011). This is depicted in figure 4.

The Kruskal-Wallis test was used to compare rate of alignment within the archwire groups, it was found that there was no statistically significant difference in the rate of alignment within the NiTi archwire group (p=0.345) nor within the CuNiTi archwire group (p=0.382). This is shown in Table 1.

A test of association between the pretreatment crowding status and the rate of alignment carried out with the Kruskal Wallis test revealed that the rate of alignment was highest with arches that presented with very severe crowding (10mm and above). This was followed by arches with severe crowding (7.0–9.9mm) and then arches that presented with moderate crowding (4.0–6.9mm). These differences, however, were not statistically significant (p = 0.37) as shown in table 2.

Figure 1. CONSORT flow chart showing patient flow during the trail



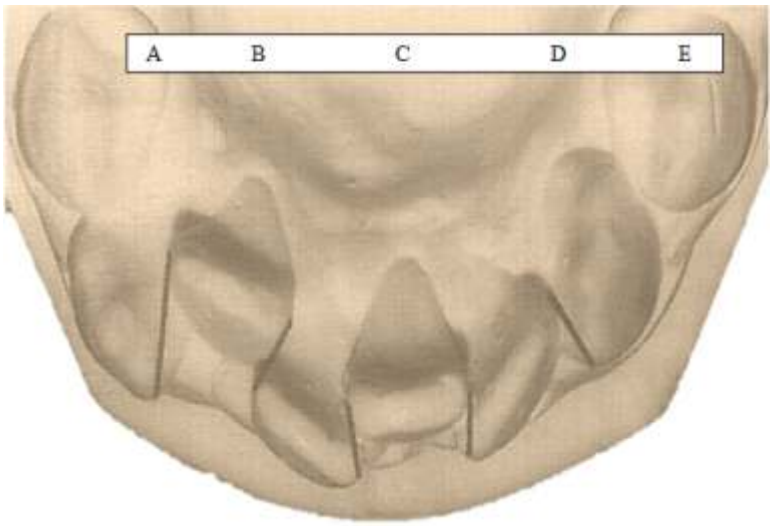


Figure 2: Schematic diagram showing contact point displacement in crowding, and the measurements in Little's Irregularity Index A+B+C+D+E = (LII)

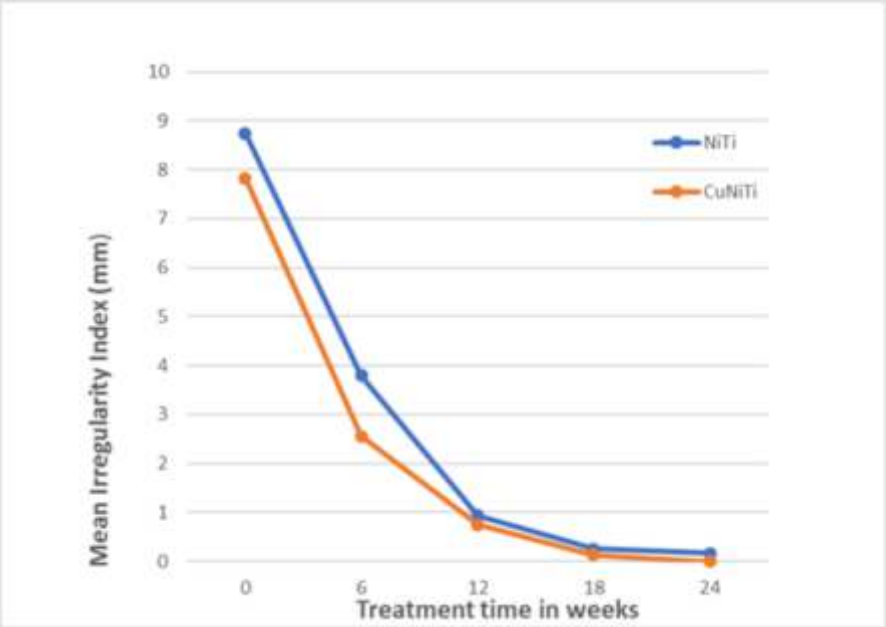


Figure 3: The reduction in irregularity index over time between the archwire types

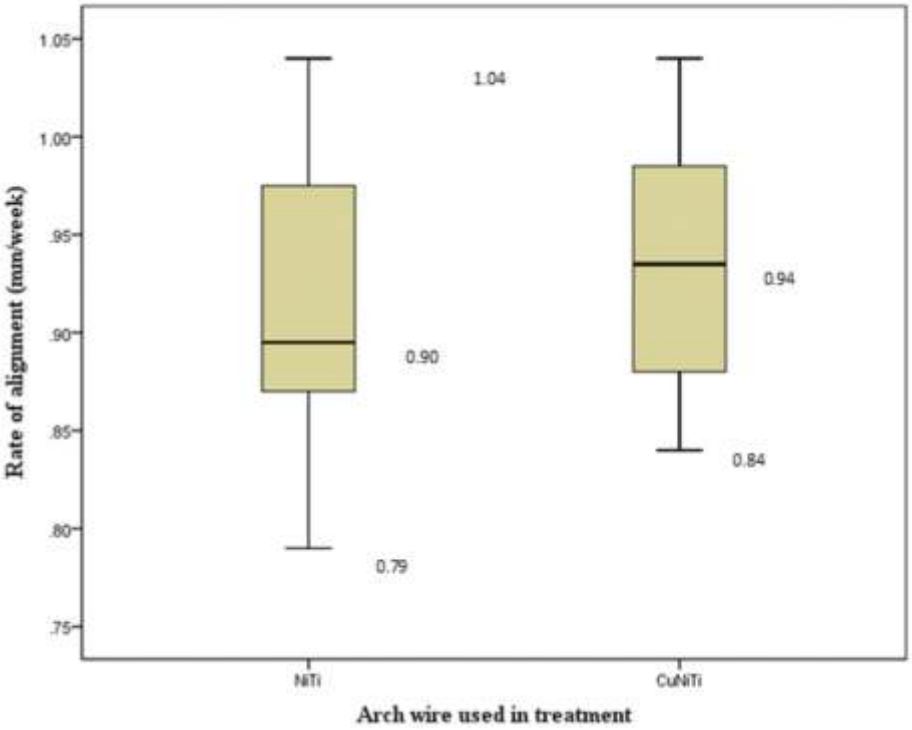


Figure 4: Box plots of the rate of alignment among the archwire types

The median value is represented by the horizontal line within the rectangular box. The lower part of the box represents the 25th quartile value while the upper part of the rectangle represents the 75th quartile value. The width of the box represents the interquartile range (IQR). The vertical lines extending from the box (whiskers) represent the total range of the values. The lowest portion of the lower whisker represents the minimum value and the highest portion of the upper whisker represents the maximum value.

Table 1: Comparison of the rate of alignment within the archwire groups

Rate of alignment	Number of Kruskal Wallis rank arches (N)	Mean Value	p Value
NiTi Arch Wires (n=32)			
Moderate crowding	10	13.15	0.345
Severe crowding	12	17.08	
Very severe crowding	10	19.15	
CuNiTi Arch Wires (n=32)			
Moderate crowding	12	16.29	0.382
Severe crowding	13	14.50	
Very severe crowding	7	20.57	

Table 2: Association between pre-treatment crowding level and rate of resolution of crowding

Pre-treatment crowding	Mean Rank	p- value
Moderate (LII=4.0-6.9mm)	29.82	0.37
Severe (LII =7.0-9.9mm)	31.22	
Very Severe (LII≥10mm)	37.85	

Discussion

Orthodontic tooth movement occurs on the application of light continuous force. During the initial alignment phase of orthodontic treatment, this force is provided by the deflection of the thin flexible archwires ligated into the slots of the brackets placed on the displaced, crowded teeth. As the archwire (which have shape memory) try to return to its original shape- the shape of a well-rounded arch, a light and continuous force is exerted on the teeth and its surrounding periodontium to bring about tooth movement and relief of the crowding.[8] At each review time, some arches had achieved alignment as their Little's irregularity index values had reduced to the set end-point. The rate of alignment - defined in the study as reduction of the irregularity (LII) over time, was similar for both archwire types. Though the values for CuNiTi archwires were slightly higher

than those for NiTi archwires, this difference was not statistically significant. The median rates could be interpreted as 3.64mm/month for the NiTi group and 3.74mm/month for the CuNiTi group. These values are comparable to the rate of alignment obtained from the study by Cobb et al.[24] where a median rate of 3.5mm/month was reported. The lack of a statistically significant difference shows that both archwires would bring about a similar amount of tooth movement on the application of force, over the same period of time, thus producing similar rates for alignment in the initial phase of orthodontic treatment. This study will be among the first from Nigeria to provide values for the rate of tooth movement produced in the initial alignment phase of orthodontic treatment when using NiTi and CuNiTi archwires.

On comparing the rate of alignment between the pre-treatment crowding levels, it was noted that the values for rate of alignment were almost equal among the 3 levels of crowding. This may indicate that teeth move at a similar rate (speed), irrespective of the level of pre-treatment crowding. However, the slightly higher value noted among arches that presented with severe and very severe crowding compared to moderate crowding, may be explained by the fact that these arches had higher values of LII compared to arches with moderate crowding, and since the rate of alignment in this study was measured as a function of change in the LII over time, then it may not be surprising that arches with higher LII reflected higher rate values. There were no available studies to compare this result with as other studies used the term "rate of alignment" interchangeably with "time of alignment". Only one study by Cobb et al.[24] actually evaluated rate of alignment as a function of reduction of LII over time. But the study by Cobb et al. did not explore the rate of alignment between the levels of pre-treatment crowding.

Conclusion

Rate of tooth movement/reduction in irregularity index over time has been presented as a means of assessment of the resolution of anterior segment crowding, in contrast to the use of only the time lapse as a measure of treatment efficiency or speed of alignment.

The more expensive CuNiTi archwires do not offer a significant advantage over the cheaper NiTi wires in producing a faster rate of tooth movement when used in initial alignment for anterior segment crowding.

Contributions

Contributions were made by all authors to data collection, analysis, and write-up of this study. The final manuscript was assessed and approved by all authors.

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Conflict of interest

None declared.

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Competing interest for a given manuscript exists when the author has ties to activities that could inappropriately influence his or her judgment, whether or not judgment is in fact affected. Financial relationships with industry for example, through employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family, are usually considered to be the most important competing interests. However, conflicts can

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Original articles should report original research relevant to basic and clinical orthodontics including randomized trials, intervention studies, studies of screening and diagnostic tests, cohort studies, cost effectiveness analyses and case control studies. While reporting randomized controlled trials (RCT), authors must attempt to be in conformity with the consolidated standards of reporting trial.

(CONSORT) statements

Each manuscript should be accompanied with a structured abstract (divided into background, methods, results and conclusions) in no more than 250 words. Four to five key words to facilitate indexing should be provided in alphabetical order along with the abstract. The text should be divided in sections on introduction, methods, results, discussion and conclusion.

Acknowledgment section may be included where necessary. Number of tables and figures should be limited to the very relevant ones and may be compressed if necessary. The typical text length for such contributions is 2500-3 500 words (excluding title page, abstract, tables, figures, acknowledgments and references).

Brief Report

Short accounts of original studies are published as brief reports. The text should be divided into sections, i.e., abstract, introduction, methods, results and discussion.

Abstract should be of 100-150 words highlighting the aims, methods and main results along with 3-4 key words.

The text should contain no more than 1500 words, 3 illustrations or tables and up to 20 references, preferably recent publications.

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.

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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.

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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.
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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.

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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/)

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