

WEST AFRICAN JOURNAL OF ORTHODONTICS

VOLUME 8, NUMBER 2

Print ISSN: 2315-9634
E-ISSN: 3141-5822

DECEMBER 2019

**Dental Arch Dimensions in Sickle
Cell Anaemia**



**Tooth Movement in the resolution
of Crowding**



**Oral Ornaments and Orthodontic
Treatment**



Management of Midline Diastema



**Orthodontic Management of
Anterior Crowding**

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Dental Arch Dimensions in Ghanaian patients with Sick Cell Anaemia

Siale EE^a, Newman-Nartey M^b, Amoah G^b

Abstract

Background: Sick Cell Anaemia (SCA) presents with multisystemic complications which may include dentofacial effects. Dental arch dimension variations have been demonstrated to occur in some chronic haematological diseases and may also occur in SCA.

The aim of this study is to determine the average dental arch dimension in Ghanaian patients with SCA and compare the findings with those from haematologically healthy individuals.

Methods: The study involved 120 participants comprising 60 individuals with SCA and 60 age and sex-matched haematologically healthy individuals without SCA (controls). Each consisted of 30 males and 30 females aged between 18 and 35 years with a mean age of 25.29 ± 5.32 years. Measurements of dental arch dimensions were made directly on the dental study casts using a digital sliding caliper. Differences in dental arch dimensions between patients with SCA and controls were determined using the Two sample t-test for unpaired data. The level of significance was set at $p < 0.05$.

Results: An assessment of dental arch dimension revealed that the mandibular arch depth of patients with SCA (25.18 ± 2.17 mm) was significantly smaller than those in the controls (25.92 ± 1.74 mm) ($p=0.04$). Additionally, the mandibular arch length of patients with SCA (69.13 ± 4.89 mm) was reduced compared to controls (70.90 ± 4.19 mm) ($p=0.03$). Individuals with SCA generally demonstrated smaller means for other parameters assessed, but these differences were not statistically significant.

Conclusion: This study demonstrated the differences in arch diameter parameters between patients with SCA and the haematologically healthy controls and this must be taken into consideration during orthodontic diagnosis and treatment planning for affected individuals.

Keywords: Dental- arch dimensions, Gnathopathy, Sick cell anaemia,

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Introduction

Sickle cell disease (SCD) is a hereditary blood disorder characterized by abnormally shaped red blood cells. Affected individuals usually present with chronic anaemia. The anaemia associated with SCD is caused by an abnormal haemoglobin mutation, haemoglobin (Hb) S, which results in glutamic acid being replaced by valine on the beta chain. This mutation causes chronic haemolytic anaemia and vaso-occlusive episodes with ischemic injury of many tissues.¹ There are several forms of SCD and the principal genotypes include homozygous sickle cell

anaemia (SCA), sickle-haemoglobin C disease, and sickle cell- β -thalassaemia. About 100 million people worldwide are affected by the disease.² There is a particularly high prevalence in Africa and people of African descent around the world.^{3,4} Currently, the prevalence of SCD in Ghana is 2% of all births annually with a carrier rate of 30% of the population.⁵

Clinical manifestations of the disease include both acute and chronic presentations. Acute presentations of the disease include pain crises, acute chest syndrome, priapism and strokes.³ Chronic complications include nephropathies and

chronic bone pain.⁶ SCA has been documented to be associated with craniofacial manifestations amongst which are an increased incidence of osteomyelitis of the jaw bones, bossing of the frontal and parietal bones, and maxillary prognathism (sickle cell gnathopathy).⁷ Oral manifestations of the disease include pulp necrosis, atrophy of the papillae of the tongue, neuropathy of the mental nerve, enamel defects, tooth eruption disturbances, and dental malocclusion⁸.

Malocclusion is a significant dentofacial complication of SCA.⁹ Several studies have demonstrated that malocclusions are more prevalent in individuals with SCA than in the general population.^{7,9,10} Furthermore, individuals with SCA appear to be more prone to developing severe forms of malocclusion than the general population.⁷ Although the aetiology of malocclusion in SCA has not been extensively studied, similar to the development of malocclusion in the general population, there is likely to be a complex interaction of factors which may include skeletal, dental, and soft tissue factors.

Sickle cell gnathopathy (maxillary prominence due to compensatory bone marrow hyperplasia in the maxilla) which occurs in about a third of individuals with SCA¹¹ may have an effect on the arch dimensions of affected individuals. These discrepancies in arch dimensions, in addition to tooth size variations, can contribute to the development of malocclusion in SCA and may result in spacing or crowding of the dentition. Although actual discrepancies in arch dimensions and tooth size have not been studied in detail in SCA, some studies have described a reduction in arch dimensions and mesiodistal tooth width in other haemoglobinopathies.^{12,13} It is therefore plausible that in individuals with Sickle Cell Gnathopathy, arch dimensions may be affected.

Studies on the dentofacial effects of SCA in Ghana are lacking, therefore, this study aim to determine the average dental arch dimensions of Ghanaian patients with SCA and compare the findings with those from unaffected (SCD-free) individuals.

Materials and Methods

Sickle cell disease (SCD) is a hereditary blood disorder characterized by abnormally shaped red blood cells. Affected individuals usually present with chronic anaemia. The anaemia associated with SCD is caused by an abnormal haemoglobin mutation, haemoglobin (Hb) S, which results in glutamic acid being replaced by valine on the beta chain. This mutation causes chronic haemolytic anaemia and vaso-occlusive episodes with ischemic injury of many tissues.¹ There are several forms of SCD and the principal genotypes include homozygous sickle cell anaemia (SCA), sickle-haemoglobin C disease, and sickle cell- β -thalassaemia. About 100 million people worldwide are affected by the disease.² There is a particularly high prevalence in Africa and people of African descent around the world.^{3,4} Currently, the prevalence of SCD in Ghana is 2% of all births annually with a carrier rate of 30% of the population.⁵ Clinical manifestations of the disease include both acute and chronic presentations. Acute presentations of the disease include pain crises, acute chest syndrome, priapism and strokes.³ Chronic complications include nephropathies and chronic bone pain.⁶ SCA has been documented to be associated with craniofacial manifestations amongst which are an increased incidence of osteomyelitis of the jaw bones, bossing of the frontal and parietal bones, and maxillary prognathism (sickle cell gnathopathy).⁷ Oral manifestations of the disease include pulp necrosis, atrophy of the papillae of the tongue, neuropathy of the mental nerve, enamel defects, tooth eruption disturbances, and dental malocclusion⁸.

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Figure 1: Measurement of arch widths.

ICW – Inter-canine width, IPW – Inter-premolar width, IMW – Inter-molar width

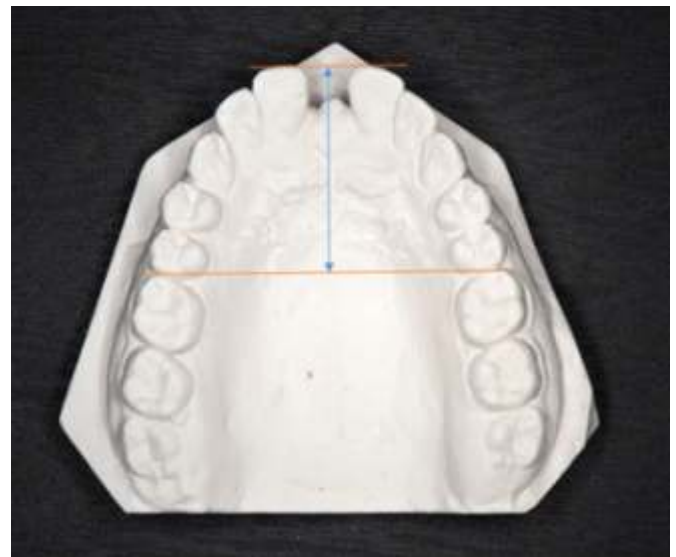


Figure 2: Measurement of Arch depth



Figure 3: Measurement of Arch length



Figure 4: Measurement of palatal height

Assessment of Random Error

The assessment of random error associated with measurements in this study was carried out by repeating all measurements on 25 randomly selected casts after a period of 2 weeks from the initial measurement. The random error was then calculated using Dahlberg's formula¹⁵:

$$D = \sqrt{\sum_{i=1}^N \frac{d_i^2}{2N}}$$

Where D is the Dahlberg error, (d) is the difference between two readings of the same variable and (N) is the sample size that was re-measured.

Table 1 shows the random error for measurements of the maxillary and mandibular arch dimensions. Dahlberg's method showed that the mandibular arch length measurement demonstrated the greatest error (0.31) while the maxillary palatal height demonstrated the least error (0.09).

Table 1: Assessment of measurement error of Arch dimensions by Dahlberg's method

Arch dimensions	Maxillary arch	Mandibular arch
Arch length (mm)	0.169	0.310
Arch depth (mm)	0.126	0.093
Inter-canine width (mm)	0.208	0.115
Inter-premolar width (mm)	0.112	0.102
Inter-molar width (mm)	0.106	0.174
Palatal height (mm)	0.090	NA

Descriptive statistics were presented as mean $\pm$ standard deviation. Differences in arch dimensions and tooth sizes between SCA patients and controls were determined using the Student's t-test for unpaired data. All p-values < 0.05 were judged statistically significant. Data was analyzed using SPSS version 24.

Data collected were entered into and analyzed using Statistical Package for the Social Sciences (SPSS) version 24.0. The data was summarized as the mean $\pm$ standard deviation for continuous variables and percentages for categorical variables. Differences in arch dimensions between individuals with SCA and controls were determined using the Student's t-test for unpaired data. All p-values < 0.05 were judged statistically significant

Results

Dental arch dimensions for patients with SCA and controls are shown in Table 2.

A comparison of maxillary arch dimensions between patients with SCA and controls revealed that mean arch length was reduced in patients with SCA (80.00 ± 5.17 mm) compared to controls (81.38 ± 4.69 mm). Arch depth was also reduced in patients with SCA (29.56 ± 2.66 mm) when compared to the mean value for controls (30.35 ± 2.38 mm). A reduction in the mean inter-canine width was observed in patients with SCA (36.87 ± 3.27 mm) when compared to haematologically - healthy participants (37.42 ± 2.48 mm). The differences in dimensions listed above were, however, not statistically significant. Patients with SCA, on the

other hand, showed increases in the maxillary inter-molar width and palatal height when compared with controls. These differences were also not statistically significant.

When the mean arch dimensions mandibular arch were assessed and compared between individuals with SCA and non-SCD controls it was observed that with the exception of the inter-molar width, where individuals with SCA had average dimensions greater than that of controls, all other arch

dimensions assessed in the mandible showed mean values lower in patients with SCA than in controls. The mean mandibular arch length of patients with SCA was 69.13 ± 4.89 mm, a value that was determined to be significantly lower than that of controls (70.90 ± 4.19 mm; $p = 0.03$). A statistically significant difference in the arch depth was also recorded, with patients with SCA having a reduced average arch depth of 25.18 ± 2.17 mm and non-SCD controls, a value of 25.92 ± 1.74 mm; $p=0.04$.

Table 2: Arch dimensions of patients with SCA and control participants.

Arch dimension	SCA (mean $\pm$ sd)	Control (mean $\pm$ sd)	P-value
Mx arch length (mm)	80.00 $\pm$ 5.17	81.38 $\pm$ 4.69	0.12
Mx arch depth (mm)	29.56 $\pm$ 2.66	30.35 $\pm$ 2.38	0.08
Mx inter-canine width (mm)	36.87 $\pm$ 3.27	37.42 $\pm$ 2.48	0.30
Mx inter-premolar width (mm)	50.89 $\pm$ 3.28	51.02 $\pm$ 3.15	0.81
Mx inter-molar width (mm)	55.90 $\pm$ 3.31	55.27 $\pm$ 3.14	0.28
Mx Palatal height (mm)	17.88 $\pm$ 2.07	17.19 $\pm$ 2.33	0.08
Mn arch length (mm)	69.13 $\pm$ 4.89	70.90 $\pm$ 4.19	0.03*
Mn arch depth (mm)	25.18 $\pm$ 2.17	25.92 $\pm$ 1.74	0.04*
Mn inter-canine width (mm)	28.33 $\pm$ 3.28	28.71 $\pm$ 2.54	0.47
Mn inter-premolar width (mm)	42.32 $\pm$ 0.54	42.68 $\pm$ 3.21	0.57
Mn inter-molar width (mm)	48.08 $\pm$ 3.41	47.60 $\pm$ 2.89	0.41

Data presented as mean $\pm$ standard deviation *Significance at $p<0.05$

Mx: maxillary; Mn: mandibular

Discussion

Dental arch dimensions, as demonstrated earlier, exhibit a strong genetic influence. It has however been shown that environmental and pathological factors, among others, can influence the size of the maxillary and mandibular arches¹⁶. Studies exploring

the effect of SCD on arch dimensions were not found in the literature; however, research exploring the effects of haemoglobinopathies such as thalassaemia major have produced interesting results. Thalassaemia major is the most severe form of Beta thalassaemia, a haematological condition that results

in the reduced production of beta-haemoglobin chains. It is usually common in Mediterranean populations and causes severe disease with symptoms similar to SCA.

Hattab *et al.*¹² Kumar *et al.*¹³ and Al-Wahadni¹⁷, demonstrated that in general, individuals with thalassaemia major had reduced dental arch dimensions when compared to haematologically healthy controls.

In this present study, an assessment of maxillary and mandibular arch dimensions revealed that average arch dimensions were generally reduced in patients with SCA compared to controls. With the exception of maxillary and mandibular inter-molar width, as well as the palatal height, all other parameters showed mean values that were reduced in patients with SCA in comparison with controls. These differences were however not statistically significant. Statistically significant differences were however observed for mandibular arch length and arch depth, with patients with SCA exhibiting reduced mean values, compared to the controls. These findings agree with values obtained by Hattab *et al.*¹² who recorded reduced values for arch depth and perimeter in patients with thalassaemia major. Hattab *et al.*¹², however, noticed a smaller difference in mandibular arch depth between cases and controls than in the maxilla where a greater difference in means was observed. This was attributed to the thicker cortical bone in the mandible, which prevented expansion. This finding, however, is contrary to this current study as no significant difference in the maxillary arch depth was recorded between cases and controls.

In this study, it was observed that the mean value for maxillary and mandibular inter-molar widths was greater in individuals with SCA when compared to the controls, although this difference was not statistically significant. These values are at variance with those obtained by Hattab *et al.*¹², Al-Wahadni *et al.*¹³ and Kumar *et al.*¹⁷, who noticed greater values for

inter-molar width in controls when compared to patients with thalassaemia major. These findings suggest that the arch forms of individuals with SCA in this study may be wider posteriorly and narrower anteriorly. An analysis of arch forms was, however, not performed in this study and may constitute a basis for further research.

Additionally, mean palatal height was increased in individuals with SCA when compared to the controls, a difference that was not statistically significant. This finding may, however, suggest an increased vertical development of the maxillary alveolar arches. It is possible that the hyperplasia of the bone marrow thought to cause maxillary prominence in sickle cell gnathopathy may actually result in the vertical development of the maxillary alveolar bone and cause an increase in measured palatal height. Further studies exploring this hypothesis would however be required.

The findings of our study also appear to conflict with studies that have suggested an increased prominence of the maxilla with proclination of teeth and spacing in individuals with SCA.¹¹ Those findings would logically have translated to a general increase in arch dimensions in patients with SCA compared to the controls, however, the converse was observed to be the case in this study. Some cephalometric studies have suggested that the increase in maxillary prominence observed in SCA may be due to a reduced cranial base length associated with a retrognathic mandible and not maxillary prognathism as initially thought.¹⁸ A possible cause for reduced mandibular arch depth and length in patients with SCA compared to controls could be the growth retardation that occurs in SCA. Studies have demonstrated that individuals with SCA generally grow and develop more slowly, often reaching puberty later than their peers. Additionally, adults

with SCA are generally shorter and thinner than the general population.^{19,20} The reduced mandibular arch length and depth in this study could therefore be a reflection of general growth retardation that occurs in SCA.

Conclusion

In this study, a comparison of average arch dimensions between individuals with SCA and controls without SCD revealed generally reduced mean values for individuals with SCA compared to the controls with statistically significant differences noted for mandibular arch length and depth. It is therefore recommended that proper orthodontic diagnosis and treatment planning be performed, especially in patients with SCA, as their arch dimensions may not match that of the general population.

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Acknowledgements

We wish to thank all the participants who took part in this study. We would also like to acknowledge the nurses and resident doctors of the Orthodontic and Paedodontics department of University of Ghana Dental School for their assistance with data collection.

Contributions

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

Funding/grants

This study was funded solely by the authors.

Conflict of interest

None declared.

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Rate of Tooth Movement in the Resolution of Anterior Segment Crowding

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Abstract

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

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

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

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

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

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Introduction

Dental crowding is a malocclusion characterized by insufficient space to accommodate all the teeth present in the dental arch thus, the teeth are too close together presenting abnormal positions such as overlapping, protrusion of teeth, displacement of teeth in different directions¹. The prevalence of anterior segment crowding in Nigeria is put at 15.1% - 43%²⁻⁶. Anterior

segment crowding occurs within the region of the incisors and canines, while posterior segment crowding occurs in the region of the premolars and molars. Excessively large teeth or excessively small jaw bases and a combination of the two have are some of the factors responsible for the space deficit noted in crowded jaw⁷.

Anterior segment crowding is one of the most common forms of malocclusion and a frequent reason for presenting to the orthodontic clinic⁸. This is because of the oral health, esthetic and psychological problems associated with the malocclusion. The highly visible anterior dentition contributes largely to the appearance of the face with

a pleasing dental appearance impacting positively on an individual's self-esteem and quality of life^{9,10}, while the converse is the case with an unattractive dental appearance such as occurs in crowding. Bullying, discrimination, taunting and name calling amongst others have been reported to have been meted out on children with anterior crowding, with negative consequences on their social interactions and academic performance¹¹⁻¹⁵

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

The initial phase of orthodontic treatment involves the use of small-diameter flexible archwires made of different alloys such as the Nickel Titanium (NiTi) archwire and the newer, costlier Copper Nickel Titanium (CuNiTi) archwires. The duration of orthodontic treatment, which ranges from eighteen months to twenty-four months, is usually the major complaints of patients concerning this treatment. Several authors have presented techniques and products, including archwires, which are said to reduce the length of time for orthodontic treatment. Some other studies present the amount of time taken for alignment of malocclusion¹⁹⁻²³, however, few studies have quantified the amount of tooth movement vis-a-vis the time involved in the alignment stages of anterior segment crowding, which would be the true rate of alignment-the rate of reduction of tooth irregularity.²⁴

The aim of this study was to present the rate of tooth

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

Materials and Methods

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

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

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

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

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

The participants' biodata was obtained and recorded, pretreatment study models were also obtained, on which pretreatment Little's Irregularity Index- LII0 (Fig 2) was measured using a fine beaked digital caliper (CB Calipers, Brown and Sharpe, U.S.A. Accuracy +/- 0.02 per 150mm. Resolution 0.01mm) and recorded. The participants' orthodontic treatment was then commenced by placement of the brackets, using the standard acid etch direct bonding technique

and Roth 0.022 prescription attachments (Redi-Pak Prescription kit, Lancer Orthodontics Inc., 2330 Cousteau Court, C.A, U.S.A). The allotted archwires- NiTi (G4™ nickel titanium archwire, G&H wire company U.S.A) or CuNiTi (Damon optimal force copper NiTi®, Ormco Corporation, Glendora, C.A, U.S.A) were then placed and ligated using elastic ligatures. The 0.014" diameter arch wire was used first, followed by 0.016" diameter archwire in both NiTi and CuNiTi groups. The participants were given post-operative instructions –verbal and written.

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

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

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

Results

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

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

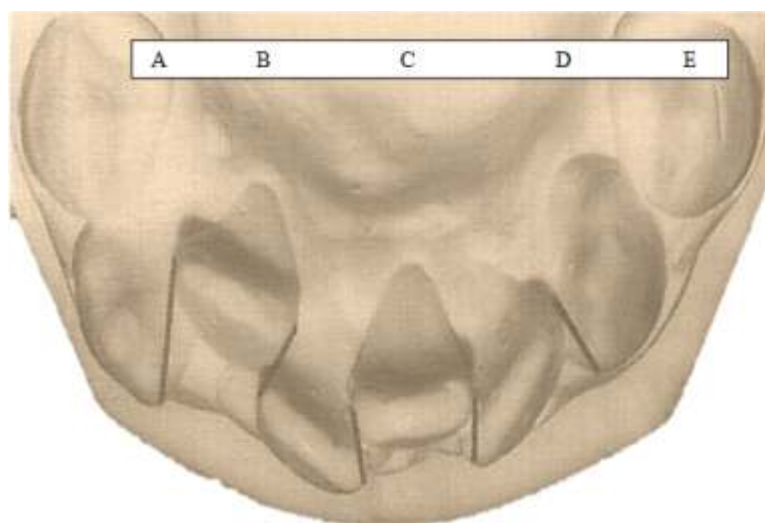
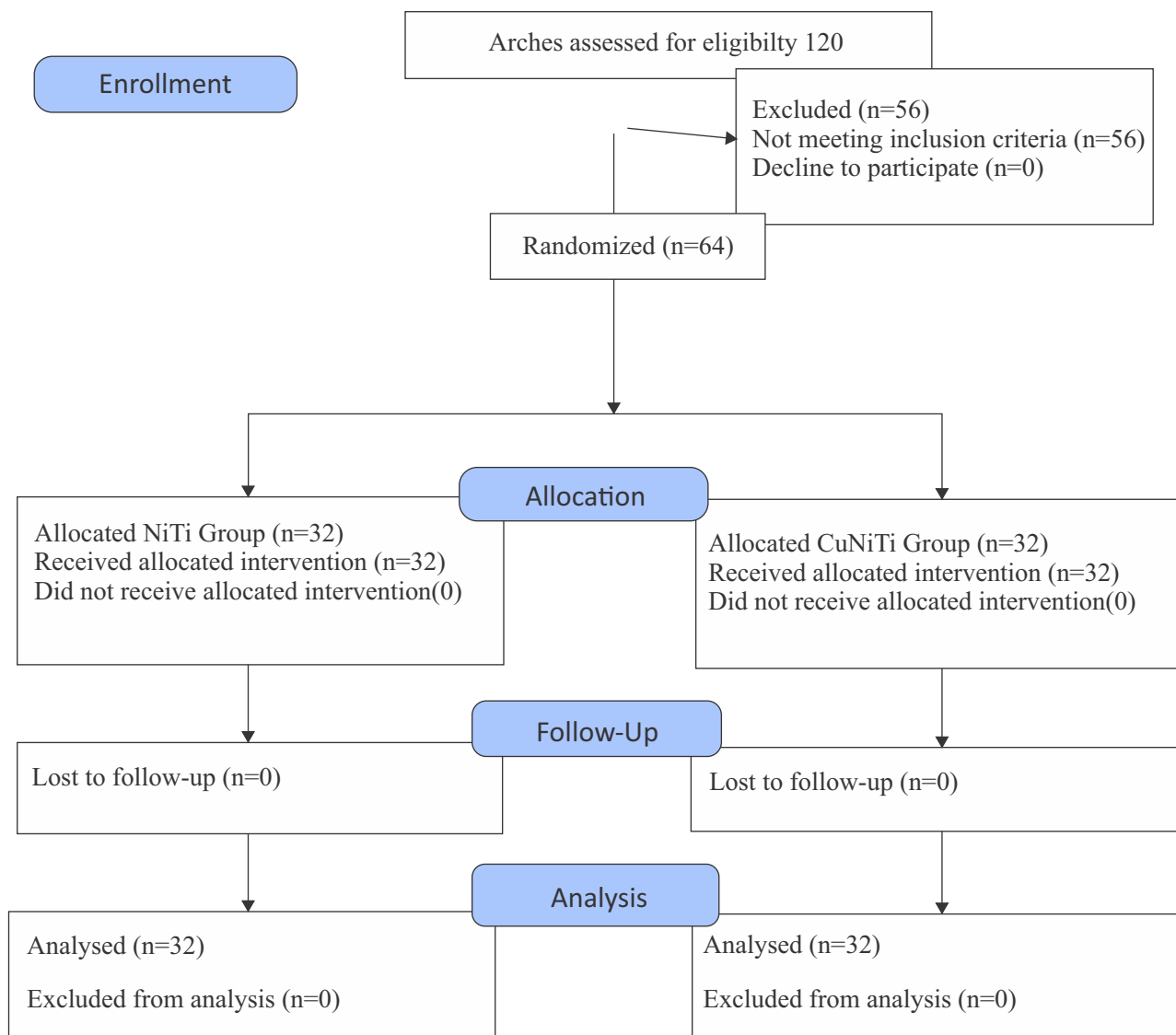
At the end of the 24-week study period, the mean irregularity index was 0.00 ± 0.00 mm for arches treated with CuNiTi archwires while it was 0.16 ± 0.89 mm for arches treated with NiTi archwires. At the points of review, the mean irregularity index was consistently lower in arches treated with CuNiTi compared to arches treated with NiTi archwires.

However, when subjected to the Mann-Whitney U test, this difference was not statistically significant at the review times. This is shown in figure 3- a diagrammatic representation of the reduction of the LII of the arch wire groups.

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

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

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

Figure 1. CONSORT flow chart showing patient flow during the trial**Figure 2: Schematic diagram showing contact point displacement in crowding, and the measurements in Little's Irregularity Index $A+B+C+D+E = (LII)$**

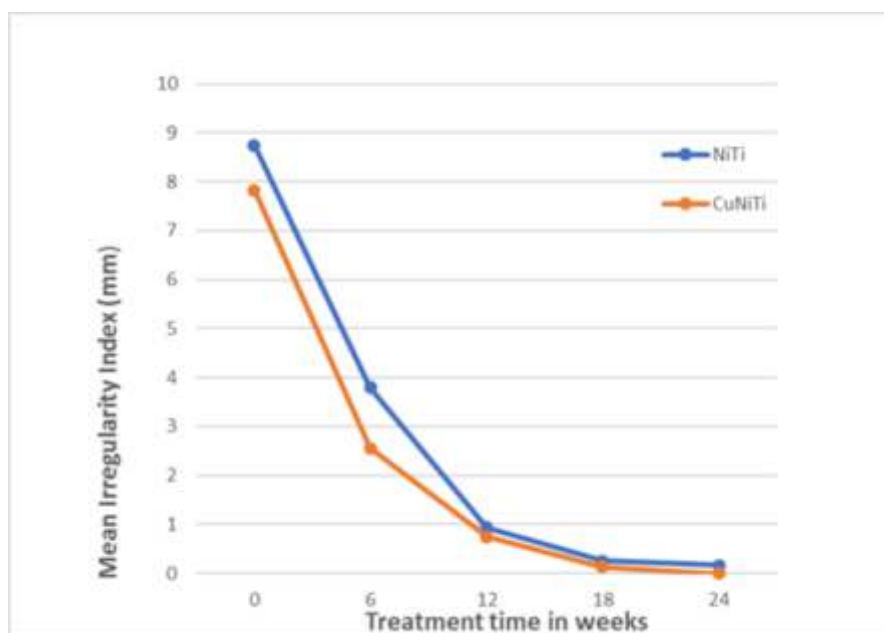


Figure 3: The reduction in irregularity index over time between the archwire types

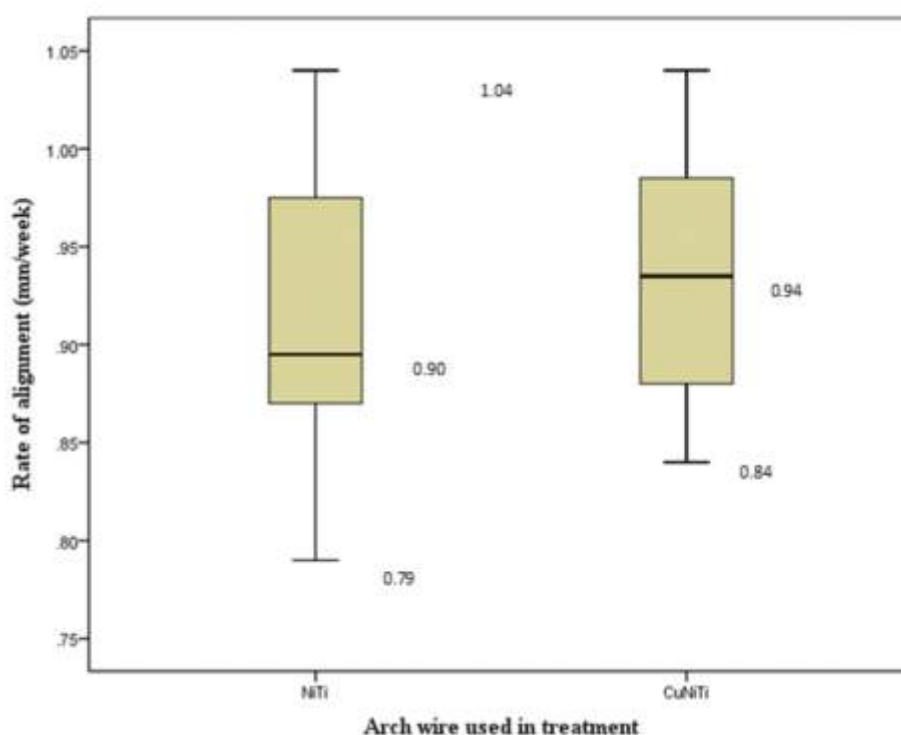


Figure 4: Box plots of the rate of alignment among the archwire types

The median value is represented by the horizontal line within the rectangular box. The lower part of the box represents the 25th quartile value while the upper part of the rectangle represents the 75th quartile value. The width of the box represents the interquartile

range (IQR). The vertical lines extending from the box (whiskers) represent the total range of the values. The lowest portion of the lower whisker represents the minimum value and the highest portion of the upper whisker represents the maximum value.

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

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

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

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

Discussion

Orthodontic tooth movement occurs on the application of light continuous force. During the initial alignment phase of orthodontic treatment, this force is provided by the deflection of the thin flexible archwires ligated into the slots of the brackets placed on the displaced, crowded teeth. As the archwire (which have shape memory) try to return to its original shape- the shape of a well-rounded arch, a

light and continuous force is exerted on the teeth and its surrounding periodontium to bring about tooth movement and relief of the crowding.⁸ At each review time, some arches had achieved alignment as their Little's irregularity index values had reduced to the set end-point. The rate of alignment - defined in the study as reduction of the irregularity (LII) over time, was similar for both archwire types. Though the values for CuNiTi archwires were slightly higher

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

On comparing the rate of alignment between the pre-treatment crowding levels, it was noted that the values for rate of alignment were almost equal among the 3 levels of crowding. This may indicate that teeth move at a similar rate (speed), irrespective of the level of pre-treatment crowding. However, the slightly higher value noted among arches that presented with severe and very severe crowding compared to moderate crowding, may be explained by the fact that these arches had higher values of LII compared to arches with moderate crowding, and since the rate of alignment in this study was measured as a function of change in the LII over time, then it may not be surprising that arches with higher LII reflected higher rate values. There were no available

studies to compare this result with as other studies used the term “rate of alignment” interchangeably with “time of alignment”. Only one study by Cobb et al.²⁴ actually evaluated rate of alignment as a function of reduction of LII over time. But the study by Cobb et al. did not explore the rate of alignment between the levels of pre-treatment crowding.

Conclusion

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

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

Contributions

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

Funding/grants

This study was funded solely by the authors.

Conflict of interest

None declared.

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Adorning with Oral Ornaments and its Implication on Orthodontic Treatment: A Review of the Literature and Case Reports.

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Abstract

The prevalence of perioral/oral body modifications has been on the increase in recent years with the dental impact documented. This paper aimed to review the literature regarding the use of various types of oral ornaments and to highlight the clinical implication for orthodontic treatment. Two case reports of female orthodontic patients who presented with silver and gold rings fitted between their teeth were also presented.

The literature contains a limited number of studies, case reports, and reviews describing a wide variety of dental ornaments and complications that could arise following their use. One of the cases presented with an adverse effect associated with the use of dental ornaments. Intra-oral examination of the patient revealed a 2mm space between the lower right central and lateral incisors following the loss of one of the fitted rings, and a shift in the lower dental centre line. Patients need better information on the potential complications associated with the use of oral ornaments. Dental practitioners should educate patients about potential side effects and possible oral, dental, and orthodontic complications.

Keywords: Oral Ornaments, Orthodontic implications, Orthodontic treatment

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Introduction

Enhancing dento-facial appearance has become an integral part of orthodontics and dentistry generally in recent years.¹ This development has paved the way for the growth of modern materials and techniques. However, adornment with tooth jewellery is fast becoming one of the latest unprofessional methods of improving dental appearance in the society today. Humans have always felt the need to modify their bodies by

permanent or temporary means, for different reasons.¹

Nowadays, people are becoming increasingly self-conscious of their appearance and smile, looking for various treatments including body art and cosmetic dental treatments. This is to achieve the desired aesthetic appearance and attention, make a fashion statement, and be unique in the society. Dental aesthetics is not only considered a sign of beauty, but also a sign of wealth and higher social status.¹ Tooth decorations such as tooth jewellery and tattoos have also been used by patients in different parts of the world to enhance dental aesthetics.²⁻⁴ In recent years, the use of orthodontic brackets as tooth decorations or “decorative braces” has emerged.⁵

Tooth decoration refers to “the process of deliberately changing or altering natural tooth tissue

for reasons other than treating a disease". As dentists, therefore, it is not uncommon to come across people who demand something more than just treating oral diseases. Like any other treatment, dental treatments have become one of the necessary aspects of attaining good quality of life.⁶

Despite different reports regarding the use of dental ornaments in many parts of the world, there is a scarcity of data regarding its knowledge and practice among dentists in Nigeria. The purpose of this paper was to report two cases and review the literature on the subject of dental adornment and highlight its implication for orthodontic treatment.

Case report 1

A 25-year-old female student presented in the Orthodontic unit of the Department of Child Dental Health at the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun State, Nigeria for a routine orthodontic assessment.

Clinical assessment

Extraoral findings: The patient had a straight facial profile and a class I skeletal pattern. The labiomental groove was marked with a normal nasolabial angle and the lips were competent with Jackson's classification lip pattern of 3/1.

Intraoral examination: This showed a full complement of all the permanent dentition with an upper midline diastema measuring about 5mm. The lower labial segment showed a 2mm space between

the lower right central and lateral incisors, and a silver ring between the lower left central and lateral incisors. (Figure 1) The ring spanned from the coronal part of the teeth to the interdental gingivae. The incisal relationship was class I with overjet and overbite of 2mm respectively. The canine relationship was class III on the right and class I on the left. The lower centre line was shifted to the left side by about 2mm.

Further enquiry about the presence and purpose of the silver ring on the patient revealed that it was inserted for cosmetic reasons, to improve her facial appearance and self-esteem. The patient revealed that she had two rings fitted, but the ring fitted between the lower right central and lateral incisors fell off a few months after fitting, leaving behind a space between the teeth. On further questioning, she said the rings were fitted by a beautician. She went further to reveal that she was attracted by the appearance and beauty of the ring the first time she saw it being worn by her close relative who later introduced her to the beautician. She claimed she paid a sum of six thousand naira (N6,000) to have the rings fitted. The rings were fitted using a plier and the procedure lasted twenty minutes. She also gave a history of pain during the process of insertion which lasted for a period of three days, but later subsided.



Figure 1: Extraoral and intraoral photographs of case 1.

Case report 2

A 35 year- old trader presented at the orthodontic clinic for an orthodontic assessment.

Intraoral examination showed missing third molars in all quadrants. The upper labial segment showed 3mm space between the upper left lateral incisor and canine, two gold rings between the upper left central and lateral incisors, and between the upper left lateral incisor and canine.

The patient revealed that the rings were fitted by a beautician a year before her presentation in the

orthodontic clinic. She also revealed that the purpose of fitting the ring was purely for beauty and fashion. The patient claimed that her self- esteem had greatly improved following the insertion of the rings. The fitting of the rings was done using a plier and the procedure lasted for a period of twenty-five minutes. She gave a history of sharp pain during the insertion which lasted for about five days but later subsided without the use of analgesics. It cost her a sum of six thousand naira (N6,000) to get the two rings fitted.



Figure 2: Intraoral photographs of case 2.

A Visit to the Beautician's Workshop

A visit to the beautician workshop showed a well-decorated room with many beauticians busy with various cosmetic works being carried out on customers.

On interrogation, one of the beauticians provided insight into a wide range of cosmetic activities available in their practice. She listed a number of activities from body massage, to body piercing and tooth whitening.



Figure 3: Advertising billboard depicting a wide range of the beautician's activities.

Discussion

Discussion and/review of the literature.

The use of body art such as tooth rings, intraoral jewelry, tooth tattoo and piercing of oral and perioral tissues has gained much popularity among adolescents and young adults. Tooth jewelry existed as far back as 2500 B C when it was practiced among the ancient people of southern North America, Egypt and China.⁷ During this period, it was used as a part of the religious rituals and traditions, tribal identification and survival purposes. But today, it is more concentrated on cosmetic function, regaining momentum as a fashion and style statement by many young people. It is a cosmetic dental procedure in which a diamond or any other stone or ring is attached to the tooth surface in order to gain a spark and to look more fashionable.⁸ With the increasing interest in cosmetic dentistry, the use of dental jewelry is gaining importance by the day.

Tooth jewelry, a form of self-expression, has been shown to add special confidence to smile, especially when professionally done.⁹ Aesthetics is believed to be enhanced with the use of tooth jewelry and by doing so, elevates the patients' self esteem and self confidence. Nevertheless, tooth jewelry is perceived

to be indicated only in patients with good oral hygiene and low caries index.

Types of Tooth Jewelry

The various tooth jewelry commonly used include tooth gems, grill jewelry, dazzlers and twinkles, veneer jewelry, tooth rings, tongue studs, lip studs, lip rings, cheek studs and fashionable braces.

Tooth gems

A tooth gem is a crystal glass mounted on a thin foil of aluminum. They help in creating spark and are available in different shapes and colours. (Fig.2) Available shapes include round crystals, gold letters and numbers, and gold facings. Tooth gems are available in nine different colours; diamond, rainbow, ruby, sapphire, emerald, emerald green, aquamarine, pink, and sapphire light.⁹ The desired design can be bonded directly on the tooth surface in a manner similar to the bonding of an orthodontic bracket. It can be removed anytime or can be replaced with any other stone, as there's no drilling involved in the procedure. These crystal glass stones are available in two different sizes, 1.8 mm and 2.6 mm in diameter and ideally for short term attachment.



Fig.4: Tooth Gem

Dazzlers and twinkles

These are the collection of 24-carat gold and white gold jewelry filled with special glass or precious stones and are available in different designs. (Fig.3) The stones are attached directly or embedded in precious metal and then attached to teeth. The metal on which the stones are attached are available in various shapes and sizes.¹⁰

Twinkles are specially designed to be bonded to the tooth and their patented backside is similar to an orthodontic bracket which makes them last longer.

The most commonly used teeth for attachment are the maxillary incisors and canines.



Figure 5: Twinkles

Tooth rings

Another option which helps in the establishment of the standard of living among youngsters is the use of tooth rings. This is similar to tooth gems but the procedure is a little different from tooth gems. In dental rings, a small hole is placed towards the disto-incisal corner of the maxillary incisors and the ring is hung through it. (Fig.4) The most commonly preferred teeth are the maxillary central incisors and the size of the perforation depends on the thickness of the ring selected. Sometimes these rings are embedded with precious stones.

While selecting the diameter of the ring, the available overjet is taken into consideration to avoid occlusal interference. The rings are sometimes made to connect the two central incisors or the central incisor to the lateral incisor.¹¹



Figure 6: Tooth Ring

Dental grills

Grills are most popular with American hip-hop stars and rappers. This is tooth jewelry worn by 18 to 35 year old hip-hop artists and disco jockeys to add on to the extravagance of their performance. It is believed to symbolize monetary success, which is especially important for the social underclass. They are made of solid metal such as gold, silver, or platinum and can also be used with precious stones. Most commonly, they are used to cover the entire section of the maxillary and mandibular anterior teeth. (Fig.6)

The design, positioning, and material is completely unique to the individual. Earlier, they were fitted permanently after tooth preparation but nowadays grills are generally removable.¹²



Figure 7: Dental Grill

Dental tattoo

Dental tattoo, also known as tooth Tattoo, is an ornamental design on teeth. It involves the application of various shades of porcelain in various designs like heart symbols and pets carved on dental ceramic crown and bridge before cementation to the teeth. (Fig.7)



Figure 8: Dental Tattoo

Removable tooth jewelry

The stones are permanently mounted on an invisible glass clear micro-skin which fits accurately onto the teeth. This requires neither etching nor preparation of the teeth. The impression is made and the micro-skin is fabricated in the lab on which the precious stones are attached. This is removable by the patient and can be fitted back when necessary.

Veneer jewelry

Veneer jewelry is made from precious jewelry, mostly gold and platinum. Tooth preparation is done to accommodate the metal veneer which is mostly embedded with precious stones. The teeth preferred for such kinds of jewelry are the cuspids and the bicuspid.

Fashion and/decorative braces

“Fashion braces” are braces that serve as fashion statements without any therapeutic effects of conventional braces. They have unique or aesthetic bracket designs and have become a popular option for many people. Due to the high cost and the belief that orthodontic treatment is an elective luxury, braces have become a sign of financial prosperity and a symbol of status, wealth, and style in some South Asian countries.¹³ Fashion braces are largely provided by dental professionals, however, cheap braces or braces like jewelry are also now available at a much lower cost, and can be fitted in a dental office by general dentists, non-dental practitioners, or even at home.¹⁴ A recent study in Saudi Arabia showed that 74% of decorative braces are not placed by dentists, but rather by the patients themselves, or a friend or family member, using over-the-counter glue.⁵

These fashion braces may have positive or negative impacts on the Oral Health Related Quality of Life (OHRQoL) of individuals. A recent study by Hakami et al¹⁵ showed changes in the OHRQoL of people

wearing braces for fashion only, when compared to those wearing it for therapeutic purposes. The fashion braces group reported significant positive impacts on the psychological and social domains compared to the therapeutic braces group. In addition, the fashion braces group reportedly showed even lower levels of psychological discomfort and disability, which means that fashion braces may indeed help people feel more confident and satisfied with themselves.



Figure 9: Fashion braces with superglue



Figure 10: Removable fashion braces with clasps

Clinical Implications of Dental Ornaments on Orthodontic Practice.

Orthodontic tooth movement is made possible by application of light but prolonged forces. Since most of these tooth jewelries are worn on the tooth surfaces, they can apply pressure to the teeth in a manner similar to the light prolonged forces in the natural environment, including the lips, cheeks, or tongue resting against the teeth. They therefore have the same potential as orthodontic forces to cause the teeth to move to a different location.¹⁶

Tooth jewelry can sometimes cause ulceration of the lips with subsequent interference with lip function. Injury to the soft tissue of the lip could result in scarring and contracture, causing the incisors in this vicinity to move lingually as the lip tightens against them.¹⁶ The ball of the laberette or lip barbell from a tooth-ring rubbing against the mandibular anterior teeth has been shown to cause dehiscence of the facial gingiva in that area.¹⁷⁻¹⁹

Other common complications associated with tooth jewelry and oral piercings include difficulty in speech, swallowing or chewing, and localised tissue overgrowth. Localised tissue overgrowth has been shown to increase the risk of keloid tissue formation.²⁰ Keloid tissue can cause facial asymmetry because of growth restriction on the affected side.²¹

Other complications associated with dental jewelry include metal hypersensitivity, which presents as an allergic reaction affecting the soft tissue. Severe metal hypersensitivity can cause severe soft tissue reaction with subsequent healing by scarring and unwanted tooth movement.^{22,23}

Fixed grills are very difficult to clean; therefore, causing plaque and calculus accumulation underneath them, which could result in periodontal breakdown and eventual tooth loss. In addition, a dental grill can result in chipped teeth, gum recession, and abrasion to adjacent teeth, as well as damage to

the enamel of the opposing teeth- all these result in unpleasant aesthetics. Another complication associated with the use of dental grill is dental caries, gingivitis, and other issues in the gingival margin especially, which if not properly handled could result in tooth loss and spacing in the arch. Unwanted tooth movement could also result from dental grills, especially removable grills worn throughout the day.

If the jewelry type used is too small the ring placed could cut off the blood supply to the surrounding soft tissue causing pain and swelling. On the other hand, if the ring used is too large or heavy, it could lacerate the oral soft tissues, which tend to heal by scarring and this may cause asymmetry.¹¹ The presence of a ring in the oral cavity also stimulates excess saliva production, causing prolonged drooling. Tooth jewelry could cause inflammation and reduced taste sensation. There have been reported cases of gingival recession and loss of alveolar bone in the anterior mandibular region with the use of tooth jewelry.²⁴ Tooth rings inserted in the contact point of two teeth could cause spacing in a manner similar to the action of orthodontic separators, as seen in one of the cases reported in this study, and subsequent drifting of the adjacent tooth, and/or a shift in the dental centre-line. In addition, despite the psychological and social benefits reported with the use of fashion braces, Hakami et al¹⁵ reported in their study that the fashion braces group showed greater functional limitation and physical disability than both the therapeutic and control groups. In other words, people with fashion braces had more problems pronouncing some words, felt their sense of taste worsened, had unsatisfactory diets, and had to interrupt meals due to their braces. In addition, adverse effects on dentition such as unwanted tooth movement, root resorption, caries, and white-spot lesions are some of the potential harms that can result when decorative braces are used.

Unsupervised tooth movement could result in traumatic occlusion which could cause gingival recession.²⁵ In addition, moving teeth without proper treatment planning can move these teeth out of the bone envelope, resulting in bone dehiscence and recession.²⁶ The use of superglue in bonding most of the dental jewelry is toxic and can cause hypersensitivity reactions, swelling, and inflammation of the oral mucosa.²⁷ Furthermore, the use of superglue and other Cyanoacrylates in the oral cavity should be discouraged. This is because when used in bonding, they polymerise via an exothermic reaction which can cause thermal injuries to both the teeth and oral mucosa.²⁸

Conclusion

Though people may prioritise the psychosocial benefits obtained by wearing dental ornaments, the long-term physical and functional consequences are worth thinking about. As health care providers, there is a need to educate the general public about the potential harm and possible oral, dental, and orthodontic complications that could arise from the use of these ornaments

Contribution of authors: Authors contributed substantially to the concept, design, and write-up of the manuscript.

Funding: Funded by the authors.

Conflict of interest: Nil

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Orthodontic Management of Maxillary And Mandibular Midline Diastema

Umeh OD^a, Offojebe UL^b

Abstract

A 23 year-old male with the chief complaint of upper and lower central gaps in his teeth. Orthodontic evaluation gave a diagnosis of Angle's Class I malocclusion on Skeletal Pattern 2 with maxillary and mandibular midline diastema, upper and lower anterior spacing, rotated teeth, abnormal frenal attachment, and non-consonant smile. Malocclusion was successfully treated with upper and lower fixed orthodontic appliance therapy. An aesthetic and stable occlusion was achieved at the completion of treatment. Fixed lingual and thermoplastic retainers were used to ensure stability of treatment outcome

Key words: Diastema, Malocclusion, Orthodontics

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Introduction

Midline diastema is characterized by the occurrence of space between the central incisors in the maxilla and less frequently in the mandible.¹

The prevalence of diastema was found to be 75.3% (Caucasoid), 68.2% (Mongoloids), and 73.9%

(Negroids) in the maxilla, while for the mandible it was found to be 24.7% (Caucasoid), 31.8% (mongoloids), 26.1% (Negroids).² A Nigerian study found the incidence of midline diastema to be 26.1% (maxilla- 21.0%, mandible- 1.9%, and both arches- 3.2%),³ while another found it to be 37%.⁴ It has been shown that midline diastema is more common in the maxilla than in the mandible, with a slight female preponderance.^{3,4,5}

Local factors like abnormal labial frenulum, missing maxillary lateral incisors, ectopic maxillary canines, missing teeth, anterior traumatic bite, tooth size - arch length discrepancies, mesio-distal angulation of the central incisors, inter-arch relationship, oral habits, presence of supernumerary tooth, pathologic lesions of the hard and soft tissue, iatrogenic causes, or physiologic development have been associated with the etiology of midline diastema. In addition to all these, genetic influences also play a vital role in its etiology.^{6,7}

Midline diastema is usually considered a thing of beauty in this part of the world.⁵ It was found that midline diastemas located in the maxilla, of about 2mm to 3mm in width, are preferred to their larger counterparts.⁸ There has been reports of individuals going as far as artificially creating maxillary midline diastema.⁹ The decision to treat is usually dependent on patient's preference and presence of any other associated occlusal discrepancies.⁵

The outcome of midline diastemas varies, some

resolving spontaneously while others may require intervention.¹⁰ Possible therapeutic approaches to the management of midline diastemas requiring intervention may include either orthodontic, restorative, or surgical approach. Various combinations of the therapeutic approaches mentioned above may also be employed.¹¹

Diagnosis and Aetiology

A 23 year-old male with the chief complaint of large gaps between the upper and lower front teeth (maxillary and mandibular midline diastema). He was more concerned about the gap in the upper arch

proportions. The lips were mildly incompetent with a Jackson's lip pattern of 2 over 1, with a non-consonant smile (Fig 1). Intraoral evaluation revealed a full complement of teeth from the central incisors to the third molar in all quadrants. The molar relationships were Angle's Class I on both sides. Anterior overjet was 3mm and overbite was reduced and complete. The upper midline was coincident with the midline of the face, and a lower midline deviation to the right by 1 mm. There was also the presence of maxillary abnormal frenal attachment (Figure 1).

Examination of the upper arch revealed a moderate upper anterior segment spacing of 6.5 millimeters



Figure 1: Pre-treatment facial and intraoral photographs

and also wanted to close up other spaces between the teeth. He was eager to improve his appearance and self-esteem by undergoing orthodontic treatment. He was in good health with no significant systemic medical history. Extra oral evaluation revealed a concave profile with facial symmetry, good chin-throat support, soft tissue line, and normal vertical

inclusive of a midline diastema of 4 millimeters (mm), proclined upper incisors, and slight mesiolabial rotations of the upper left central incisors and canine (Figure 1). The lower arch revealed a 3mm midline diastema, 3mm posterior segment spacing, proclined incisors, rotation of the mandibular left canine, and an exaggerated curve of spee.

The panoramic radiograph showed the presence of all the teeth. Presence of periodontal compromise was evidenced by horizontal and vertical bone loss, especially on the mesial and distal root surfaces of the mandibular left second premolar and right second



Figure 2: Pre-treatment panoramic radiograph

molar, as well as the mesial surface of the mandibular left second molar (Figure 2).

Cephalometric analysis showed a Class I skeletal pattern 2 with increased upper and lower incisal angles, proclined upper and lower incisors and reduced interincisal angle (IIA), Frankfort mandibular plane angle (FMA) and lower facial



Figure 3: Pre-treatment cephalometric radiograph

height (LFH) (Figure 3, Table 1).

Based on these findings, the patient was diagnosed with Angles Class I malocclusion on Skeletal Pattern 2, complicated by maxillary and mandibular midline diastema, severe upper anterior segment spacing, mild lower posterior segment spacing. Also diagnosed were, proclined maxillary and mandibular incisors, low maxillary frenal attachment, lower midline deviation, mild rotations and exaggerated curve of spee in the mandible .

Treatment Objectives

The orthodontic treatment objectives for this patient were to (1) close up the maxillary and mandibular midline diastema as well as other spaces (2) retrocline proclined upper and lower incisors (3) correct mandibular midline deviation (4) derotate rotated teeth (5) level the mandibular curve of spee (6) achieve lip competence and (7) achieve a consonant smile. These objectives were to be achieved while maintaining the stable occlusion, and the Class I molar relationship with the ultimate aim of improving the patient's appearance and self-confidence.

Treatment Alternatives

The primary complaint of the patient was the midline diastema in the mandibular and maxillary arches. Based on literature review, the following treatment options were recommended:

1. Fixed appliance therapy, pre-adjusted edgewise; the non-extraction treatment. The options of using either the metal or ceramic Roth 022 slot and space closure on 019 X 025 stainless steel wire was suggested. This will be followed by frenectomy to reposition the frenal attachment at the end of space closure.
2. The use of aligners without extractions followed by the frenectomy procedure was the second option. This option is more aesthetic than the previous option. A major drawback to this option was the high cost of treatment relative to option 1.

The Retention plan was to use fixed lingual and thermoplastic retainers in the upper and lower arches.

After explaining the pros and cons of each alternative to the patient, he selected the first option for treatment.

Treatment Progress

Treatment began with oral hygiene prophylaxis and



Figure 4: Intra treatment photographs



Figure 5: Post treatment facial and intraoral photographs

periodontal management of the periodontally compromised teeth. This was followed by bonding the teeth from the incisors to the second molars in all quadrants. Bondable buccal tubes were used on the molars instead of bands due to the presence of periodontal pockets around the molars at presentation. Levelling and alignment was achieved by sequential use of nickel titanium wires (014, 016, 018, 020 inches) and 020 inches stainless steel wires. The midline diastema and other intra arch diastema were closed by the use of elastic chain and active tie backs on 019 by 025 inches stainless steel wire.(Figure 4)

Active treatment took 19 months. Fixed lingual and thermoplastic retainers were used to maintain the positions of the teeth after treatment.

Treatment Results

The teeth were well aligned and leveled at the end of treatment. The Class I molar and canine relationships were maintained. Lip competence was achieved with a satisfactory consonant smile (Figure 5)

Complete closure of the mandibular and maxillary midline diastema as well as other spaces within the

area was achieved (Figure 5). There was correction of the mandibular midline deviation, derotation of rotated teeth and leveling of the exaggerated curve of spee in the mandible.

The post treatment cephalometric analysis showed that the normal mandibular and maxillary incisal



Figure 6: Post treatment cephalometric radiograph

angles were achieved with satisfactory soft tissue balance. (Figure 6, Table 2).

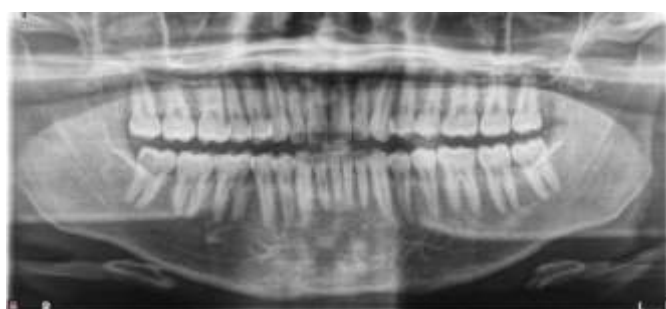
Root parallelism was achieved and there was significant root resorption from the evaluation of the post treatment panoramic radiograph (Figure 7).

Table 1: Pre-treatment cephalometric measurements

Measurement	Pre-treatment values	Range for Nigerian norms	Comment
SNA	87.5°	85.5 ° ±3.5	Normal
SNB	82.5°	82.7 ° ±3.0	Normal
ANB	5°	2-4 °	Increased
U1 TO FP	128°	119-127 °	Increased
L1 TO MP	108°	96-104 °	Increased
IIA	101.5°	108-116 °	Reduced
FMA	23°	24-26 °	Reduced
LFH	53%	55%	Reduced

Table 2: Post-treatment cephalometric measurements

Measurement	Post-treatment values	Range for Nigerian norms	Comment
SNA	87.5°	85.5 ° ±3.5	Normal
SNB	83°	82.7 ° ±3.0	Normal
ANB	4.5°	2-4 °	Increased
U1 TO FP	124°	119-127 °	Normal
L1 TO MP	101°	96-104 °	Normal
IIA	112°	108-116 °	Normal
FMA	24.5°	24-26 °	Reduced
LFH	54%	55%	Reduced

**Figure 7: Post treatment panoramic radiograph****Figure 8: Pre and post treatment facial and intraoral photographs**

Discussion

The presence of a midline diastema may pose both an aesthetic and psychological problem due to its prominent position in the dental arch, hence the constant request for correction by the patients, especially wide diastemas. Although multiple developmental, genetic and environmental factors have been incriminated in the aetiology of midline line diastema, it is believed to be mainly a multifactorial phenomenon.^{6,7} Nonetheless, for effective management, accurate diagnosis and aetiology is required, putting into consideration also if it occurs as a single entity or in conjunction with other dental or occlusal anomalies.^{6,12,13}

Management of midline diastema is usually interdisciplinary in approach; with treatment options ranging from simple or complex restorative treatment to orthodontic and surgical procedures depending on the aetiology. In this case report, the aetiology was a combination of tooth size-arch length discrepancy and high frenal attachment. Orthodontic treatment was considered due to the existence of other occlusal anomalies which were of concern to the patient, followed by frenectomy at the completion of orthodontic space closure.

In the orthodontic management of this patient, the use of bands as attachment on the molars were avoided to prevent further plaque accumulation, bacterial colonization and aggravation of the existing periodontal disease. Separator placement and band cementation have been associated with bacteremia.¹⁴

Treatment outcome in the case report was successful. The maxillary and mandibular midline diastema was closed at the end of treatment. Upper and lower spaces were closed and incisor proclination were corrected. Derotation of teeth was carried out and

overbite corrected. Lip competence and a consonant smile achieved. Most importantly, the periodontal health of the patient was preserved at the end of orthodontic treatment as seen in the post orthodontic treatment panoramic radiograph (Figure. 7).

The patient however declined the frenectomy procedure after completion of orthodontic treatment despite being informed extensively of the risk of relapse if not carried out. A fixed lingual retainer in conjunction with thermoplastic retainer was therefore employed as the retention protocol.

Retention protocol of midline diastema is of extreme importance for long term stability of treatment outcome, with aetiology of importance in this decision making.⁷

Conclusion

Orthodontic treatment is a treatment option for the management of midline diastema. This case reports a case of maxillary and mandibular midline diastema occurring in conjunction with other occlusal anomalies. The aetiologic factors implicated were tooth size- arch length discrepancy and abnormal frenal attachment. It was successfully treated using a fixed orthodontic appliance. The treatment outcome was satisfactory.

Authors' Contributions

All the authors contributed to the conceptualization, design, and write-up of the manuscript.

Funding/Grants

Self-funded

Conflict of Interest

Nil

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Orthodontic Management of a Bilaterally Missing Lower Incisors with Moderate Upper Anterior Crowding.

Adeyemi TE^a, Otuyemi OD^b

Abstract

Background: Hypodontia is also known as tooth agenesis and it refers to a situation whereby one or more teeth are absent due to lack of formation of one or more teeth. This shows how a case of bilaterally missing mandibular lateral incisors was managed.

Methods: The case was managed with the use of fixed orthodontic appliance therapy and crown reshaping.

Results: The maxillary anterior crowding was resolved; the space created by the missing mandibular lateral incisors; over malocclusion traits identified were resolved satisfactorily.

Conclusion:

The malocclusion was successfully treated with upper and lower fixed orthodontic appliance therapy.

An aesthetic and stable occlusion was achieved at the completion of treatment. Hawley's retainers were used to ensure stability of treatment outcome.

Keywords: Hypodontia, Lateral incisors, mandibular incisors, Crowding, Crown conversion

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Introduction

Hypodontia is also known as tooth agenesis and it refers to a situation whereby one or more teeth are absent due to lack of formation of one or more teeth. It is the most common craniofacial malformation in humans which can occur as part of a known genetic syndrome or as a non-syndromic isolated trait.¹

The mandibular second premolars, maxillary lateral incisors, followed by the mandibular incisors and maxillary premolars are the most affected teeth.²

Hypodontia may affect the speech, aesthetics, chewing and balance of the occlusion due to unfavorable occlusal contacts as a result of the supra-eruption of the opposing teeth or how the teeth adjacent to it is inclined, thereby affecting the quality of life too.^{3,4}

A number of treatment options are available for hypodontia which includes: space closure with the repositioning of the canines mesially, followed by teeth recontouring; or space opening followed by prosthetic replacement of the missing lateral incisor.^{5,6}

This manuscript discusses the treatment options available for hypodontia and reports the orthodontic treatment given to a 33-year-old female with bilateral hypodontia of the mandibular lateral incisors.

Case report

A 33-year-old female with chief complaint of not liking the arrangement of her teeth. She was very

concerned about the overlapping of the upper front teeth and the spaces in the lower front jaw.

She was willing to undergo treatment to correct the arrangement of her upper teeth and to close the spaces in the lower teeth in order to improve her appearance and self-esteem. She had no known systemic disease. Extraoral evaluation revealed a concave profile with facial symmetry and normal vertical proportions. Lips were potentially competent with a Jacksons lip pattern of 2 over 1; intraoral evaluation revealed a bilaterally missing lower lateral incisors with other complement of teeth present in both jaws from the central incisors to the third molar in all quadrants. The molar relationships were Angle's Class I on both sides with skeletal pattern 2 complicated by: bilaterally missing mandibular lateral incisors, increased overjet of 8mm, deep and traumatic overbite, disto-labial rotation of maxillary central incisors; moderate upper anterior crowding; lower midline deviation to the left by 1mm, mild lower anterior segment spacing, bilaterally impacted mandibular third



Figure 1: Pre treatment photographs

molars. (Figures 1 and 2)

The panoramic radiograph showed the presence of all the teeth except the mandibular lateral incisors; it also shows impacted third molars in all quadrants; cephalometric analysis showed values as presented in Figure 3 and Table 1.

Treatment objectives: The objectives of treatment in this patients were to: To level and align upper and lower arches, correct overbite, correct midline deviation, correct overjet, close spaces, crown conversion of the mandibular canines to laterals and mandibular first premolars to canines bilaterally,

Surgically extract impacted molars, maintain angle's class I relationship and retention of the achieved treatment outcomes.

Treatment options: Based on the complaints of the patient and evidence from available literature, the following options were considered possible:

1. Interdisciplinary management with restorative dentist for crown conversion of the mandibular canines to laterals and mandibular first premolars to canines bilaterally together with Upper and lower fixed appliance with

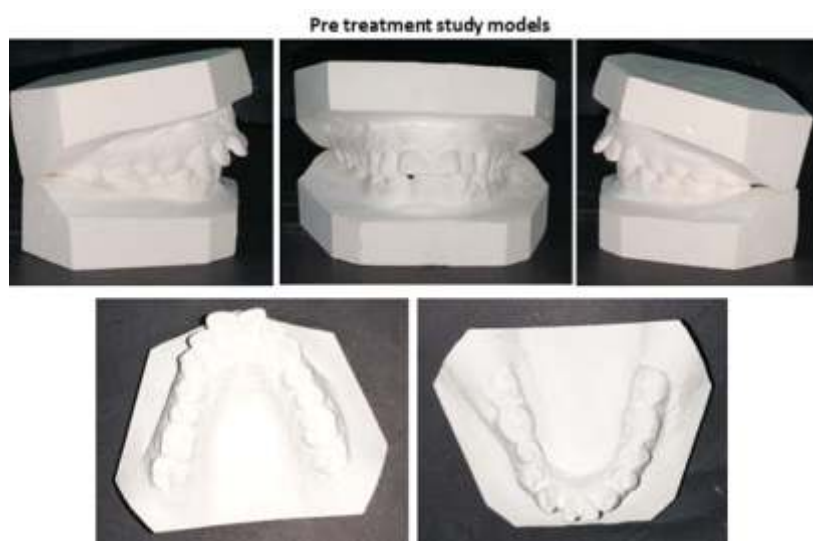


Figure 2: Pre treatment study models

extractions of the maxillary first premolars.

2. Interdisciplinary management with restorative dentist to replace missing lateral incisors bilaterally together with Upper and lower fixed appliance with extractions of the maxillary first premolars.

Treatment plan

Interdisciplinary management with a restorative dentist for crown conversion of the mandibular canines to laterals and mandibular first premolars to canines bilaterally, with Upper and lower fixed appliance with extractions of the maxillary first premolars was adopted for the patient for the correction of her malocclusion.

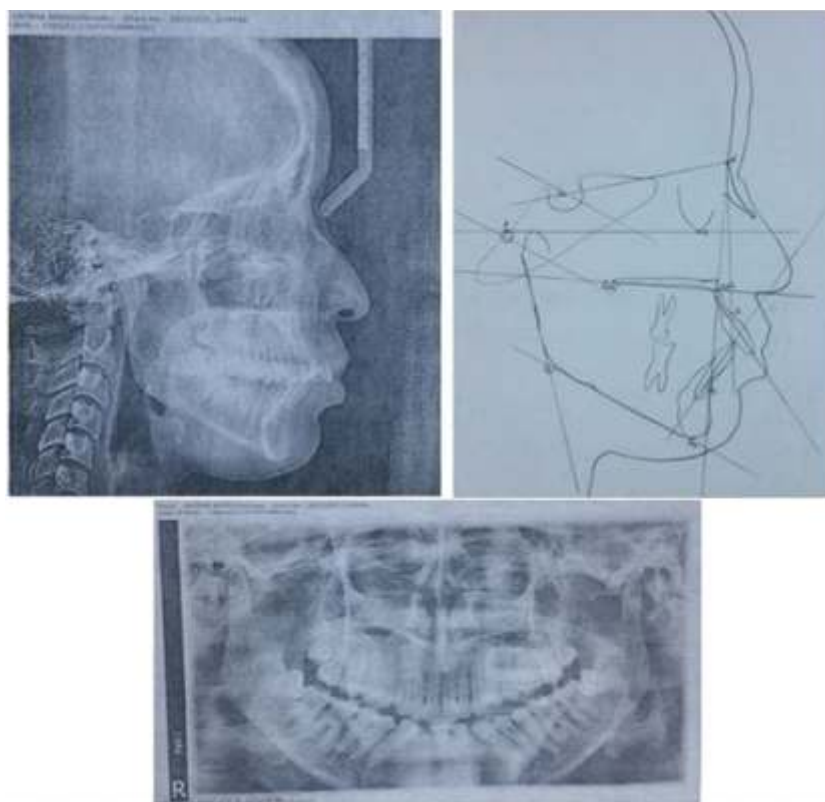


Figure 3: Pre treatment radiographs

Table 1: Pre treatment Cephalometric Analysis

Parameter	Obtained values	Normal Value	Analysis
SNA	80°	85.3 ±2.7°	Decreased
SNB	74,5°	82.5±3.5 °	Decreased
ANB	5.5°	2-4 °	Increased
SKP	2		
U1-MXP	128°	119-127 °	Increased
L1-MDP	96.5°	96-104 °	Normal
U1-L1	113°	108-116 °	Normal
MMPA	23°		
FMPA	26.5°	24-26 °	
LFHP	54.5%		

Treatment progression: Treatment began with oral hygiene prophylaxis and extraction of impacted third molars in all quadrants and maxillary first premolars.

This was followed two weeks later by cementing molar bands on all the first molar teeth, using glass ionomer cement and bonding Roth 022 prescription

brackets, using orthodontic composite. Lacebacks were put in all quadrants from canine to first molar; Levelling and alignment was achieved by the sequential use of nickel titanium wires (014, 016, 018, 020 inches) and stainless steel wires (020, 0.016 X 0.025, 0.019 X 0.025 inches).

The intra-arch spaces were closed by the use of elastic chains on 019 by 025 inches stainless steel wire; the midline deviation was corrected by use of

Class II elastics on the left and class III elastics on the right side. (Figure 4)

Conversion of mandibular canine to lateral incisor and premolar to canine, bilaterally done by the restorative dentist and the brackets repositioned thereafter.

Active treatment took 15 months. Hawley's retainers were used to maintain the positions of the teeth after treatment.

Treatment progress



Figure 4: Treatment progress photographs



Figure 5: Post treatment photographs



Figure 6: Post treatment Hawley's retainers



Figure 7: Post treatment study models

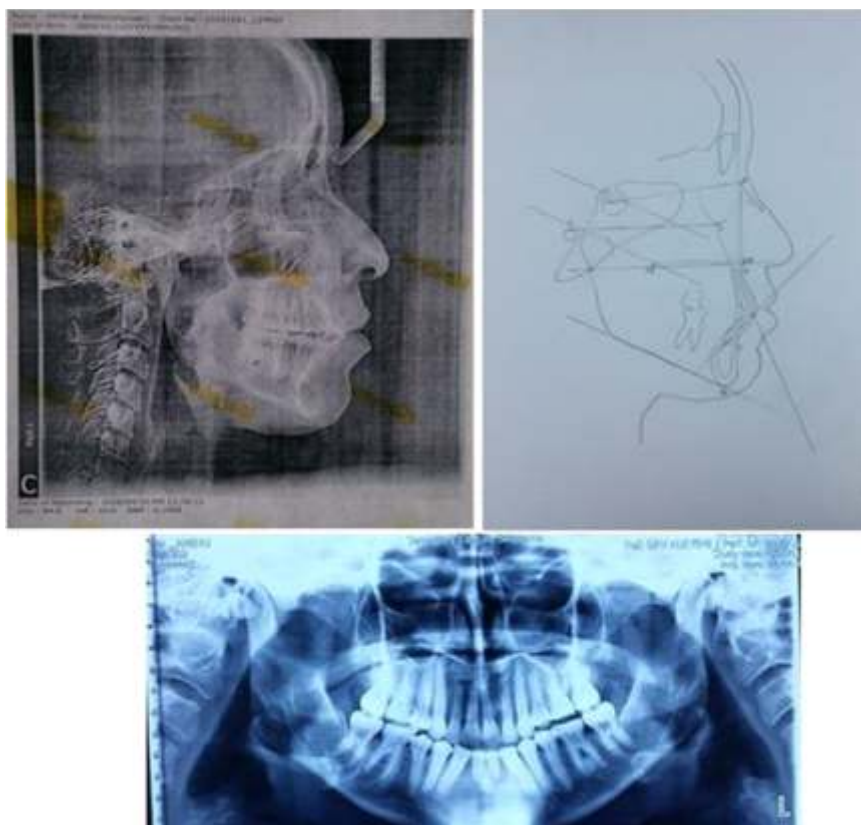


Figure 8: Post treatment radiographs

Table 2: Pre treatment Cephalometric Analysis

Parameter	Post treatment	Pre treatment	Normal Value	Analysis
SNA	83	80°	85.3 ±2.7°	Normal
SNB	80	74,5°	82.5±3.5 °	Normal
ANB	3	5.5°	2-4 °	Normal
SKP	1	2		
U1-MXP	112	128°	119-127 °	Decreased
L1-MDP	112	96.5°	96-104 °	Increased
U1-L1	112	113°	108-116 °	Normal
MMPA	26.5	23°		
FMPA	25.5	26.5°	24-26 °	
LFHP	60	54.5%		

**Figure 9: Pre and Post treatment photographs**

Treatment results

The teeth were well aligned and leveled at the end of treatment. The Class I molar and canine relationships were maintained. Lip competence was achieved with a satisfactory consonant smile; the mandibular midline was corrected; overjet and overjet reduced; spaces closed; crown conversions of mandibular canines to lateral incisors and mandibular first premolars to canines (Figures 5, 6, 7 and 9)

The post treatment cephalometric analysis showed that the normal mandibular and maxillary incisal angles were achieved with satisfactory soft tissue balance; root parallelism was also achieved. (Figure 8, Table 2).

Discussion

We treated a case of moderate crowding of the maxillary anterior with bilaterally missing mandibular lateral incisors amongst other malocclusion traits.

In order to create space for the resolution of the maxillary anterior crowding and also have space to reduce the overjet, extractions of the first maxillary premolars were carried out.

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The mandibular lateral incisors were bilaterally missing and after discussing treatment options with the patient, we agreed that the best option for the patient was to close the space orthodontically and carry out crown conversions accordingly. Among the Caucasians,⁷ the maxillary lateral incisors are the most commonly missing teeth while the mandibular incisors are the most commonly missing among the Japanese.⁸

The treatment of this patient progressed according to plan starting with surgical extractions of impacted teeth, routine extractions of the maxillary first premolar teeth, fixed orthodontic appliance therapy, crown conversion and finally retention. The objectives of treatment were achieved as shown in the steps outlined.

Conclusion

This shows that the malocclusion in the 33 year old female was successfully treated with upper and lower fixed orthodontic appliance therapy.

An aesthetic and stable occlusion was achieved at the completion of treatment. Hawley's retainers were used to ensure stability of treatment outcome.

Instructions for Authors

West African Journal of Orthodontics is a peer-reviewed journal published by affiliated Orthodontic Groups and Associations in the West African Sub region. The journal gives priority to reports of outstanding clinical and experimental and epidemiological works on malocclusion, dento-facial defects as well as important contributions related to common orthodontic problems in children, adolescents and adults worldwide.

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Acknowledgements

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