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Original Articles

Our inaugural Editor in Chief, Professor O.D Otuyemi, who founded the journal in 2012 has taken a bow after leading the Editorial board meritoriously for the past 13years. The Editorial Board is very grateful to Prof Otuyemi, for his visionary leadership of WAJO, which remains the only orthodontic specialty journal in Sub Saharan Africa and one of the few in the African continent. This edition of the journal marks my first as the new Editor in Chief, and I am very grateful for the opportunity to serve in this capacity.

In this edition, we have an interesting article by Etim et al, which looks at the use of One-Ceph, a smartphone-based mobile application in cephalometric analysis. This is becoming more relevant as artificial intelligence plays a greater role in orthodontic diagnosis and treatment planning. The findings from this pilot study present huge possibilities for the use of these applications in our environment. The study by Fadeju and Shobayo, provides a retrospective review of the complications of orthodontic treatment seen at a tertiary health facility in South-Western Nigeria. The findings of this study provide a better understanding of some of the common complications of orthodontic treatment seen in our environment. The case report by Chukwuma et al provides a detailed description of the orthodontic management of an adult patient with Class III malocclusion and a tongue habit, using the preadjusted edgewise appliance system.

Finally, this edition includes the book of abstracts for the 19th Annual Scientific conference of the Nigerian Association of Orthodontists, held in Benin-City, Edo State, from September 23-26, 2025. This provides a detailed summary of each of the 21 oral, poster and case presentations made at the conference. Overall, this is a very interesting and educative edition of the journal which makes for good scientific reading.

Ikenna Gerald Isiekwe

Editor in Chief

Prevalence and Distribution of Dental and Occlusal Anomalies in Paediatric Patients with Endocrine Disorders at The Lagos University Teaching Hospital, Nigeria.

Adeloye AY,[a] Oyenusi EE,[b] Utomi IL,[c] Ibenye VN,[a] Alayo MO[a]

Abstract

Background. Dental anomalies involve abnormalities in the number, size, and shape of teeth, as well as structural defects or disruptions in the eruption pattern . Genetic and epigenetic defects throughout the stages of tooth development have been the main aetiological factors. Occlusal anomalies, such as crowding, spacing, deep bite, open bite, and crossbite, are deviations from the normal alignment of teeth and jaws. Endocrine disorders such as hypothyroidism, growth hormone deficiency, and acromegaly are associated with various dental anomalies, including enamel defects, delayed tooth eruption, changes in tooth size, and position. The identification of dental and occlusal anomalies is important since they can cause disturbances such as malocclusion, increased susceptibility to caries, and aesthetic concerns.

Aim. To determine the prevalence and distribution of dental and occlusal anomalies amongst paediatric patients in the paediatric endocrinology clinic, LUTH.

Methods. This is a Hospital-based Cross-Sectional study conducted at the Paediatric Endocrinology clinic, LUTH. Informed consent and assent were obtained. Ethical approval was obtained. Participants were recruited via a convenient sampling technique, until 50 participants aged 7-18 years, were obtained with a confirmed diagnosis of an endocrine disorder by the physician. Clinical examination was done with dental examination sets. Data was analysed using SPSS version 26 with a p value set at <0.05.

Results. A total of fifty participants with 54.0% females and 46.0% males participated in the study with a mean age of 11.52 ± 4.9 years. The prevalence of dental and occlusal anomalies was 56.0%. The frequencies of the various occlusal and dental anomalies included Crowding 16.0%, Crossbite 16.0%, Open bite 16.0%, Missing teeth 8.0%, Enamel defects 16.0%, and Microdontia 2.0%.

Conclusion. Dental and occlusal anomalies are prevalent and commonly distributed amongst paediatric patients with endocrine disorders. Timely identification can minimise complications by enabling early treatment planning, less extensive interception, and a more favourable prognosis.

Keywords: Dental and Occlusal Anomalies, Endocrine Disorders

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ORIGINAL ARTICLE

Introduction

Endocrine disorders are rare causes of oral diseases.[1] Therefore, oral changes could sometimes raise suspicion of these conditions. Various endocrine disorders that can occur in children include Type 1 diabetes mellitus (T1DM), hyperthyroidism, hypothyroidism, and growth hormone deficiency[1], among others. A Nigerian study conducted in a teaching hospital in Lagos, on the pattern and burden of paediatric endocrine disorders, noted that Diabetes mellitus, pubertal, and thyroid disorders constituted the commonest paediatric endocrine disorders encountered.[2] Dental anomalies involve abnormalities in the number, size, and shape of teeth, structural defects, or eruption pattern disruptions. Genetic and epigenetic defects throughout the stages of tooth development have been the main aetiological factors.[3] Environmental factors occurring during the pre and post-natal developmental phases could also play a role in triggering dental anomalies.[3] Occlusal anomalies such as crowding, spacing, deep bite, open bites, and crossbites are deviations from normal alignment of teeth and jaws.[4] Endocrine disorders

such as hypothyroidism, growth hormone deficiency and acromegaly, are associated with various dental anomalies including enamel defects, delayed tooth eruption, changes in tooth size and position.[5] The identification of dental and occlusal anomalies are important since they can cause disturbances such as malocclusion, increased susceptibility to caries and aesthetic concerns.[5] Oral features associated with hypopituitarism include delayed eruption rate, retained deciduous teeth, small clinical crowns, small roots, small arches, retarded growth of maxilla and mandible and crowding of teeth resulting in malocclusion. The permanent teeth show a delayed pattern of eruption.[6] Dentists should be aware of the risks and difficulties that may arise in the management of patients with endocrine disorders.[7]

Gigantism: Excess growth hormone in children is characterised by the general symmetrical overgrowth of the parts of the body. Oral features include prognathic mandible, malocclusion, interdental spacing, and hypercementosis of the roots.[8]

Hyperparathyroidism: Malocclusion due to the drifting of teeth resulting in spacing of teeth could be one of the first signs of the disease with panoramic radiographs revealing rarefaction of the jaws.[1]

Hypothyroidism: Malocclusion and delayed eruption of teeth can also occur with thickening of the lips and macroglossia.[9] The long-term effects of severe hypothyroidism on craniofacial growth and dental development have also included impaction of the mandibular second molars.[9,10]

There is a paucity of knowledge of the prevalence and distribution of dental and occlusal anomalies amongst paediatric patients with endocrine disorders. It is important for every dentist to be aware of the oral manifestations of endocrine disorders to avoid the resulting complications. This study aims to determine the prevalence and distribution of dental and occlusal anomalies among patients attending the paediatric endocrinology clinic at the Lagos University Teaching Hospital (LUTH).

Dental and occlusal anomalies form an important oral manifestation of endocrine disorders, which help dental surgeons and orthodontists to diagnose and treat the patients appropriately.

Timely identification can minimise complications by enabling early treatment planning, less extensive interception, and a more favourable prognosis.

The objectives of this study were to determine the prevalence and distribution of dental anomalies of endocrine disorders among paediatric patients aged 7years and above in LUTH, and to determine the prevalence and distribution of occlusal anomalies of endocrine disorders among paediatric patients aged 7years and above in LUTH. Finally, to determine the frequency of distribution of the different types of endocrine disorders with dental and occlusal anomalies among children aged 7 years and above, attending the LUTH paediatric endocrinology clinic.

Materials and Methods

The study design was a descriptive cross-sectional study of paediatric patients aged 7-18 years. The research was conducted at the Lagos University Teaching Hospital, Idi -Araba, Lagos State South-West, Nigeria. The study population comprised patients aged 7-18 years old attending the Paediatric Endocrinology Clinic in LUTH. A participant was recruited into the study if they were paediatric patients aged 7-18years with endocrine conditions who were willing to participate in the study and whose parents had given written informed consent. A participant was excluded if they were paediatric patients with other co-morbidities such as cancer, mental health disorders, chronic heart disease, and other health conditions with oral manifestations.

A convenient sampling technique was used to recruit the participants. The paediatric endocrinology unit runs two clinics on Thursdays for children with diabetes and on Fridays for other endocrine conditions. Participants were recruited from these two clinics.

Recruitment was done consecutively after obtaining written informed consent from parents/caregivers and assent from the children aged 7 years and above. Both previously and newly diagnosed cases were

recruited consecutively as they presented to the outpatient clinic once consent and assent were obtained. The study was conducted over three months.

Sample Size Determination

This was determined by applying the formulae for sample size determination by Leslie Kish [1965]

$n=z^2pq/d^2$

Based on the assumption that the researcher desires to have a 95% confidence interval. [z value of 1.96, where. n=the estimate of the population size, z=critical value at the level of the chosen confidence level[z=1.96], d^2=the precision level set at 0.05 ,p= estimated proportion of an attribute that is present in the population=%, 95% confidence level,10% margin of error, population proportion, p= 3% (0.03) based on previous study on proportion of children with posterior cross bite suffering from thyroid disorders.

$1.96^2 \times 0.03 \times (1-0.03) / 0.05^2$

$= (3.84 \times 0.03 \times 0.97) / 0.0025$

$= 0.111744/0.0025$

= 44.7 (approx. 45), Addition of 10% for non-response: 45 + 4.5 = 49.5 (approx. 50)

Data Collection and Analysis

Data collection tools such as questionnaires, gloves, and examination sets were used to collect the required data. Relevant clinical and demographic data were obtained by interviewing each caregiver via questionnaires and physically examining each child. Extraoral and intraoral examinations were carried out to assess the oral cavity for any dental anomaly and occlusal anomaly associated with different types of endocrine conditions. Questions on awareness of oral conditions specific for their endocrine conditions were assessed through the research proforma. The available clinical notes and investigations of each participating child were also reviewed and information such as age at diagnosis, sex, presenting clinical features, drug history and other relevant clinical information were retrieved and filled into a research proforma.

The data contained in the questionnaires were classified and transformed into tables. Descriptive statistics was used.

Data processing and analysis were carried out using Statistical Package for Social Sciences (SPSS version 21). The statistical significance was determined by the Chi-square test and the confidence interval was set as $p<0.05$. Chi-square analysis was used to compare the differences between proportions, while the student's t-test was used to compare differences between means, as applicable. A probability {p value} of <0.05 was taken as statistically significant.

Ethical approval (ADM/DSCST/HREC/APP/7375) for the research was obtained from the Health Research Ethics Committee of the Lagos University Teaching Hospital, Idi-Araba, Lagos before commencement of the study. Written informed consent from parents and assent from children aged 7yrs and above were obtained after explaining in detail and in simple language, both verbally and in a leaflet, what the study was all about. Any information that was not clear was further explained.

Assent was obtained from each child who was old enough to give it (7 years and above). The purpose of the research, the procedures involved, and how the information obtained would be handled were explained to both the parents/caregiver and the child (according to the child's age of comprehension).

Participants were made to understand that participation in the research was entirely voluntary and that refusal to participate would not affect the treatment of the child. They were also made to understand that at any point of the research, if they no longer felt like continuing with the study, they were free to withdraw without any retribution, and the usual treatment of the child would not be affected by the decision. The privacy of the subjects and confidentiality of the information obtained from them were strictly ensured. The data collected was safeguarded and coded. The tests were at no financial cost to the subjects. The principal investigator bore the cost of the investigations. Information on how and where to reach the principal investigator was

provided to the parents and the children.

The benefit of the research to the participating subjects is that if oral manifestations of complications were detected, steps would be taken to institute timely intervention and treatment to prevent further complications by the dental team. Additionally, necessary information at the point of transition to adult care beyond 18 years was obtained so that monitoring of the oral cavity is incorporated with the other essential aspects of the care of the patient. The results of the dental examination were communicated to the parents/caregivers, and the study participants were treated with utmost respect, no bodily harm/injury resulted from the study. All the data gathered were treated with utmost confidentiality. The privacy of the subjects was respected during the research. Informed consent was sought from patients and parents/caregivers.

Results

A total of 50 participants were recruited with a mean age of 11.52 ± 4.9 years, as shown in **Table 1**. Gender distribution showed that a larger proportion of participants were female (27, 54.0%) compared to males (23, 46.0%). For the educational level of the informants, the majority had secondary (26, 52.0%) or tertiary (23, 46.0%) education, with only a small minority (1, 2.0%) having primary education (Table 1).

Table 1: Socio-demographic characteristics of participants

Variable	Frequency (n=50)	Percentage
Age (Mean±SD)	11.52±4.9	
Sex of patients		
Male	23	46.0
Female	27	54.0
Educational level of informant		
Primary	1	2.0
Secondary	26	52.0
Tertiary	2	46.0

Table 2 details the endocrine abnormalities among the 50 participants. Type 1 Diabetes Mellitus was the most frequent condition, affecting 27 individuals (54.0%). Hypothyroidism was the second most common, present in 7 participants (14.0%), followed by congenital adrenal hyperplasia, identified in 6 participants (12.0%). Type 2 Diabetes Mellitus was found in 3 participants (6.0%). The remaining abnormalities were less common, each affecting 1 participant (2.0% for each condition): adrenal insufficiency, Turner syndrome, diabetes insipidus, Cushing syndrome, metabolic syndromes, retarded penile growth, hyperthyroidism, and juvenile idiopathic short stature.

Table 2: Endocrine abnormality among participants

Variable	Frequency (n=50)	Percentage
Type of endocrine abnormality		
Type 1 DM	27	54.0
Type 2 DM	3	6.0
Hypothyroidism	7	14.0
Congenital adrenal hyperplasia	6	12.0
Adrenal insufficiency	1	2.0
Turner syndrome	1	2.0
Diabetes insipidus	1	2.0
Cushing syndrome	1	2.0
Metabolic syndrome	1	2.0
Retarded penile growth	1	2.0
Hyperthyroidism	1	2.0
Juvenile idiopathic short stature	1	2.0

Table 3 details the dental and occlusal anomalies (hard tissue) assessment findings among the 50 participants. Several occlusal and dental anomalies were equally prevalent, each affecting 8 (16.0%) individuals: crowding, crossbite, open bite, enamel defects, and missing teeth were observed in 4 (8.0%) participants. Microdontia was found in 1 (2.0%) participant. Notably, no cases of macrodontia or malformed teeth were reported among the participants (0, 0.0% for both).

Table 3: Dental and occlusal anomalies(Hard tissue) assessment

Variable	Frequency (n=50)	Percentage (%)
Crowding	8	16.0
Crossbite	8	16.0
Open bite	8	16.0
Missing teeth	4	8.0
Enamel defects	8	16.0
Microdontia	1	2.0
Macrodontia	0	0.0
Malformed teeth	0	0.0

Occlusal and dental manifestations were also commonly observed in 28 participants (56%), while 22 participants (44%) did not present with such issues.

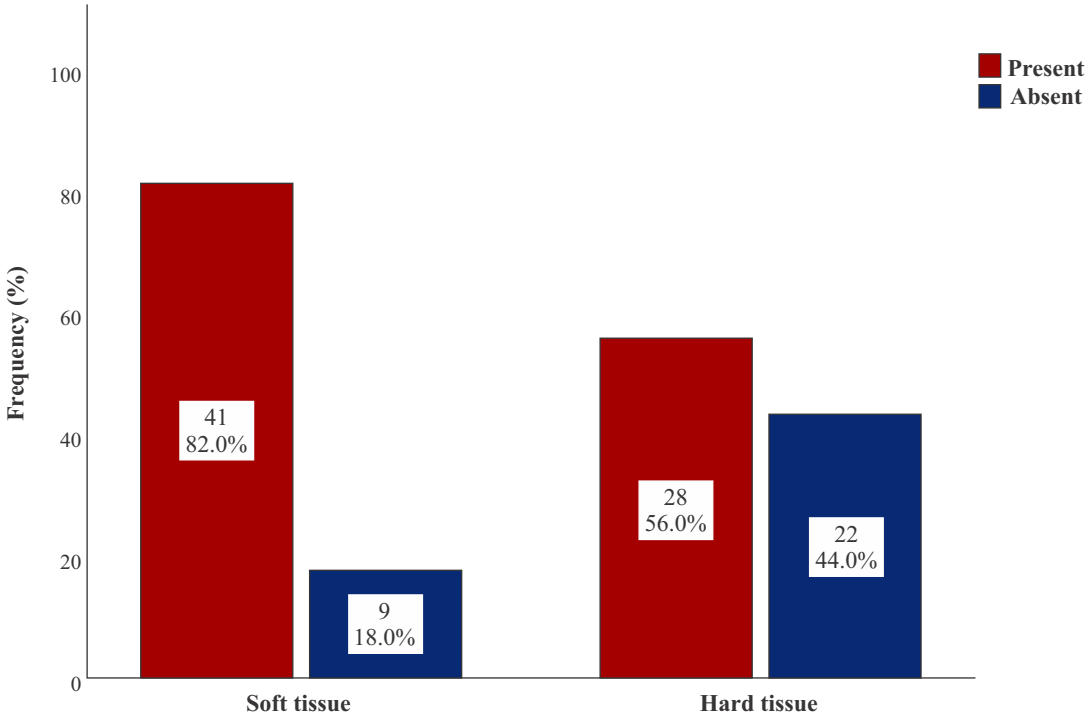

Figure 1: Prevalence and distribution of occlusal and dental anomalies(Hard tissue) of endocrine disorders among paediatric patients in LUTH

Discussion

Endocrine disorders are associated with various dental and occlusal anomalies which include delayed eruption of teeth, enamel hypoplasia, variation in tooth size, number, and shape which may be noted by dentists before the endocrinologist's diagnosis [1,2].

Tooth development could be delayed in conditions like hypothyroidism, macroglossia, and mandibular or maxillary prognathism causing malocclusion, which could be seen in acromegaly. Enamel hypoplasia due to chronic hypocalcaemia can be noted in Hypothyroidism.[9] Dentists can prompt interdisciplinary collaboration with endocrinologists to manage these systemic conditions through early identification of the anomalies.[7]

The clinical manifestations of dental anomalies include different degrees of severity, ranging from mild to severe cases, represented by disturbances in the number, size, shape, position, and structure of the teeth.[11] Its prevalence can range from 5.46% to 74.7%,[11] because of different ethnicities and diagnostic criteria.[12] Different frequencies are reported in the literature for dental anomalies.[13] Some authors attribute these conflicting results to differences in ethnicity, diagnostic criteria,[13] and environmental and nutritional factors.[12] The prevalence of dental anomalies was greater in males than in females in a study done by Clarissa et al.[14] This study noted a higher prevalence of females with endocrine disorders compared to males.

A Nigerian study conducted in a teaching hospital in Lagos, on the pattern and burden of paediatric endocrine disorders noted that Diabetes mellitus, pubertal, and thyroid disorders constituted the commonest paediatric endocrine disorders encountered.[2]

In this study, Type I diabetes mellitus emerged as the predominant endocrine disorder, affecting 61.9% of participants, with hypothyroidism constituting the second most common condition. This distribution

mirrors findings from Benin City, Nigeria, where diabetes mellitus similarly dominated the paediatric endocrine disease spectrum.[15]

Enamel defects emerged as the predominant finding, documented in 10 participants (23.8%). These structural enamel irregularities, including hypoplastic formations and opacity variations, have been consistently identified as primary dental anomalies in hypoparathyroid patients according to systematic review findings.[15 16 17]Similarly, research conducted in India examining oral health patterns among children with thyroid dysfunction reported enamel defects as the second most common dental abnormality observed.[17]The prevalence of enamel defects in our cohort suggests a significant relationship between endocrine dysfunction and tooth development processes. This finding indicates that hormonal imbalances during critical periods of amelogenesis (enamel formation) may disrupt normal mineralisation patterns, resulting in structural defects that persist throughout the patient's lifetime.[17]The consistency of these findings across different endocrine conditions (hypoparathyroidism and thyroid disorders) implies a broader mechanism whereby endocrine dysregulation interferes with calcium metabolism and protein synthesis essential for proper enamel formation.

Additional prevalent findings encompassed anterior open bite in 16.7%, and posterior crossbite in 14.3% of cases. The occurrence of open bite demonstrates concordance with Indian research examining children with thyroid dysfunction, which documented anterior open bite in 23% of subjects,[18] However, a notable discrepancy exists regarding posterior crossbite prevalence, as the referenced Indian study reported this malocclusion in only 3% of their paediatric cohort,[16]substantially lower than our observed frequency. The substantial occurrence of malocclusions, particularly open bite patterns, suggests that endocrine disorders may significantly influence craniofacial growth and development trajectories.[1718]

The consistency in open bite prevalence across different populations indicates a possible causal relationship between endocrine dysfunction and vertical growth disturbances affecting jaw development and tooth eruption patterns.[15] Conversely, the marked difference in posterior crossbite frequency between studies may reflect population-specific genetic factors, varying severity of endocrine conditions, treatment protocols, or methodological differences in malocclusion assessment.

Conclusion

This study demonstrates that children with endocrine disorders attending the Lagos University Teaching Hospital paediatric endocrinology clinic exhibit occlusal and dental anomalies. Dental and occlusal anomalies are 56.0% prevalent and commonly distributed amongst paediatric patients with endocrine disorders in LUTH, with type 1 DM being the most predominant endocrine disorder in this study. The findings from this study highlights the need for coordinated interprofessional management involving endocrinologists, paediatric dentists, and orthodontists.

Recommendations

It is therefore recommended that timely identification of occlusal and dental anomalies is necessary to minimise complications by enabling early treatment planning, less extensive interception and more favourable prognosis.

Future research should focus on longitudinal studies to better understand the relationship between endocrine control and the development of dental and occlusal anomalies in Nigerian children.

Authors' Contribution: AAY and EEO conceptualized the study, AAY was involved in the proposal which was reviewd by ILU and EEO, IBF and AAY structured the questionnaire. AAY, IBF, IVN and OMA were involved in data collection. AAY was involved in data analysis and discussion.ILU and EEO reviewed the whole manuscript.

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Conflict of Interest - None to declare

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Alignment Efficiency of Superelastic and Heat-Activated Nickel–Titanium Archwires During Initial Orthodontic Alignment: A Randomized Clinical Trial

Ben-Okoye AL[a], Utomi IL[b], Isiekwe IG[b]

Abstract

Background: Levelling and alignment constitute the initial and one of the most critical phases of fixed orthodontic treatment. Nickel–titanium (NiTi) archwires are routinely used during this stage because of their favourable biomechanical properties; however, the comparative clinical alignment efficiency of superelastic and heat-activated NiTi archwires remains uncertain.

Aim: To compare the clinical alignment efficiency of superelastic nickel–titanium (SENT) and heat-activated nickel–titanium (HANT) archwires during the initial alignment phase of fixed orthodontic treatment in patients with mild-to-moderate anterior crowding.

Methods: In this randomized clinical trial, orthodontic patients aged 11–25 years presenting with 3.0–6.9 mm of anterior segment crowding and requiring non-extraction fixed appliance therapy were randomly allocated (1:1) to either the HANT or SENT group. Both groups followed an identical archwire sequence (0.014-inch, 0.016-inch, and 0.018-inch NiTi), with each archwire maintained for four weeks. Anterior segment crowding was measured at baseline and at 4-week intervals over a 12-week period. Changes in alignment were analysed using repeated-measures analysis of variance (ANOVA), with statistical significance set at $P < 0.05$.

Results: Thirty-eight dental arches were randomized and included in the final analysis (19 arches per group). The mean participant age was 20.05 ± 5.14 years, and baseline demographic and clinical characteristics were comparable between groups ($P > 0.05$). Over the 12-week observation period, the mean reduction in anterior segment crowding was 3.90 mm in the HANT group and 3.46 mm in the SENT group. The between-group difference was not statistically significant ($P = 0.809$).

Conclusions: Heat-activated and Superelastic nickel–titanium archwires demonstrated comparable clinical efficiency for the alignment of mild-to-moderate anterior crowding during the initial phase of fixed orthodontic treatment.

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ORIGINAL ARTICLE

Introduction

Dental crowding is one of the most prevalent malocclusions encountered in orthodontic practice and arises from a discrepancy between tooth size and arch dimensions, resulting in irregular tooth alignment.[1] It is commonly classified as mild (0–3 mm), moderate (4–7 mm), or severe (>7 mm) according to the degree of space discrepancy.[2,3] Global prevalence estimates range from 16% to 59%, with anterior segment crowding representing one of the most frequent clinical presentations.[4] Nigerian studies similarly report a high prevalence of anterior crowding, particularly in the mandibular anterior region, highlighting its importance within the local orthodontic population.[1,5]

Levelling and alignment constitute the initial phase of fixed appliance therapy and establish the foundation for subsequent stages of orthodontic treatment.[6 7,8] Efficient resolution of crowding during this stage facilitates progression through treatment while

minimizing patient discomfort and reducing the risk of undesirable biological effects.[9,10] Consequently, initial aligning archwires are designed to deliver light, continuous forces that promote controlled tooth movement while preserving periodontal health.[7,8]

Nickel–titanium (NiTi) archwires have become the materials of choice during the alignment phase because of their low stiffness, high elasticity, and ability to produce relatively constant orthodontic forces over a wide range of activation.[11,12] Contemporary NiTi archwires are broadly categorized as conventional, superelastic, and heat-activated alloys.[11,13] Superelastic nickel–titanium (SENT) archwires undergo stress-induced phase transformation and generate relatively constant forces with high spring-back characteristics.[11] In contrast, heat-activated nickel–titanium (HANT) archwires exhibit thermally induced shape memory, becoming more flexible at lower temperatures and expressing orthodontic forces as they approach intraoral temperature.[11,14,15] These characteristics may facilitate archwire engagement in crowded dentitions while delivering lower force levels than superelastic wires.[16,17]

Although both archwire types are widely used during initial alignment, their comparative clinical performance remains uncertain.[18–20] Some randomized clinical trials have reported more rapid alignment with superelastic NiTi archwires, whereas others have found no significant differences between superelastic and heat-activated NiTi in the rate of crowding resolution.[21,22] Systematic reviews, including Cochrane reviews, have concluded that the available evidence is insufficient to establish the superiority of either archwire because of considerable heterogeneity in study design, including differences in bracket systems, ligation methods, extraction protocols, and outcome measures.[8,14,23–27]

The biological effects of these archwires have also attracted considerable interest.[28,29] Because superelastic NiTi archwires deliver relatively continuous forces and exhibit greater spring-back, they have been hypothesized to increase the risk of orthodontically induced inflammatory root resorption compared with heat-activated wires, which generate lighter and more intermittent force delivery.[19,30] However, current clinical evidence remains inconclusive, and few randomized trials have evaluated root resorption alongside alignment efficiency.[19,30]

Accordingly, this randomized clinical trial compared the alignment efficiency of superelastic and heat-activated nickel–titanium archwires during the first 12 weeks of fixed appliance therapy in patients with mild-to-moderate anterior segment crowding. To minimize sources of bias identified in previous investigations, treatment variables—including bracket prescription, slot dimension, ligation method, archwire sequence, and non-extraction treatment protocol—were standardized across both study groups.[31–34].

Methods

Study design

This single-centre, parallel-group randomized clinical trial employed a non-stratified randomization design with an equal allocation ratio (1:1). The trial was conducted at the Orthodontic Unit, Department of Child Dental Health, Lagos University Teaching Hospital, Lagos, Nigeria. Ethical approval was obtained from the Lagos University Teaching Hospital Health Research Ethics Committee (ADM/DCST/HREC/APP/5061), and the trial was registered with the Pan African Clinical Trials Registry (PACTR202307594421954).

Participants

Patients aged 11–25 years who required comprehensive fixed appliance therapy were screened for eligibility. Participants were included if they presented with mild-to-moderate anterior segment crowding (Little's Irregularity Index, 3.0–6.9 mm), had fully erupted permanent anterior teeth in the study arch, required non-extraction treatment, and provided written informed consent or assent.

Patients were excluded if they had crowding <3.0

mm or >6.9 mm, anterior spacing, craniofacial anomalies, impacted teeth requiring surgical exposure, lingually or palatally displaced teeth that precluded bracket placement at bonding, previous orthodontic treatment, planned extraction therapy, or were taking medications known to influence orthodontic tooth movement, including bisphosphonates and non-steroidal anti-inflammatory drugs.

Sample size

Sample size was calculated for a two-arm parallel randomized clinical trial with normally distributed continuous outcomes, assuming 90% statistical power and a two-sided significance level of 5%. After allowing for possible attrition, a minimum sample of 19 arches per group (38 arches in total) was required. The calculated sample size was consistent with those reported in comparable randomized clinical trials.[20,28,31,35,36] Participants contributed one or both arches, provided they satisfied the eligibility criteria.

Randomization

Participants were recruited consecutively after meeting the eligibility criteria and providing written informed consent. Eligible participants were randomly assigned to either the superelastic nickel–titanium (SENT) or heat-activated nickel–titanium (HANT) group using simple randomization with a 1:1 allocation ratio. The allocation sequence consisted of 38 sequentially prepared, opaque, sequentially numbered and sealed envelopes containing equal numbers of treatment assignments (paper slips written SENT or HANT). A study-independent individual who was not involved in treatment delivery or outcome assessment prepared and administered the envelopes. Following enrolment, each participant selected one sealed envelope, and the treatment assignment contained therein determined the archwire group. The allocation remained concealed until the envelope was opened immediately before initiation of treatment.

Orthodontic intervention

Following prophylaxis with oil-free pumice, enamel surfaces were etched with 37% phosphoric acid for 30 seconds before bonding pre-adjusted edgewise Roth prescription 0.022-inch brackets (Equilibrium® 2; Dentaurum, Ispringen, Germany). Brackets were bonded using Ortho Solo™ primer and Enlight™ orthodontic adhesive (Ormco Corporation, Glendora, CA, USA). Bracket positioning was standardized using a bracket-positioning gauge.

Participants assigned to the SENT group received Rematitan Lite nickel–titanium archwires (Dentaurum, Germany), while those in the HANT group received Tensic thermo-active nickel–titanium archwires (Dentaurum, Germany). Both groups followed an identical archwire sequence of 0.014-inch, 0.016-inch, and 0.018-inch archwires, with each archwire maintained for four weeks.

Participants were reviewed at 4-week intervals over a 12-week observation period. At each visit, the subsequent archwire in the sequence was inserted, and alginate impressions were obtained to produce dental stone study casts. Casts obtained at baseline, 4, 8, and 12 weeks were designated T0, T1, T2, and T3, respectively.

Outcome measures

Alignment efficiency, assessed as the reduction in anterior segment crowding measured on serial study casts using Little's Irregularity Index. Measurements were obtained at baseline and after 4, 8, and 12 weeks of treatment.

Statistical analysis

Data were analysed using IBM SPSS Statistics (Version 26.0; IBM Corp., Armonk, NY, USA). Normality was assessed using the Shapiro–Wilk test. Continuous variables were summarized as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages.

Baseline differences between treatment groups were evaluated using the independent-samples *t*-test for

continuous variables and Fisher's exact test for categorical variables. Changes in anterior segment crowding and root length between groups were compared using independent-samples *t*-tests. Repeated-measures analysis of variance (ANOVA) was used to evaluate changes in anterior segment crowding over time. Statistical significance was set at $P < 0.05$.

Measurement reliability

Intra-examiner reproducibility was assessed by repeating measurements on five study casts and five CBCT images after a one-week interval. Measurement error was evaluated using Dahlberg's formula, which yielded a value of 0.79.

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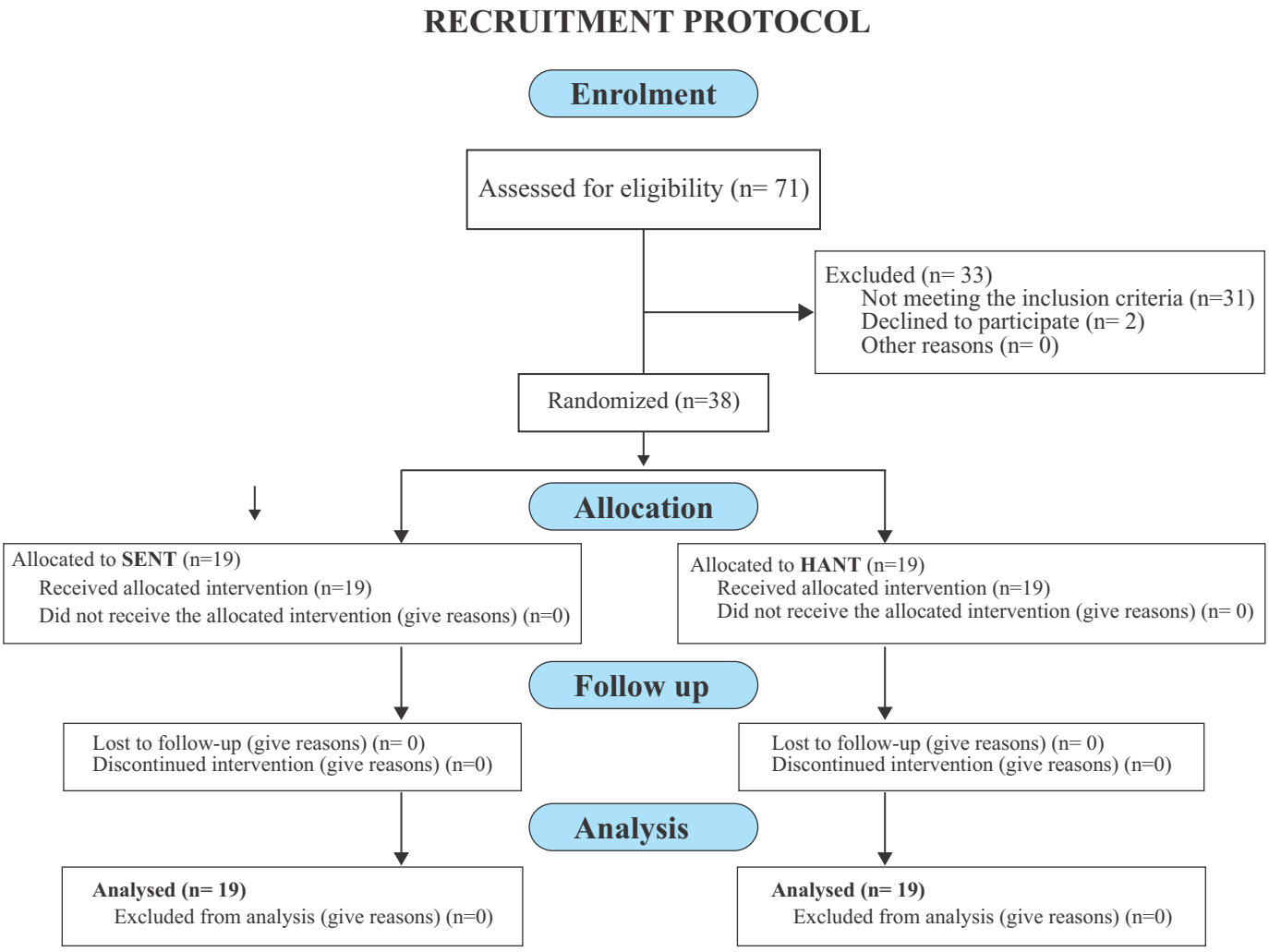

Figure 1: Recruitment Protocol

Results

A total of 38 arches were enrolled and included in the analysis. The study population comprised 14 females (66.7%) and 7 males (33.3%), with a mean age of 20.05 ± 5.14 years (range, 11–25 years). The mean age was 19.0 ± 5.0 years in the SENT group and 21.2 ± 5.3 years in the HANT group, with no statistically significant difference between groups ($P = 0.340$).

Table 1: Socio-demographic characteristics of participants from which thirty-eight arches were recruited.

	SENT N (%)	HANT N (%)	Total	Fisher exact test	*p*-value
Age (Mean ± SD)	19.00 ± 5.0	21.20 ± 5.3			
Gender					
Male	3 (27.3)	4 (40.0)	7 (33.3)	0.978*	0.340
Female	8 (72.7)	6 (60.0)	14 (66.7)	0.382	0.537

Distribution of arches and severity of crowding between the archwire groups.

A total of 38 dental arches were randomized, with 19 arches allocated to each treatment group. Both the SENT and HANT groups comprised nine maxillary (47.4%) and ten mandibular (52.6%) arches (Figure 1).

At baseline, the majority of arches exhibited moderate anterior segment crowding according to Little's Irregularity Index. In the SENT group, 18 arches (94.7%) presented with moderate crowding and one arch (5.3%) with mild crowding. In the HANT group, 12 arches (63.2%) had moderate crowding, while seven arches (36.8%) exhibited mild crowding. The baseline distribution of crowding severity was comparable between the two treatment groups, with no statistically significant difference (*P* = 0.616).

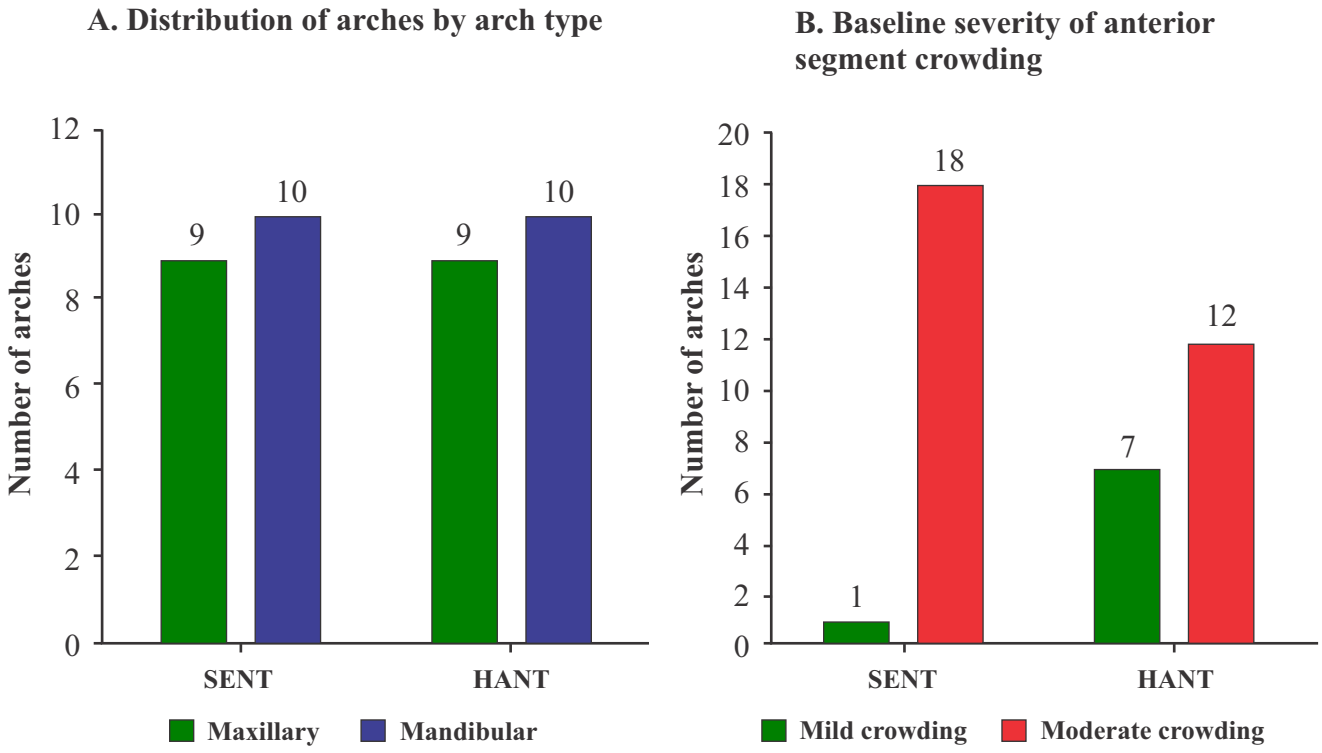

Figure 2: Distribution of maxillary and mandibular arches (Panel A) and baseline severity of anterior segment crowding according to Little's irregularity Index (Panel B) in the superelastic nickel-titanium (SENT) and heat-activated nickel-titanium (HANT) groups

Changes in anterior segment crowding within treatment groups

In both treatment groups, mean anterior segment crowding (ASC) decreased progressively throughout the 12-week observation period (Table 2). In the SENT group, the reduction in ASC was observed in both the maxillary and mandibular arches at each review interval, with mean residual crowding of <1.0 mm in both arches by week 12. Although the maxillary arch demonstrated consistently lower mean ASC than the mandibular arch throughout treatment, the differences were not statistically significant ($P > 0.05$).

Similarly, the HANT group exhibited a progressive reduction in ASC in both arches over time. By week 12, mean residual crowding was 1.18 ± 0.30 mm in the maxillary arch and 0.77 ± 0.20 mm in the mandibular arch. While the mandibular arch consistently demonstrated lower mean ASC than the maxillary arch, the between-arch differences were not statistically significant ($P > 0.05$) (Table 2).

Table 2: Comparison of anterior segment crowding at various review times, within each archwire group.

	Maxillary arch Mean±SD (mm)	Mandibular arch Mean±SD (mm)	t-value	*p*-value
SENT				
Baseline	4.26 ± 0.6	4.89 ± 1.0	-1.616	0.124
4 weeks review period	2.76 ± 0.7	3.15 ± 1.3	-0.801	0.434
8 weeks review period	1.45 ± 0.5	1.9 ± 0.7	-1.328	0.202
12 weeks review period	0.49 ± 0.1	0.89 ± 0.5	-1.313	0.207
HANT				
Baseline	4.62 ± 0.6	4.25 ± 0.8	1.080	0.295
4 weeks review period	2.80 ± 0.6	2.59 ± 0.7	0.655	0.522
8 weeks review period	1.97 ± 0.7	1.55 ± 0.5	1.419	0.174
12 weeks review period	1.18 ± 0.3	0.77 ± 0.2	1.647	0.118

Comparison of the Anterior Segment crowding between the archwire groups at the review times.

Mean anterior segment crowding (ASC) decreased progressively in both treatment groups throughout the 12-week study period (Table 3). At 4 weeks, mean ASC was slightly greater in the SENT group than in the HANT group (2.96 ± 0.60 mm vs. 2.69 ± 0.70 mm); however, the difference was not statistically significant ($P = 0.352$). By 8 weeks, mean ASC was comparable between the SENT and HANT groups (1.72 ± 0.40 mm vs. 1.75 ± 0.50 mm; $P = 0.897$). At the end of the 12-week observation period, residual crowding remained lower in the SENT group (0.70 ± 0.20 mm) than in the HANT group (0.96 ± 0.30 mm), although the between-group difference did not reach statistical significance ($P = 0.202$).

Repeated-measures analysis of variance demonstrated a significant reduction in anterior segment crowding over time within both treatment groups ($P < 0.001$). However, no statistically significant differences in alignment efficiency were observed between the SENT and HANT archwires at any assessment interval (Tables 3 and 6).gnificant (p < 0.001). This is shown in Table VI.

Table 3: Comparison of the anterior segment crowding between the archwire groups at the review times.

	SENT (n=19) Mean±SD (mm)	HANT (n=19) Mean±SD (mm)	t-value	*p*-value
Baseline	4.59 ± 0.9	4.43 ± 0.8	0.609	0.546
4 weeks review period	2.96 ± 0.6	2.69 ± 0.7	0.944	0.352
8 weeks review period	1.72 ± 0.4	1.75 ± 0.5	0.130	0.897
12 weeks review period	0.70 ± 0.2	0.96 ± 0.3	0.130	0.202
F-value	**10.047**	**8.722**		
p-value	**<0.001***	**<0.001***		

Reduction in anterior segment crowding at different treatment intervals

The reduction in anterior segment crowding (ASC) was evaluated over three treatment intervals: Δ1 (baseline–4 weeks), Δ2 (4–8 weeks), and Δ3 (8–12 weeks) (Table 4). During Δ1, the HANT group demonstrated a slightly greater mean reduction in ASC than the SENT group (1.74 ± 0.40 mm vs. 1.63 ± 0.50 mm), although the difference was not statistically significant (P = 0.499).

In contrast, the SENT group exhibited greater mean reductions in ASC during both Δ2 (1.25 ± 0.40 mm vs. 0.94 ± 0.30 mm; P = 0.073) and Δ3 (1.02 ± 0.40 mm vs. 0.78 ± 0.20 mm; P = 0.091). Similar trends were observed in both the maxillary and mandibular arches. However, none of the between-group differences reached statistical significance. significant. This is shown in Table 4.

Table 4: Comparison of the anterior segment crowding between the archwire groups at the review times.

	SENT (n=19) Mean±SD (mm)	HANT (n=19) Mean±SD (mm)	t-value	*p*-value
Δ1	1.63 ± 0.5	1.74 ± 0.4	0.683	0.499
Δ2	1.25 ± 0.4	0.94 ± 0.3	1.846	0.073
Δ3	1.0 ± 0.4	0.78 ± 0.2	1.738	0.091
	Maxillary arch			
Δ1	1.50 ± 0.4	1.82 ± 0.6	1.351	0.195
Δ2	1.30 ± 0.5	0.83 ± 0.5	1.946	0.069
Δ3	0.97 ± 0.3	0.79 ± 0.2	1.473	0.160
	Mandibular arch			
Δ1	1.74 ± 0.6	1.66 ± 0.3	0.359	0.724
Δ2	1.20 ± 0.7	1.04 ± 0.3	0.681	0.504
Δ3	1.06 ± 0.7	0.78 ± 0.3	1.190	0.249

$\Delta 1^{\measuredangle 1}$ = Baseline - 4 weeks $\Delta 2$, $^{\measuredangle 2}$ = 4 weeks - 8 weeks , $^{\measuredangle 3}$ and $\Delta 3$ = 8 weeks - 12 weeks.

Discussion

The present randomized clinical trial compared the alignment efficiency of superelastic nickel–titanium (SENT) and heat-activated nickel–titanium (HANT) archwires during the initial 12 weeks of fixed appliance therapy in patients with mild-to-moderate anterior segment crowding. Both archwire systems produced significant reductions in anterior segment crowding over the study period. Although HANT demonstrated a marginally greater reduction in crowding during the first four weeks of treatment, SENT achieved numerically greater reductions during the subsequent treatment intervals and exhibited lower residual crowding at 12 weeks. However, none of the between-group differences reached statistical significance, indicating that both archwire systems demonstrated comparable clinical alignment efficiency.

The comparable baseline characteristics observed between the two treatment groups suggest that the randomization procedure was successful in minimizing selection bias. There were no statistically significant differences in age, sex distribution, malocclusion characteristics, or baseline anterior segment crowding, thereby reducing the likelihood that these variables influenced the treatment outcomes. The inclusion of both maxillary and mandibular arches, together with standardized bracket prescription, slot dimension, ligation method, archwire sequence, and a uniform non-extraction treatment protocol, further strengthened the internal validity of the study by minimizing potential confounding factors identified in previous clinical trials.

Progressive reduction in anterior segment crowding was observed in both treatment groups throughout the 12-week observation period, reflecting the effectiveness of nickel–titanium archwires during the initial alignment phase. This finding is consistent with the well-established biomechanical properties of NiTi alloys, which provide relatively light and continuous orthodontic forces capable of producing efficient tooth movement while minimizing adverse effects on the supporting periodontal tissues.[8,11,21,30,34,36–40]

An interesting observation in the present study was the difference in the pattern of alignment over time. During the first four weeks of treatment, the HANT group demonstrated a slightly greater reduction in anterior segment crowding than the SENT group, although this difference was not statistically significant. This early numerical advantage may reflect the greater flexibility of heat-activated NiTi archwires at lower temperatures, allowing easier engagement of displaced teeth during initial archwire placement.[11,41,42] Their thermally activated phase transformation enables the delivery of relatively light forces as intraoral temperature increases, which may facilitate early alignment in crowded dentitions.[11,15,43,44]

In contrast, SENT archwires demonstrated numerically greater reductions in anterior segment crowding during the 4–8 week and 8–12 week treatment intervals. Although these differences also failed to reach statistical significance, they may reflect the sustained force delivery associated with the superelastic properties of SENT archwires.[11,14,44,45] As tooth alignment progresses and archwire deflection decreases, superelastic alloys may be better able to maintain relatively constant force levels because of their lower hysteresis and greater spring-back characteristics.[44–46] Nevertheless, these observations were not statistically significant, the differences may be the result of biomechanics.

Despite these differences in alignment patterns, both archwire systems produced similar overall reductions in anterior segment crowding after 12 weeks. Repeated-measures analysis of variance demonstrated significant improvement in alignment over time within each treatment group, whereas no significant differences were observed between groups at any assessment interval. These findings suggest that, under standardized clinical conditions, the choice between superelastic and heat-activated nickel–titanium archwires has little influence on the overall efficiency of initial alignment in patients with mild-to-moderate crowding.[7,14,23,26,27,47]

The findings of the present study are consistent with several randomized clinical trials that have reported comparable alignment efficiency between superelastic and heat-activated NiTi archwires. Studies by Nabbat et al.[31], Ong et al.[18], Abdelrahman et al.[48], Pandis et al.[39], Mahmoud et al. [30], and Cioffi et al.[49] similarly demonstrated no statistically significant differences in the rate of alignment despite small numerical differences favouring one archwire system over the other. Collectively, these findings support the conclusions of previous systematic reviews and Cochrane reviews, which reported insufficient high-quality evidence to establish the superiority of either superelastic or heat-activated NiTi archwires during the alignment phase of orthodontic treatment.[7,14,23,26,27,47]

In contrast, Serafim et al.[50] reported significantly greater alignment with heat-activated NiTi archwires. However, direct comparison with the present findings should be interpreted with caution because that study compared heat-activated NiTi with conventional NiTi rather than with superelastic NiTi. Conventional NiTi archwires possess different mechanical characteristics and generally exhibit lower superelastic behaviour than modern superelastic alloys, making comparisons between studies inherently difficult.[11,14,36,40,51,52]

Assessment of the maxillary and mandibular arches demonstrated progressive reduction in anterior segment crowding irrespective of arch location. Although numerical differences were observed between arches within each treatment group, these differences were not statistically significant. Variations in baseline crowding and differences in inter-bracket span between the maxillary and mandibular arches may partly explain these observations, but their clinical impact appears minimal under the treatment protocol employed in the present study.

From a clinical perspective, the findings suggest that both superelastic and heat-activated nickel–titanium archwires can be expected to provide comparable alignment efficiency during the initial phase of fixed appliance therapy. Consequently, archwire selection may reasonably be based on other clinically relevant considerations, including ease of ligation, patient comfort, cost, operator preference, and biological effects such as orthodontically induced root resorption, rather than alignment efficiency alone.

Overall, the findings of this study indicate that both superelastic and heat-activated nickel–titanium archwires provide effective and clinically comparable alignment of mild-to-moderate anterior crowding during the initial stage of fixed appliance therapy. Although each archwire exhibited a slightly different pattern of alignment over time, these differences were not statistically significant and are unlikely to be clinically meaningful.

LIMITATIONS

First, it was conducted at a single tertiary referral centre, which may limit the generalizability of the findings to other clinical settings and populations. Second, the 12-week follow-up period restricted the evaluation to the initial alignment phase of orthodontic treatment. Although adequate for evaluating early alignment, longer observation periods may be required to determine whether differences emerge during subsequent treatment stages. Finally, because some participants contributed both maxillary and mandibular arches, complete statistical independence of observations could not be assumed. Future multicentre randomized clinical trials with larger sample sizes, longer follow-up periods, and statistical methods that account for clustering of arches within participants are recommended to provide more robust evidence regarding the comparative clinical performance of these archwire systems.

CONCLUSION

Both superelastic nickel–titanium (SENT) and heat-activated nickel–titanium (HANT) archwires produced significant reductions in anterior segment crowding during the initial 12 weeks of fixed appliance therapy. No statistically significant differences in alignment efficiency were observed between the two archwire systems at any assessment

interval. The choice between SENT and HANT archwires should therefore be guided by clinical considerations such as ease of handling, patient comfort, operator preference, and cost, rather than expectations of superior alignment efficiency.

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Dental Arch Width Dimensions among Pre-treatment Orthodontic Patients In A Nigerian Tertiary Hospital.

*Osadiaye HE, *Otaren NJ.

Abstract

Background: Accurate assessment of dental arch width is essential for orthodontic diagnosis and treatment planning, as it influences space availability, occlusal relationships, aesthetics, and long-term stability. Arch width varies by gender, age, ethnicity, and arch form, yet most normative data are derived from non-African populations, limiting their applicability in African clinical settings. This study aimed to determine maxillary and mandibular arch width dimensions among pre-treatment orthodontic patients attending a Nigerian tertiary hospital.

Methods: This descriptive cross-sectional study was conducted at the Orthodontic Clinic of the University of Benin Teaching Hospital. Pre-treatment maxillary and mandibular dental casts of 150 orthodontic patients were analysed. Intercanine and intermolar arch widths were measured using a calibrated digital caliper. Data was analysed using SPSS version 27. Descriptive statistics were computed, and comparisons were made by sex, age group, and anterior arch form, with statistical significance set at $p < 0.05$.

Results: The mean age of participants was 17.92 ± 9.05 years, with females constituting 62.3% of the sample. Males demonstrated higher mean values for all arch width parameters. A statistically significant difference was observed in maxillary intercanine width, which was greater in males than females ($p = 0.041$). No significant age-related differences were found in any arch width parameter. Casts with anterior spacing exhibited significantly greater maxillary ($p = 0.007$) and mandibular ($p = 0.003$) intermolar widths, while crowded arches demonstrated reduced posterior arch widths.

Conclusion: Dental arch width among pre-treatment orthodontic patients varies significantly by sex and anterior arch form but not by age. Posterior arch width plays a key role in the presence of spacing and crowding. These findings highlight the importance of population-specific arch width assessment to support accurate, evidence-based orthodontic treatment planning in African populations.

Keywords: Dental arch width; Orthodontic patients; Pre-treatment asses; Tertiary health facility

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ORIGINAL ARTICLE

Introduction

Orthodontic diagnosis and treatment planning rely heavily on accurate evaluation of dental and skeletal parameters, among which arch width is a critical determinant.[1] Arch width describes the transverse dimension of the dental arches and directly influences space availability, occlusal relationships, facial aesthetics, and long-term treatment stability.[2,3] Decisions regarding arch expansion, extraction therapy, or non-extraction approaches are largely guided by pre-treatment arch width assessment.[4,5]

Malocclusion remains a major public health concern globally, with epidemiological studies reporting prevalence rates ranging from 56% to over 75% in children and adolescents, and approximately 30–45% of these individuals present with moderate to severe malocclusion requiring orthodontic intervention.[6–8] Transverse discrepancies, including reduced arch width and posterior crossbite, account for an estimated 8–23% of orthodontic problems, emphasising the clinical importance of arch width evaluation during treatment planning.[9,10]

Several studies have demonstrated that reduced maxillary or mandibular arch width is strongly associated with dental crowding, while increased arch width may influence post-treatment if not properly managed.[11,12] Differences in arch width have

also been shown to vary by sex, age, ethnicity, and craniofacial pattern, with males generally exhibiting wider arches than females and significant inter-population variations reported across Caucasian, Asian, and African groups.[1,13]

Despite this, most available normative data on arch width are derived from non-African populations, limiting their applicability in African clinical settings. Evidence suggests that African populations tend to have broader dental arches compared with Caucasian populations.[14,15] Yet, orthodontic treatment planning in many tertiary facilities continues to rely on reference values derived from external populations. This mismatch may contribute to suboptimal treatment outcomes, including instability and relapse.

Tertiary health facilities serve as major referral centres and manage a high volume of orthodontic cases, offering a representative pool for evaluating dental arch characteristics. Establishing baseline arch width measurements among pre-treatment orthodontic patients in such settings is essential for developing population-specific reference values, improving diagnostic precision, and guiding evidence-based orthodontic care.

This study, therefore, seeks to determine the arch width of pre-treatment orthodontic patients attending a tertiary health facility, providing locally relevant data that may enhance treatment planning, optimise clinical outcomes, and contribute to the existing body of orthodontic literature.

Materials and methods

Study Design

This descriptive cross-sectional study was conducted at the Orthodontic Clinic of the University of Benin Teaching Hospital (UBTH). This tertiary health facility provides specialised orthodontic care and serves as a major referral centre to the Benin Metropolis and neigbouring states such as Ondo and Delta.

Study Population

The study population consisted of pre-treatment orthodontic patients attending the Orthodontic clinic of the University of Benin Teaching Hospital (UBTH). A total of 150 patients were included in the study. Pre-treatment maxillary and mandibular dental casts obtained before the commencement of any orthodontic treatment were used for analysis.

Inclusion and Exclusion Criteria

Patients with complete permanent dentition up to the first molars and well-preserved pre-treatment dental casts were included. Dental casts that were fractured, or had missing teeth affecting the measurement landmarks were excluded.

Data Collection

Maxillary and mandibular dental arch widths were measured on the pre-treatment dental casts using a digital fibre composite caliper calibrated to the nearest 0.01 mm. The following parameters were assessed:

- Intercanine arch width, defined as the linear distance between the cusp tips of the right and left permanent canines.
- Intermolar arch width, defined as the linear distance between the mesiobuccal cusp tips of the right and left permanent first molars.

All measurements were taken under standardised conditions to reduce measurement error.

Figure 1: Measurement of maxillary intermolar width using digital caliper

Figure 2: Measurement of mandibular intercanine width using digital caliper

Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 27. Descriptive statistics were used to compute the means, standard deviations, and ranges of maxillary and mandibular intercanine and intermolar arch widths. Statistical significance was set at a p-value of < 0.05.

Ethical Considerations

Ethical approval for the study was obtained from the Health Research and Ethics Committee of the University of Benin Teaching Hospital. Patient confidentiality was strictly maintained.

Results

Table 1: Sociodemographic Characteristics of the Study Population

Variables	Frequency (n=150)	Percentage (%)
Sex		
Male	56	37.3
Female	94	62.3
Age group(years)		
≤13	76	50.8
>13	74	49.2
Mean ± SD	17.92 ± 9.05	

A total of 150 pairs of maxillary and mandibular dental casts were included in the study. The mean age of the participants was 17.92 ± 9.05 years. Participants aged 13 years or younger were 76 (50.8%), while those older than 13 years were 74 (49.2%). Females constituted the majority of the study population, accounting for 94 participants (62.3%), whereas males were 56 (37.3%

Table 2: Arch Width Distribution According to Gender (N = 150)

Arch width (mm)	Male (Mean ± SD)	Female (Mean ± SD)	p-value
Maxillary			
Inter-canine width	35.65 ± 4.05	33.61 ± 3.50	0.041*
Inter-molar width	40.83 ± 3.58	39.37 ± 3.66	0.134
Mandibular			
Inter-canine width	27.87 ± 2.32	26.50 ± 3.32	0.088
Inter-molar width	34.43 ± 3.42	33.95 ± 3.71	0.610

Statistically significant (p < 0.05).

Male dental casts demonstrated higher mean values for all maxillary and mandibular arch width parameters compared with females. The mean maxillary inter-canine width among males was 35.65 ± 4.05 mm, which was significantly higher than the corresponding value of 33.61 ± 3.50 mm observed among females (p = 0.041). The mean maxillary inter-molar width was 40.83 ± 3.58 mm in males and 39.37 ± 3.66 mm in females, although this difference was not statistically significant (p = 0.134).

For the mandibular arch, the mean inter-canine width was 27.87 ± 2.32 mm in males compared with 26.50 ± 3.32 mm in females (p = 0.088), while the mean inter-molar width was 34.43 ± 3.42 mm among males and 33.95 ± 3.71 mm among females (p = 0.610). These differences were not statistically significant.

Table 3: Arch Width Distribution According to Age Group (N = 150)

Arch width (mm)	≤13 years (Mean ± SD)	>13 years (Mean ± SD)	p-value
Maxillary			
Inter-canine width	34.97 ± 3.73	33.77 ± 3.88	0.222
Inter-molar width	40.00 ± 3.29	39.83 ± 4.09	0.861
Mandibular			
Inter-canine width	27.58 ± 2.71	26.43 ± 3.29	0.141
Inter-molar width	34.10 ± 3.30	34.17 ± 3.91	0.940

Among participants aged 13 years or younger, the mean maxillary inter-canine width was 34.97 ± 3.73 mm, compared with 33.77 ± 3.88 mm among those older than 13 years (p = 0.222). The mean maxillary inter-molar width was 40.00 ± 3.29 mm in the younger age group and 39.83 ± 4.09 mm in the older group (p = 0.861).

In the mandibular arch, participants aged 13 years or younger had a mean inter-canine width of 27.58 ± 2.71 mm, while those older than 13 years had a mean value of 26.43 ± 3.29 mm (p = 0.141). The mean mandibular inter-molar width was 34.10 ± 3.30 mm in the younger group and 34.17 ± 3.91 mm in the older group (p = 0.940). No statistically significant age-related differences were observed in any arch width parameter.

Table 4: Comparison of Mean Arch Widths by Anterior Arch Form

Arch width (mm)	Spacing (Mean ± SD)	p-value	Crowding (Mean ± SD)	p-value	Normal (Mean ± SD)	p-value
Maxillary						
Inter-canine width	35.30 ± 4.09	0.190	33.75 ± 4.26	0.305	34.22 ± 2.58	0.840
Inter-molar width	41.70 ± 3.33	0.007*	39.04 ± 3.46	0.305	39.28 ± 3.79	0.383
Mandibular						
Inter-canine width	27.65 ± 2.35	0.258	27.04 ± 4.07	0.959	26.33 ± 1.75	0.259
Inter-molar width	36.05 ± 3.63	0.003*	32.88 ± 3.22	0.026*	33.89 ± 3.20	0.735

Statistically significant (p < 0.05).

Casts with anterior spacing, crowding, and normal anterior arch forms showed comparable mean maxillary inter-canine widths, with values of 35.30 ± 4.09 mm, 33.75 ± 4.26 mm, and 34.22 ± 2.58 mm, respectively, and no statistically significant difference was observed ($p > 0.05$). In contrast, the mean maxillary inter-molar width was highest among casts with anterior spacing at 41.70 ± 3.33 mm, compared with 39.04 ± 3.46 mm among casts with crowding and 39.28 ± 3.79 mm among those with normal anterior arch forms, and this difference was statistically significant ($p = 0.007$).

In the mandibular arch, the mean inter-canine widths for spacing, crowding, and normal anterior arch forms were 27.65 ± 2.35 mm, 27.04 ± 4.07 mm, and 26.33 ± 1.75 mm, respectively, with no statistically significant differences observed ($p > 0.05$). However, the mean mandibular inter-molar width was significantly greater in casts with anterior spacing at 36.05 ± 3.63 mm compared with those with crowding at 32.88 ± 3.22 mm ($p = 0.026$) and those with normal anterior arch forms at 33.89 ± 3.20 mm ($p = 0.003$).

Discussion

This study evaluated maxillary and mandibular arch widths among pre-treatment orthodontic patients attending a tertiary health facility, to provide locally relevant baseline data to guide orthodontic diagnosis and treatment planning. The findings demonstrate significant associations between arch width and sex as well as anterior arch form, while age showed no significant influence on transverse arch dimensions.

The overall arch width values observed in this study are consistent with findings from African populations, which have been reported to exhibit relatively broader dental arches compared with Caucasian populations. Mack[16] reported wider maxillary and mandibular arch dimensions among Nigerian orthodontic patients when compared with established Caucasian norms, attributing these differences to ethnic and genetic influences on craniofacial morphology. Similar observations were also made by Janson *et al.*[17] , who emphasised the limitation of applying foreign normative values to African orthodontic patients. These findings support the need for population-specific reference standards in orthodontic practice.

Sexual dimorphism in arch width was evident in this study, with males demonstrating consistently higher mean values for all arch width parameters, although statistical significance was observed only for maxillary inter-canine width. This pattern aligns with the findings of Aluko *et al.*[18] and Etetafia *et al.*[19], who reported significantly wider maxillary inter-canine and intermolar widths in males compared with females. Comparable results were also documented by Wankhede *et al.*[20] who attributed male predominance in arch width to larger skeletal dimensions, prolonged growth periods, and increased masticatory muscle strength. Although not all parameters reached statistical significance in the present study, the observed trend remains clinically relevant for individualized treatment planning.

Age did not significantly influence maxillary or mandibular arch widths in this study. This finding was different from findings from Salem *et al.*[21] in Egypt, which showed moderate growth in arch widths with increasing age. The lack of age-related variation observed in this study may therefore reflect the completion of transverse growth in the study population.

The relationship between arch width and anterior arch form revealed important clinical insights. While inter-canine widths did not differ significantly across spacing, crowding, and normal arch forms, intermolar widths were significantly greater in casts with anterior spacing and significantly reduced in crowded arches. These findings are consistent with those of Selmani and Gjorgova[22], who reported a strong association between reduced posterior arch width and dental crowding. Also, Osemwenkhae *et al.*[23] also showed that dental arch shape also significantly affected the severity and prevalence of dental crowding in a cohort of untreated orthodontic patients. Posterior arch width has been shown to contribute more substantially to arch perimeter and space availability than anterior width, explaining its stronger association with crowding and spacing

patterns.[24]

The significantly wider mandibular and maxillary intermolar widths observed in spaced arches further support the concept that transverse posterior dimensions play a crucial role in maintaining dental alignment.[1] Failure to adequately assess and manage posterior transverse deficiencies may therefore result in unstable treatment outcomes and increased relapse rates.[25]

The clinical implications of this study are particularly relevant in tertiary health facilities, where complex orthodontic cases are commonly managed. The use of locally derived arch width data may enhance diagnostic precision, guide appropriate selection of expansion or extraction protocols, and improve long-term treatment stability. This is especially important in African populations, where broader arch forms may allow for more conservative, non-extraction approaches when appropriately assessed.[14]

Limitations

This study has some limitations. The use of dental casts, while reliable for measuring dental arch widths, does not assess underlying skeletal transverse relationships or soft tissue influences. This was mitigated by employing standardised anatomical landmarks and calibrated digital calipers to ensure measurement accuracy. Additionally, the single-centre nature of the study may limit generalisability; however, the inclusion of a relatively large and diverse sample of pre-treatment orthodontic patients enhances the representativeness of the findings.

Conclusion

This study established baseline maxillary and mandibular arch width measurements among pre-treatment orthodontic patients in a tertiary health facility. Arch width varied significantly by sex and anterior arch form, with males demonstrating wider arches and posterior arch width playing a significant role in spacing and crowding, while age showed no significant influence. These findings highlight the importance of population-specific arch width assessment in orthodontic diagnosis and support evidence-based treatment planning in African orthodontic populations.

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Conflict of Interest - None to declare

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Detrimental Effects of Orthodontic Treatments: A Review Article

Adeloye AY and Uwaoma EN

Abstract

Orthodontic treatment plays a vital role in correcting malocclusions, improving oral function, and enhancing aesthetic appearance. However, like any medical intervention, it carries the risk of adverse effects. This article critically reviews the various detrimental outcomes associated with orthodontic therapy, including physiological, psychological, systemic, and appliance-related complications. It also explores management strategies aimed at preventing or mitigating these effects.

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ORIGINAL ARTICLE

Introduction

Orthodontics is the dental specialty focused on the study of craniofacial growth, dental development, and occlusal function, with particular attention to the diagnosis and treatment of dentofacial anomalies.[1] Treatment modalities such as fixed appliances, clear aligners, and removable appliances are instrumental in correcting dental malocclusions, enhancing function, and improving facial aesthetics. While these therapeutic outcomes are well recognized, it is imperative to acknowledge that orthodontic interventions may also be associated with adverse effects, some of which may be transient and others irreversible.[2] Understanding these complications is essential for proactive risk management throughout the orthodontic care process.

Physiological and Biological Effects

1. Root Resorption

Root resorption is among the most frequently encountered adverse outcomes of orthodontic treatment.[1] It is an inflammatory process initiated by localized ischemia and subsequent necrosis of the periodontal ligament under orthodontic force.[1] The onset and progression of root resorption are associated with risk factors which are related to the orthodontic treatment such as the duration of treatment, the magnitude of the force applied, the direction of the tooth movement, the method of force application, the orthodontic movement and that are patient-related such as individual susceptibility on a genetic basis, some systemic diseases, anomalies in root morphology, dental trauma, and previous endodontic treatment.[1]

Clinical evidence shows that root length loss of approximately 1 mm during a two-year fixed appliance therapy is common and usually not clinically significant. A relationship has been observed between changes in overjet and the severity of root resorption. The greater the overjet during orthodontic treatment, the more severe the root resorption in the maxillary anterior teeth.[1] This is because greater tooth movement is required to reduce the overjet. However, an increased overbite may be associated with greater root resorption of the maxillary lateral incisors.[1]

It has been established that the deeper the overbite, the greater the root resorption observed in the distal

root of the maxillary permanent first molar and the maxillary incisors.[1] However. susceptibility to root resorption varies among teeth. Research indicates that maxillary teeth are more prone to resorption than mandibular teeth.[1] Anterior teeth are generally more susceptible than posterior teeth.[1] In the lower arch, canines are the most affected, followed by lateral and central incisors.[1] Root resorption in molars and premolars is minimal, typically less than 1 mm.[1]

Management: Periodic radiographic monitoring, light orthodontic forces, and modification of treatment plans are essential preventive strategies.[1, 3] Prevention of root resorption during orthodontic treatment involves controlling risk factors.[1]

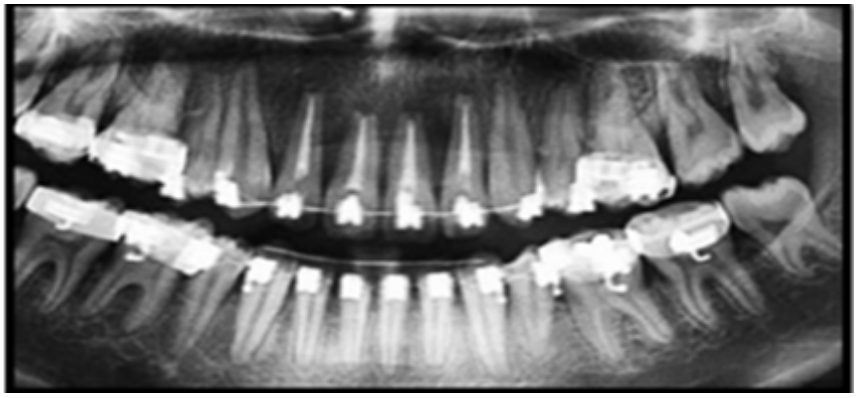

Figure 1.1: Panoramic radiograph showing resorption of the apical roots of maxillary anterior teeth. **(Abdulrazzaq et all., 2018)**

2. Tooth Decalcification and Demineralization

Demineralization occurs as a result of prolonged plaque retention around orthodontic appliances, leading to acid-induced dissolution of the enamel matrix. White spot lesions, the earliest clinical sign, often emerge in areas around brackets and bands.[4] Contributing factors include poor oral hygiene, high sugar intake, and prolonged appliance wear.[1, 4] These lesions differ from hypocalcified enamel developmentally and can progress to caries if untreated.[4]

Management: Daily fluoride rinses, topical fluoride applications, fluoride varnish around brackets, and oral hygiene reinforcement and dietary counselling are effective.[1] Discontinuation of treatment may be warranted in severe or uncooperative cases.[5]

Preventive Measures: Use smaller brackets, remove excess adhesive during bonding, and apply glass ionomer cement when banding. Selective use of looped archwires and careful appliance placement reduce plaque retention.

Figure 1.2: *(A–D)* Case demonstrating remineralization occurring a few weeks after the completion of orthodontic treatment. Images (A) and (B) show the presence of white spot lesions immediately post-debonding. Images (C) and (D) illustrate notable remineralization, attributed to improved oral hygiene practices and the natural availability of minerals from saliva, fluoridated toothpaste, and other remineralizing agents. **Jasim HA. (2022)**

3. Periodontal Issues

Periodontal disease encompasses gingivitis, alveolar bone loss (periodontitis), loss of attached gingival support, gingival recession. The periodontal response to orthodontic appliances is influenced by host resistance, presence of systemic conditions like uncontrolled diabetes mellitus, amount and composition of dental plaque, lifestyle factors, such as smoking, which can further compromise periodontal health.[2] Fixed and removable orthodontic appliances are known to increase dental plaque accumulation and alter the composition of the oral microbiota.[2] This bacterial shift can lead to localized gingivitis during treatment; however, progression to periodontitis is rare.[2] Orthodontic tooth movement outside the alveolar housing particularly in patients with thin biotype or pre-existing recession may lead to bony dehiscence and further attachment loss.[1]

Periodontal considerations before orthodontic treatment includes a comprehensive evaluation of periodontal status, particularly in adult patients, before initiating orthodontic treatment, control of periodontal health is essential prior to starting orthodontic therapy, measurement of the level of attached gingiva from the free gingival margin to the mucogingival junction, minus the gingival sulcus depth.[2] Seek a periodontal consultation if an inadequate amount of attached gingiva is identified before treatment.[2] Management: Pre-treatment periodontal assessment, oral hygiene reinforcement, fluoride/chlorhexidine varnishes, and consultation with periodontists when required are critical.[1,2]

Figure 1.3: Lower central incisor exhibiting localised gingival recession that developed during orthodontic treatment. **Jasim HA. (2022)**

4. Gingival Hyperplasia

Gingival hyperplasia during orthodontic therapy is commonly triggered by chronic plaque accumulation, resulting in inflammation and fibrotic overgrowth.[6] It may also be influenced by genetic predisposition, drug use (e.g., phenytoin, cyclosporine), and excessive mechanical irritation from orthodontic appliances.[6]

Management: Proper oral hygiene, regular prophylaxis, appliance adjustments to reduce irritation, and in severe cases, surgical intervention (gingivectomy) are warranted.[6]

Figure 1.4: A picture showing gingival hyperplasia after completion of orthodontic treatment. **LUTH Orthodontic Clinic**

5. Black Triangle Formation

Black triangles are small, triangular gaps that appear between teeth near the gum line following orthodontic alignment. These spaces result from inadequate or absent interdental papilla, often due to underlying bone loss, recession, or root divergence.[5] When teeth are uprighted or tipped during treatment, the crowns may appear aligned, but the roots remain apart, preventing complete gingival fill.[5] This creates visible voids, posing aesthetic concerns and increasing susceptibility to plaque retention and periodontal inflammation.[5]

Management: depends on the severity of the embrasure space and the underlying cause. Mild cases may respond well to orthodontic or cosmetic intervention, while more severe cases may require restorative or surgical approaches.[5] Aligning the roots of adjacent teeth helps reduce divergence, allowing the interdental papilla to better occupy the embrasure space.[5] Crown and veneers, composite buildup, or papilla reconstruction.[5] These interventions aim to enhance aesthetics while preserving periodontal health.[5]

Figure 1.5: Black triangle showing between the maxillary central incisors. **(Athar S and Jayadev S (2020)**

7. Temporomandibular Joint Disorder (TMD)

Temporomandibular disorders (TMDs) refer to a collection of musculoskeletal and neuromuscular conditions that affect the temporomandibular joint (TMJ), masticatory muscles, and associated structures. TMD has a multifactorial etiology which can be psychological, hormonal, genetic, traumatic, and occlusal factors all contribute to its onset and progression.[1] Temporomandibular disorders may arise during or after orthodontic treatment, especially in cases where therapy extends beyond two years.[1] Patients may experience joint discomfort, clicking, or restricted mandibular movement. The use of certain appliances, such as high bite turbos, may contribute to altered occlusion and muscular adaptation, potentially exacerbating TMD symptoms. In dissatisfied cases, patients may associate the onset or worsening of TMD with their orthodontic experience, even when a direct causal link is uncertain. This misattribution can result in perceived malpractice and strained patient-practitioner relationships.[1]

Prevention of TMD: includes pre-treatment screening with detailed history and TMJ evaluation. Treatment should aim for occlusal stability and minimize interferences by using low-profile appliances or aligners. Educating patients on symptom recognition enhances early detection.

Management: involves recommending a soft diet, occlusal splints for bruxism, jaw exercises, thermal therapy, and light-force mechanics. In complex cases, multidisciplinary care involving oral specialists and physiotherapists is advised.

8. Pulpal Injury

Pulpal injury may occur when excessive apical movement during orthodontic treatment compromises vascular supply to the pulp, potentially leading to inflammation or necrosis.[1] Traumatized teeth are especially vulnerable due to pre-existing pulpal compromise.[1,2]

Management: begins with thorough clinical and radiographic assessment before treatment.[1, 2] Minimal, controlled forces should be applied, and at-risk teeth should be closely monitored.[1, 2] Early detection of pulpal or periapical changes is crucial. Collaborative care involving both the orthodontist and conservative dentist is essential for long-term success.

PSYCHOLOGICAL AND SOCIAL EFFECTS

1. Self-Esteem and Body Image Concerns

Visible orthodontic appliances, particularly during the early phase of treatment—can cause a decline in self-confidence and heightened self-consciousness among patients, especially adolescents. The appearance of the smile significantly affects adolescents' self-perception, and the presence of braces may lead to embarrassment, reluctance to smile, or social withdrawal.

2. **Bullying and Social Stigma**

Children and teenagers with visible braces are sometimes subjected to teasing or derogatory nicknames like “metal mouth” or “train tracks,” which can cause emotional distress, social anxiety, and disruption in academic performance.[7] A follow-up study reported that 78% of previously bullied adolescents ceased to be targeted after orthodontic realignment, highlighting the positive psychosocial impact of orthodontic treatment.[7] Clear aligners may similarly reduce negative peer reactions.

3. **Treatment Fatigue and Psychological Stress**

Orthodontic treatment, typically spanning 18–36 months, can lead to patient fatigue due to slow progress, frequent appointments, dietary limitations, and discomfort.[8] This prolonged burden often diminishes motivation and compliance, fostering feelings of overwhelm and psychological stress if patients feel uninformed or unsupported.[8]

4. **Social and Lifestyle Limitations**

Orthodontic treatment can interfere with everyday social routines; public eating may feel uncomfortable due to food trapping in brackets, and chewing

difficulties are common.[9,10] Speech may also be temporarily impaired by appliances such as expanders or headgear, leading some individuals to avoid dating or public speaking.[9,10] These lifestyle limitations often result in heightened self-consciousness and social anxiety, particularly in adolescents.[9,10]

5. **Financial Burden of Orthodontic Treatment**

Orthodontic treatment can impose significant financial strain on individuals and families, particularly those with limited resources or inadequate insurance coverage.[11] These costs often include not only the initial treatment but also ongoing expenses such as retainers, emergency repairs (e.g., rebonded brackets or loose bands), and extended treatment due to relapse or non-compliance.[11] Such financial pressures can generate stress for both patients and caregivers, especially when multiple family members require treatment.[11]

Management: Provide supportive communication to highlight treatment benefits and realistic timelines for improvement. Consider discreet appliances like clear aligners or lingual braces for patients concerned about appearance.

EFFECTS OF ORTHODONTIC APPLIANCES

1. Pain

Most patients experience pain or discomfort within the first 2–6 hours after appliance placement, with intensity peaking at around 24 hours and subsiding over the next 7 days.[12,13,14]

Pain perception varies due to age, gender, emotional state, and appliance type.[13,14,15]

Common procedures like separator placement and archwire activation typically induce mechanical pressure, ischemia, and inflammation—biological triggers for pain.[12,13,14,15]

Visual Analogue Scale (VAS) and Numerical Rating Scale (NRS) are widely used tools to assess this pain objectively.[13,14]

Prevention of Orthodontic Pain: Educating patients about the transient nature of orthodontic discomfort helps reduce anxiety and improve compliance.[13,15] Using light, controlled forces during appliance placement and adjustments limits inflammation and associated pain.[13] Self-ligating brackets may cause less discomfort than conventional systems due to lower friction.[13] Maintaining oral hygiene and using orthodontic wax can minimize mucosal irritation.[13]

Management: includes pharmacological and non-pharmacological methods. Paracetamol is commonly recommended for pain relief without interfering with orthodontic movement, unlike NSAIDs which may inhibit prostaglandin-mediated tooth movement.[12,14] Preoperative analgesics have also shown effectiveness in reducing pain, especially in anxious patients.[12,14] Adjunctive therapies such as low-level laser therapy, transcutaneous electrical nerve stimulation (TENS), vibratory stimulation, and analgesic chewing gum are noninvasive options shown to relieve discomfort while preserving biologic tooth movement.[13,14]

2. Allergic Reactions

Allergic reactions, though relatively uncommon, are clinically significant complications in orthodontics, particularly among sensitive individuals.[2,4] Nickel, a major component of stainless steel brackets, archwires, and auxiliaries, is the most frequently implicated allergen.[2,4] Patients with nickel hypersensitivity may present with erythema, intraoral mucosal irritation, itching, or cutaneous rashes especially around the lips and cheeks.[4]

Latex is another potential allergen, often present in elastomeric ligatures and gloves used during appliance placement.[2,16] In latex-sensitive patients, exposure can result in symptoms ranging from mild contact stomatitis and mucosal swelling to more pronounced inflammatory reactions.[16]

Management: It begins with early recognition and identification of allergenic materials during patient history-taking. Nickel-free or titanium-based appliances are strongly recommended in known sensitive individuals.[2,4] In cases where complete material avoidance is not feasible, temporary

physical barriers such as covering metal parts with protective coatings may be considered. Latex-free ligatures and gloves should be used as standard protocol in at-risk patients.[16] These preventive measures significantly reduce the likelihood of allergic reactions and enhance patient comfort throughout treatment.[2,4,16]

3. Injury or Discomfort

a. Headgear-Related Ocular and Soft Tissue Injury

Orthodontic headgear especially models using elastic traction can pose significant risk when the facebow unexpectedly recoils, striking the face, neck, or eyes.[4] Such incidents often occur during sleep or sudden patient movements, increasing the potential for soft tissue injuries or, rarely, penetrating ocular trauma.[4] Although serious eye injuries are uncommon, their severity underscores the necessity of robust preventive protocols.

Management and Prevention: All headgear systems, including Kloehn facebows, must incorporate safety features such as automatic releases or disengagement mechanisms to minimize recoil injuries.[4] Strict adherence to fitting guidelines, patient education, and routine equipment inspection is essential. Failure to uphold these safety standards may lead to medico-legal ramifications for the practitioner.[4]

b. Effects on Soft Tissues

The oral soft tissues comprising the lips, buccal mucosa, palate, floor of the mouth, and tongue are especially vulnerable during orthodontic treatment.[2,4] Repetitive friction from protruding archwire ends, labially placed brackets, or molar bands can result in irritation, ulceration, or open sores that interfere with speech, mastication, and hygiene.[4,16]

In addition to mechanical trauma, **chemical and thermal burns** may occur due to improper handling of instruments or materials.[2] Accidental contact with acid etchants, uncooled electrothermal debonding tools, or heat-sterilized pliers can cause soft tissue damage, delayed healing, and significant patient discomfort.[2]

Management and Prevention: Adherence to strict clinical protocols is essential to minimize injury risk. This includes careful trimming of archwires, smoothing sharp edges, ensuring proper bracket and band placement, and confirming that all heated tools have adequately cooled before intraoral use.[2,4,16]

4. Candida Infection:

Fixed orthodontic appliances can predispose patients to an increased colonization of *Candida* species, most notably *Candida albicans*.[2,16] These appliances create plaque-retentive niches that alter salivary flow and disturb oral hygiene, leading to microbial imbalance.[2,16] The risk of oral candidiasis is influenced by fungal virulence factors—such as adhesion and biofilm formation—as well as host immune status.[2]

Management: involves co-management with an oral medicine specialist and includes the use of **nystatin mouthwash** alongside improved oral hygiene practices and appliance care.[16]

5. Palatal Inflammation During Orthodontic Treatment

Palatal inflammation may develop during orthodontic therapy due to two primary causes: poor oral hygiene and mechanical entrapment of gingival tissue.[1]

a. Poor Oral Hygiene

In most cases, inflammation correlates directly with regions covered by the appliance and is commonly triggered by a mixed bacterial and fungal infection.[1] Poor hygiene under palatal acrylic components creates plaque-retentive zones that predispose to mucosal irritation and microbial overgrowth.[1] This condition can lead to gingival hyperplasia and, in some instances, co-occur with angular cheilitis.[1]

Management: focuses on enhancing the patient's oral hygiene through guided instruction and improved plaque control.[1] Warm saline rinses are encouraged, particularly when appliance relief allows flow beneath the palatal surface. In more severe cases,

adjunctive therapy with topical antifungal agents such as **nystatin**, **amphotericin**, or **miconazole** gel applied to the appliance surface four times daily may be necessary.[1] If angular cheilitis is present, **miconazole cream** should be applied to the commissures of the lips.[1]

b. Entrapment of Gingival Tissue and Orthodontic appliance: In some instances, gingival tissue becomes mechanically trapped between the acrylic base of the appliance and the adjacent teeth being moved, resulting in localized inflammation and discomfort.[1] Proper appliance adjustment to relieve pressure and eliminate soft tissue entrapment is essential for resolution.[1]

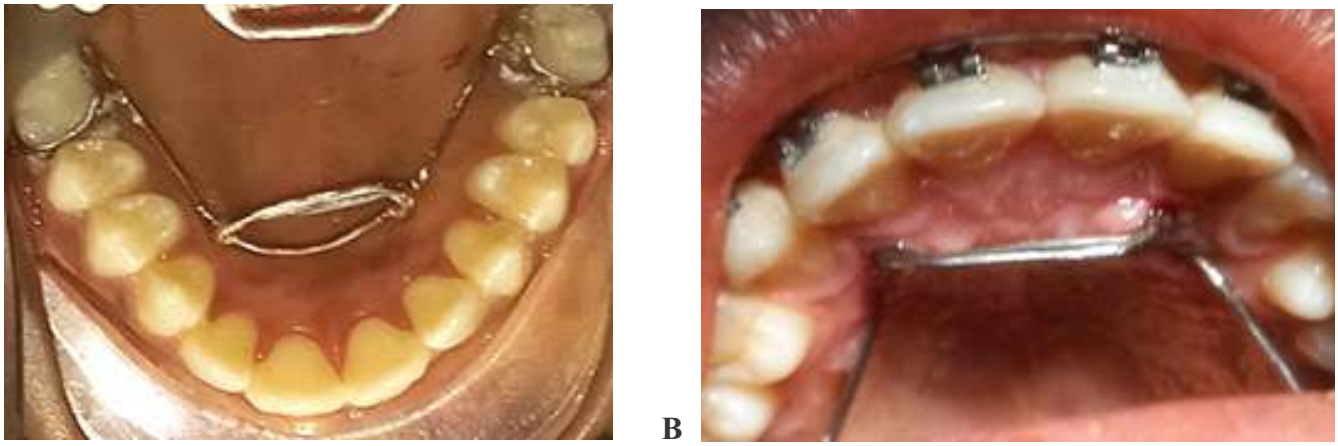

Figure 1.6: (a)Initial fitting of goal post appliance (b) Entrapment of goal post appliance **(LUTH Orthodontic Clinic)**

6**. Tissue overgrowth**

Is a common adverse effect observed during fixed orthodontic therapy.[1,6] It is typically a response to localized inflammation resulting from plaque accumulation around orthodontic appliances, poor oral hygiene, or underlying systemic predispositions.[6] Orthodontic brackets and wires create niches for microbial retention, which initiates gingival inflammation.[6] The inflammatory process stimulates fibroblastic activity and extracellular matrix production, contributing to fibrotic tissue enlargement.[1,6] If uncontrolled, it can impair aesthetics, oral hygiene access, and patient comfort.[6]

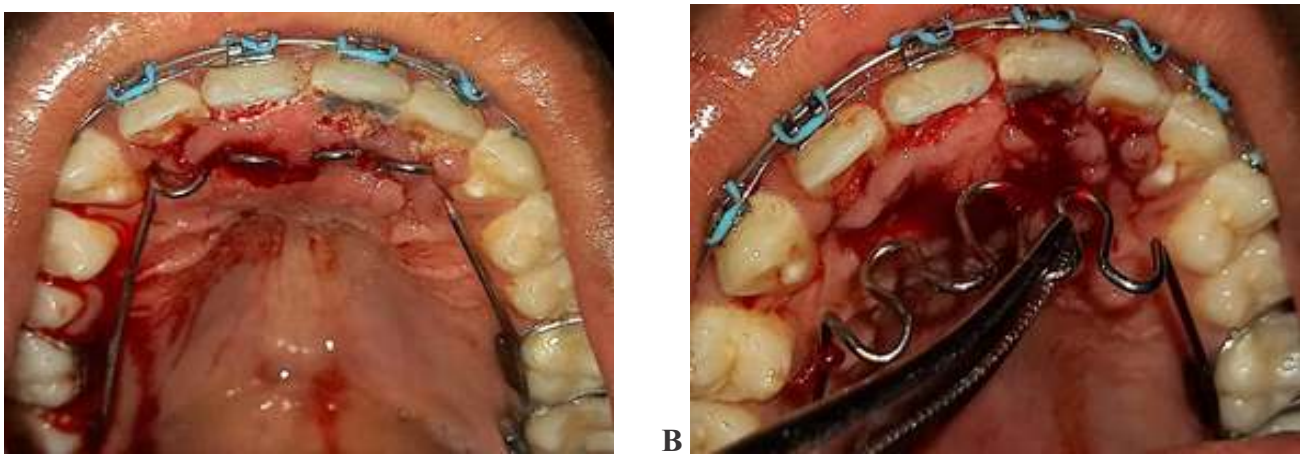

Figure 1.7: (a) Encapsulation of tongue rake which was partially embedded into the palatal mucosa (b) Tongue rake relieved from the palatal mucosa using artery forceps **(LUTH Orthodontic clinic)**

Figure 1.8: A case of fibrotic encapsulation of nance appliance was reported in a 19-year-old female patient using a Nance appliance, where the appliance became completely embedded within the mucosal tissue. **Adeloye et al., 2023**

Figure 1.9: Intraoperative clinical photographs: (A) Trans-surgical view: partial thickness palatal mucosa flap raised using a periosteal elevator to expose buried Nance appliance. (B) Retrieval of the Nance appliance from within the palatal mucosa. (C) Trans-surgical view showing the repositioned flap and the outline of the incision made. (D) Flap sutured into position using black silk sutures. **Adeloye et al., 2023**

Figure 1.10: Postoperative clinical photographs: (A) One week postoperative image after suture removal. (B) Two weeks postoperative image. (C) Four weeks postoperative image. (D) Six weeks postoperative image after fitting of new Nance appliance **Adeloye et al., 2023**

7. **Enamel wear and fracture**

Enamel wear is a documented complication of orthodontic treatment and typically results from repeated contact between tooth surfaces and appliance components such as brackets or buccal tubes.[1,4] The degree of wear varies with the bracket material, ceramic brackets are most abrasive, followed by metal and then composite brackets.[4]

In cases of deep bite, the use of ceramic brackets on the lower anterior teeth should be avoided until overjet is sufficient to prevent occlusal contact with the maxillary incisors.[4] A common site of wear is the cusp tip of the maxillary canines during retraction, as they often strike the brackets on the lower canines.[4]

Enamel fracture can also occur during the debonding phase, especially when excessive force is applied or if the bonding material has high retention strength.[1,4,2]

Figure 1.11: Upper canine cusp tip exhibiting abrasion resulting from occlusal contact with the lower canine metal bracket during orthodontic treatment**. (Jasim HA. (2022)**

LONG-TERM or POST-TREATMENT ISSUES

1. Orthodontic Relapse

Orthodontic relapse—the tendency of teeth to shift back to pre-treatment positions—remains one of the most frequent post-treatment challenges, affecting 20–50% of patients within the first 1–5 years.[17] This tendency stems from factors like incomplete periodontal fibers remodeling, unfavorable occlusion, persistent soft tissue forces, and ongoing skeletal growth.[17,18]

Poor retainer compliance is a critical contributor, with non-use after a retention phase of only 1–2 years resulting in significant relapse in up to 70% of cases after 10 years.[17,18] Soft tissue pressures from the tongue, lips, and cheeks, as well as physiological age-related changes, further contribute to tooth movement.[17]

Management and Prevention: Design a **customized retention plan** during the active treatment phase.[18] Prescribe **long-term retainer wear** (removable or fixed), with Hawley retainers showing better compliance than vacuum-formed ones after two years.[17,18] Consider adjunctive procedures such as supracrestal fiberotomy in high-risk cases.[17] Educate patients thoroughly about the risk of relapse and the **importance of lifelong retention**.[18]

2. Factors Affecting Final Treatment Outcome

In some orthodontic cases, the final treatment outcome may fall short of ideal esthetic or functional goals.[19] Common reasons include misdiagnosis or inadequate treatment planning such as failure to recognize skeletal discrepancies, growth potential, or tooth-size imbalance.[19] Poor patient compliance, like inconsistent elastic wear or poor oral hygiene, may interrupt treatment progress.[19] In some cases, undetected Bolton discrepancies contribute to residual spacing or crowding, particularly in the anterior region.[19]

3. Extraction-Related Consequences

Orthodontic extractions, while effective for space creation and bite correction, can occasionally result in unintended aesthetic and functional effects. Retraction of anterior teeth following premolar

extraction has been associated with reduced facial fullness, particularly around the lips and midface, leading to concerns about profile flattening in some patients.[20,21] These soft tissue changes are typically subtle but may affect esthetic outcomes in profile-sensitive cases.[21]

Furthermore, midline deviations or asymmetrical outcomes can occur if extraction planning is uneven or anchorage is not adequately controlled.[21] These shifts can compromise smile symmetry and long-term occlusal stability. Thorough planning, including facial analysis and anchorage reinforcement, is essential to minimize such risks.[20,21]

SYSTEMIC EFFECTS

1. Infective Endocarditis

Infective endocarditis (IE) is a rare but serious condition that may result from transient bacteremia following invasive dental procedures. The American Heart Association (AHA) recommends antibiotic prophylaxis for patients with high-risk cardiac conditions, including those with prosthetic heart valves, a history of previous infective endocarditis, certain congenital heart defects, and cardiac transplant recipients with valvulopathy.[22]

In orthodontics, prophylactic therapy is not routinely required, but may be considered in specific situations that could involve significant bleeding or mucosal trauma.[22] These include: Tooth extractions, placement of mini-implants or skeletal anchorage devices, orthognathic surgical procedures, placement or removal of orthodontic bands (which may cause gingival injury). To reduce bacteremia risk in susceptible individuals, clinicians are advised to prefer bonding brackets over banding where feasible.[22]

2. Ingestion or Aspiration of Orthodontic Components

Accidental ingestion or aspiration of small orthodontic parts, such as brackets, wires, or bands, is a known risk during treatment.[23] These components are often slippery due to saliva and easily displaced during procedures—especially in patients positioned supine or semi-reclined.[23]

Prevention involves identifying high-risk individuals during the medical history, using high-volume suction, and applying gauze, rubber dam, or cotton rolls as barriers.[23] Appliances should be well-retained, include radio-opaque markers when removable, and lack sharp edges.[23] Supporting long unsupported wire spans with tubing and thoroughly checking for missing components at each visit is essential.[23] Upright positioning may also be preferable in some cases.[23]

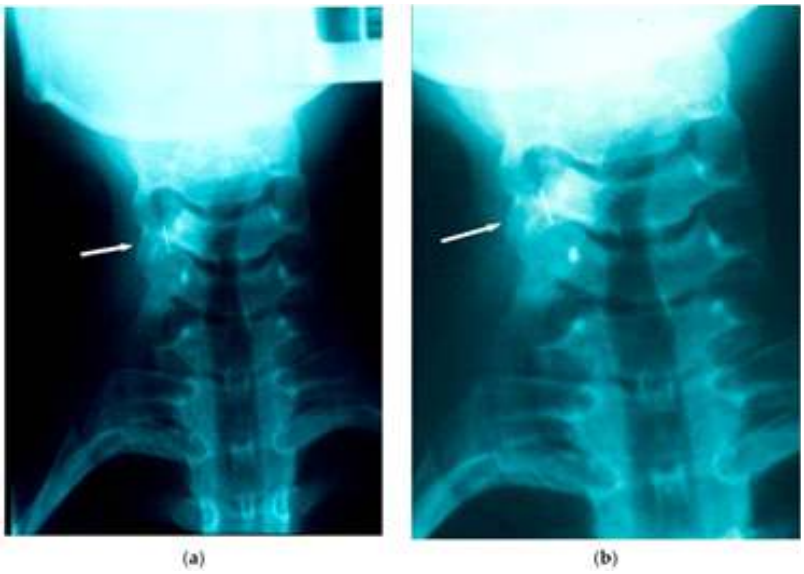

Figure 1.12: A and B showing Distal part of archwire in the right piriform recess
Puryer et al., 2016

SPEECH

Speech is a highly coordinated neuromuscular function involving respiration, phonation, articulation, and resonance.[1] Among these, articulation—the production of distinct speech sounds—depends on the tongue's precise interaction with oral structures such as the palate, alveolar ridge,

lips, and dentition.[1] Orthodontic appliances, particularly those that contact the palate or occupy intraoral space, can temporarily interfere with tongue movement and articulation.[1] Fixed labial and lingual braces, palatal expanders, Hawley retainers, and tongue-thrust therapy devices have been shown to affect speech, commonly leading to distortions in sibilant and palatal consonants.[24]

A study of adults with fixed labial appliances found that 57% experienced speech alterations post-placement, with most adapting within two months; however, 17% still had noticeable errors after eight months.[24] Similarly, rapid palatal expanders may distort speech in early weeks, although function typically returns to baseline once the device is removed.[25] These effects are usually temporary but should be considered during treatment planning, particularly for patients with speech-sensitive roles.[24,25]

Conclusion

Orthodontic treatment, like any other medical intervention, can be associated with undesirable side effects. A clear understanding of these potential adverse effects is crucial for both the orthodontist and the patient considering treatment. The etiology of detrimental effects in orthodontics is multifactorial, often influenced by factors such as genetics, oral hygiene, the type of appliance used, and the duration of treatment. A comprehensive medical, dental, and family history must be obtained prior to initiating therapy. Additionally, regular monitoring through diagnostic records such as radiographs and periodontal assessments is vital for ensuring treatment success. Equally important is securing informed consent from the patient, which should accompany a carefully structured treatment plan.

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Management of Severe Upper and Lower Spacing with Proclination Of The Upper Anterior Teeth - A Case Report

Koledoye OA, Ben-Okoye AL, Isiekwe IG

Introduction

Spacing is a form of malocclusion wherein there is a gap between two or more teeth[1] It can be localised or generalised. Midline diastema is any space seen between the adjacent central incisors that is greater than 0.5mm.[3] [4] Spacing can be perceived as unaesthetic and can negatively affect people psychosocially, preventing them from smiling in the public and losing their self-confidence.[5] Orthodontic treatment of spaces improves smile as well as boosts the confidence of patients who seek orthodontic care for the correction of this malocclusion.[5,6]

Clinical case

A 19-year-old presented at the Orthodontic clinic of the Lagos University Teaching Hospital with a complaint of "I don't like the spaces between my teeth and my upper teeth are too forward". There was no contributory medical history.

Orthodontic examination showed no facial asymmetry, straight profile as seen in skeletal pattern 1 with incompetent lips (Jackson score of 2/0). Figure 1

Figure 1: Pre-treatment Extra Oral Photos

Intra-oral examination revealed that all permanent teeth were present, and there were no decayed, missing or filled teeth. Intraoral examination revealed Angle's class l molar relationship bilaterally, the overjet was 3.5mm while the overbite was reduced and incomplete.

There was severe upper anterior spacing of 11mm, inclusive of midline diastema of 4mm, moderate lower anterior spacing of 5mm, mild lower posterior spacing of 2mm, increased upper incisal angle, and normal lower incisal angle.

Intraoral examination also showed rotation of teeth 12, 13, 22, 32 and 44, normal upper and lower arch widths and lower midline shift to the left by 0.5mm .

Figure 2: Pre-Treatment Intraoral Photos

Panoramic radiograph showed distomolars in the upper right, lower right and lower left quadrant with a mesio-angular impaction of the lower right distomolar. (Figure 3). The cephalometric analysis showed increased upper and lower incisal angles of 127.5° and 105° respectively, increased Frankfort-mandibular plane angle and lower facial height of 30° and 57% respectively, with reduced inter-incisal angle.

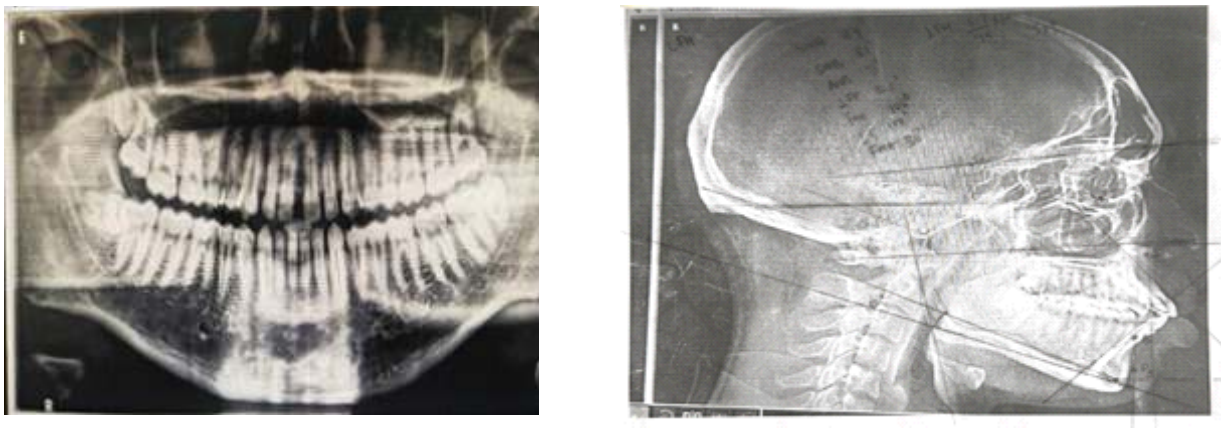

Figure 3: Pre-Treatment Panoramic and Cephalometric Radiographs

Figure 4: Pre-Treatment Study Models

Treatment Objectives

The treatment objectives were to achieve normal and complete overbite, close upper and lower spaces, derotate the rotated teeth, improve lip competence, and surgical extraction of the distomolars.

Treatment Plan

The treatment plan was Comprehensive fixed orthodontic therapy using pre-adjusted edgewise to consider the extraction of the disto-molars. Retention plan was fixed lingual retainers with Hawley's retainer and Vacuum formed thermoplastic retainers in upper and lower arches, respectively, at the end of treatment.

Treatment Progress

Complete upper and lower arch set-up was done using the Roth 0.022 prescription-pre-adjusted edgewise bracket system. Buccal tubes were bonded on 16,17,26,27,36,37,46,47. The arch wire sequence was 0.014, 0.016, 0.018, Nickel Titanium (NiTi) wires in the upper and lower arches. This was followed by 0.018, 0.020, and 0.019X0.025 Stainless steel wires (SSW) in the upper and lower arches. Space closure was done in stages; E-chain was run from 12-22, 13-17 bilaterally in the upper arch. Simultaneously, space closure was also commenced in the lower arch from 32-42.

Following space closure in the upper and lower anterior segments, figure 8 wiring using soft stainless steel wire was used to keep the spaces in the upper and lower anterior segments closed. Crimpable hooks were placed on the upper 0.019X0.025 SSW for the application of active tie back (ATB) for continued space closure in the upper arch while E-chain was run from 37-47 in the lower arch for space closure. Figure of 8 wiring was applied from 37 – 47 to keep the spaces in the lower arch closed while ATB was continued in the upper arch. The residual spaces in the upper arch were closed using E-chain from 17-27.

Diagonal elastics were placed from 11 and 12 in the upper arch to 31 and 32 in the lower arch to correct the upper midline shift. While the midline correction was achieved, the upper right canine was tending towards class ll, so right unilateral class ll elastics was worn by the patient. The patient had Kobayashi on 14, 15, 44, 45 for box elastics for posterior settling and was debonded after 19 months. Fixed lingual retainer was bonded in the upper and lower arches, after which, upper and lower impressions were taken for Hawley's and Essix retainers respectively.

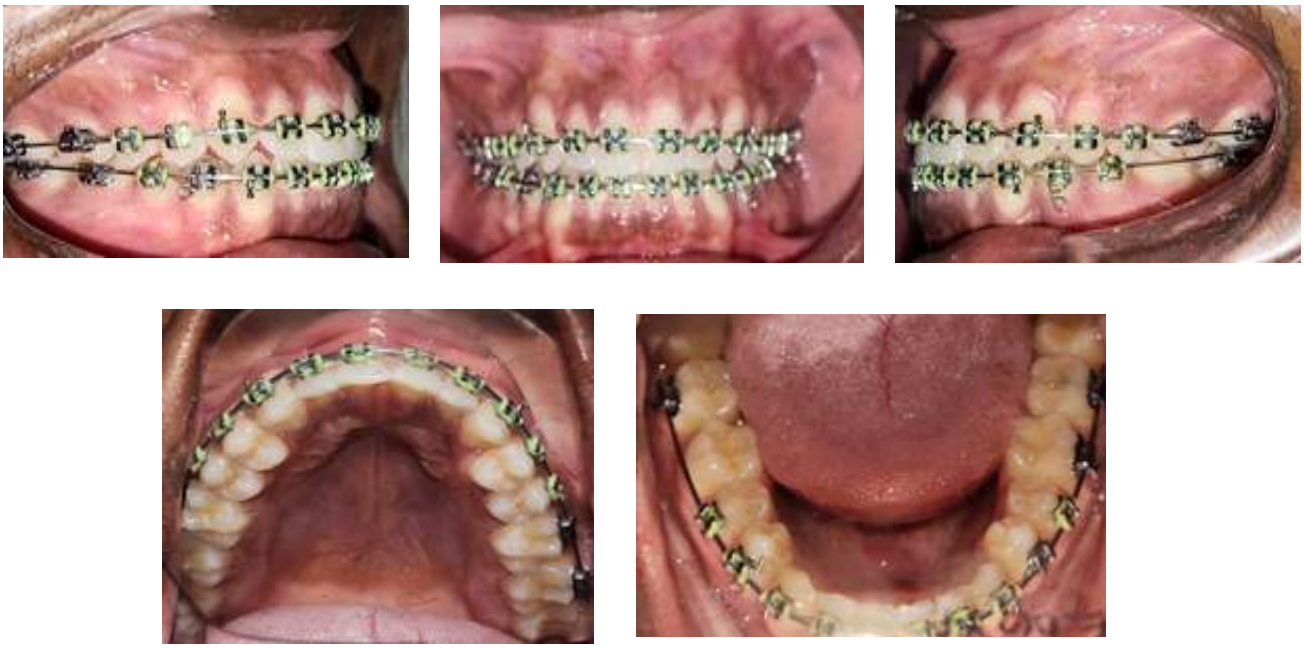

Figure 5: Intraoperative Photos

Figure 6: Post Treatment Extra-Oral Photos

Figure 7: Post Treatment Extraoral Photos

Figure 8: Pre-treatment And Post-treatment

Treatment Results

Normal overjet of 2mm, normal and complete overbite, upper and lower spaces closed, and bimaxillary proclination was reduced. The derotation of the rotated teeth, coincident midline, improved lip competence, and the smile and profile remained balanced.

Discussion

Spacing between the teeth is one of the commonest malocclusions seen in adults. This patient was managed using the preadjusted edgewise bracket system with Roth 0.022 prescription without extraction, despite the presence of the bimaxillary proclination. This decision was made because the patient presented with severe spacing and the existing spaces were enough to correct the upper and lower proclination. In addition, the pretreatment cephalometric radiograph values also showed that the upper and lower teeth proclination were just slightly above the normal range, hence, the need for extraction was precluded. The treatment and closure

of the existing space improved the upper and lower incisal inclination, lip competence, and the patient's smile at the end of the treatment. The choice of retention with fixed upper and lingual retainers was important to prevent relapse following treatment.

Conclusion

This was a case of spacing in Class 1 malocclusion. An appropriate treatment plan was determined. The treatment objectives were achieved and the treatment outcome was satisfactory. Spacing has a high relapse tendency, so fixed retainers were considered in the plan for retention.

Authors' Contribution: All the authors contributed to the manuscript

Financial Support - Funded by the authors

Conflict of Interest - None to declare

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