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Oral Health Behaviour and Compliance of Nigerian Adolescents to Orthodontic Treatment

Occlusal Relationships in the Primary Dentition of Senegalese aged 5-6 years

Evidence-based Orthodontic Practice in Nigeria

Strategic Advantage for Sustainable Success in Orthodontics

CASE REPORT
Management of a Severe Gummy Smile with TADs

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Contents

Original Articles

Oral Health Behaviour, Patient/Parent-Orthodontist Relationship and Compliance of Nigerian Adolescents to Fixed Orthodontic Appliance Treatment

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Abstract

Background: Poor oral health behaviour and non-compliance to orthodontic instructions have been reported to diminish the satisfactory outcome and benefits that a patient experiences during or after orthodontic treatment. The purposes of this study were to assess the oral health behaviour, patient/parent-orthodontist relationship, and the socio-demographic factors influencing compliance of Nigerian adolescents to fixed orthodontic appliance treatment.

Methods: A 28-item questionnaire was administered to 146 adolescents undergoing fixed orthodontic appliance treatment in three Nigerian teaching hospitals located in different cities with varying levels of population density. The questions assessed oral health behaviour, level of compliance to instructions during treatment, and the level of interaction of the patient with the orthodontist.

Results: While more female patients frequently indulged in chewing sticky sweets ($p<0.05$), the males were more involved in contact sports ($p<0.001$) during the fixed orthodontic appliance treatment. Mother's educational level, the population density of the city where the dental practice is located, and the length of treatment influenced orthodontic compliance significantly ($p<0.05$). Personal likeness for the orthodontist, awareness of the consequences of poor compliance by patients, as well as prior discussion of treatment goals with parents significantly improved compliance to orthodontic treatment.

Conclusions: This study concluded that gender affected oral health behaviour during orthodontic treatment. Mother's level of education, awareness of deleterious effects of treatment, duration of orthodontic treatment, and patient/parent-orthodontist relationship, significantly influenced compliance to fixed orthodontic appliance therapy.

Key words: Oral health behaviour, compliance, patient/parent-orthodontist relationship, fixed orthodontic treatment

ORIGINAL ARTICLE

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Introduction

Fixed orthodontic appliance therapy as an important tool in the treatment of malocclusion has long served as a means of providing patients with improved dento-facial aesthetic, functional, and psychosocial benefits. Unfortunately, negative oral health behaviour and non-compliance to orthodontic instructions have been reported to diminish the satisfaction and benefits that a patient experiences during orthodontic treatment.[1]

From the orthodontic professional point of view, treatments that should normally last for 18-24 months are unnecessarily prolonged, thus leading to frustration on the part of the orthodontist.[2,3] It is a fact that treatment with the fixed orthodontic appliance is often associated with greater plaque accumulation due to difficulty in tooth cleaning especially in areas around the brackets and the gingival margins. However, negative oral health attitudes and behaviour can also jeopardize or impede successful treatment outcome.[4] Plaque, if not removed, can lead to several adverse conditions such as the occurrence of hyperplastic gingivitis, periodontal breakdown (in severe cases), enamel decalcification and white spots caused by highly

acidic plaque, and carious lesions.[5-7] Compliance with oral hygiene instructions is essential for patients in all age groups, but critical during adolescence, as patient's behaviour, personality, and self-image are formed during this transitional phase. [9,10]

Paradoxically, the stress associated with this age makes compliance more difficult. According to Mehra et al., [11] 5% to 10% of orthodontic patients do not complete their treatment due to poor oral hygiene habits. Morris et al., [12] and Feil et al.,[13] showed a compliance rate of about 50% with long-term treatment procedures like orthodontic treatments. Orthodontists are often able to predict correctly the future compliance of new patients during their early treatment stages.[9,14,15] Some behavioural and socio-demographic factors such as gender, age, and socio-economic status, psychosocial and psychological factors, self-restraint, self-esteem, relationship with parents, peers, and the orthodontist have been found to affect compliance in adolescents.[9,14,15] General and health-related issues have also been found to influence the level of compliance in adolescent patients in several ways.[14-17] To improve patient's compliance during orthodontic treatment, Richter et al[1] reported that the award/reward system may help motivate individuals who are in the below-average complier group to comply with prescribed instructions.

Therefore, this study aimed to investigate the oral health behaviour and some socio-demographics that may militate against effective compliance to fixed orthodontic appliance treatment among Nigerian adolescents. The study also examined the relationship between patient/ parent and the orthodontist during the treatment period.

The Null hypothesis was that in this study , there are no significant gender differences in negative oral health behaviour, no significant differences in socio-demographics, and patient/ parent-orthodontist relationship between the compliant and non-compliant groups.

Materials and Methods

Ethical approval with protocol number IPHOAU/12/599U was obtained from the Health Research Ethics Committee (HERC) of the Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria. Informed consent was obtained from the participants before enrolment, after duly explaining the objectives of the study, the risks and benefits, voluntary nature of study participation, and freedom to withdraw from the study. For those younger than 18 years, parental consent was sought after obtaining the subject's assent. Participants in this study experienced no direct benefit and no compensation was paid to them.

Permission to conduct the study was obtained from each local hospital authority. The participants were randomly drawn from the orthodontic clinics of three Nigerian teaching hospitals at Ile-Ife (low-density population-280 persons/km^2), Ibadan (medium density population-985 persons/km^2) and Lagos (high density population-14,469 persons/km^2). Strict ethical standards and procedures were adhered to in administering the questionnaires. Participants' confidentiality was guaranteed by excluding identification numbers on the questionnaire so that information would not be traced back to individuals.

The inclusion criterion was patients aged 10-19 years undergoing fixed orthodontic appliance treatment. The exclusion criteria were previous orthodontic treatment and lack of consent to participate in the study.

A pre-structured self-administered questionnaire consisting of twenty-eight questions in two domains with multiple answers (yes/no) was used to assess the compliance of adolescent patients receiving fixed orthodontic appliance treatment in which the subjects were asked to tick one correct answer. The first domain assessed the oral health behaviour and the level of compliance to instructions during treatment. Second domain consisted of questions on the level of interaction of the patient with the orthodontist.

Data was entered into a personal computer and analysis was performed using Statistical Package for Social Science. (SPSS Version 16.0 for windows, SPSS inc, Chicago). Simple descriptive and inferential statistics were used for the analysis.

Results

A total of 146 adolescents currently undergoing orthodontic treatment were recruited in the study. There were 72 (49.3%) males and 74 (50.3%) females. The mean age of respondents was 14.7±2.5 years with ages ranging from 10 to 19 years, while their mean orthodontic treatment time was 16.4±12.4 months, ranging from 1 to 70 months.

Table 1 demonstrates the socio-demographic distribution of the 146 adolescent patients who participated in the study. Most of the respondents (61.6%) were young adolescents between the ages of

10 and 15 years, while the remaining 38.4% were older adolescents aged 16-19 years. There was no significant gender difference among respondents in the sample population.

Furthermore, most of the respondents (80.1%) belonged to families with more than three siblings, while about one-fifth (19.9%) of the families had three or fewer children. Most of the adolescents (63.0%) were in the middle position amongst the siblings and more than half had at least secondary school education (77.4%). Over 90% of respondents' parents (both fathers and mothers) had tertiary education. The adolescents from the low population density of Ile-Ife city constituted 42.5 percent of the respondents, while the least was from the medium population density of Ibadan city (19.9%). Only about one-third were from the high population density of the cosmopolitan city of Lagos. Also, about two-thirds of the respondents had been on treatment for 18 months or less.

Negative oral health and social behaviour detrimental to fixed orthodontic appliance treatment according to gender are presented in Tables 2 and 3. More female patients (73.0%) frequently indulged in chewing sticky sweets detrimental to good oral health behaviour than their male counterparts (50.0%) during the treatment and this was statistically significant ($p<0.05$). Similarly, more male adolescents (70.8%) were involved in contact sports during fixed orthodontic appliance treatment than their female counterparts (33.8%). The difference was also found to be quite significant statistically ($p<0.001$). Interestingly, the only three adolescent smokers reported in this study were all males.

The relationship between compliance during fixed orthodontic appliance treatment and socio-demographic characteristics is presented in Table 4. Generally, the majority of respondents in the sample population (73.3%) were compliant with treatment instructions during the treatment period. There were no significant differences in compliance regarding age group, gender, number and position of patient in the family, as well as patients' and fathers' educational levels. However, mother's educational level ($p<0.05$), population density of the city where the dental clinic is located ($p<0.001$), and the length of treatment time ($p<0.05$) influenced fixed orthodontic treatment compliance significantly.

Table 5 shows patient/parent-orthodontist relationship and the level of compliance to fixed orthodontic appliance treatment. More of the compliant group personally liked their orthodontist when compared to the non-compliant group. This difference was statistically significant ($p<0.05$). Similarly, all the compliant adolescent patients were fully aware of the consequences of poor compliance to fixed orthodontic treatment outcomes when compared to the 92.3 per cent of the non-compliant group. This was also found to be very highly statistically significant ($p<0.001$).

Previous discussion of treatment goals with parents of patients before embarking on fixed orthodontic appliance therapy had a highly significant impact on compliance to treatment ($p<0.01$).

Table 1: Socio-demographic variables of Nigerian adolescents undergoing fixed orthodontic appliance treatment

	Variables	Frequency	Percentage
Age (years)			
	10-15 (young adolescents)	90	61.6
	16-19 (older adolescents)	56	38.4
Gender			
	Male	72	49.3
	Female	74	50.7
Number of children in the family	≤3	29	19.9
	>3	117	80.1
Position in the family			
	First	30	20.5
	Middle	92	63.0
	Last	24	16.5

Variables		Frequency	Percentage
Patient's educational level			
	Primary	4	2.7
	Secondary	113	77.4
	Tertiary	29	19.9
Father's educational level			
	Primary	5	3.4
	Secondary	6	4.1
	Tertiary	135	92.5
Mother's educational level			
	Primary	7	4.8
	Secondary	7	4.8
	Tertiary	132	90.4
Location			
	Low population density (Ile-Ife)	62	42.5
	Medium population density (Ibadan)	29	19.9
	High population density (Lagos)	55	37.6
Length of orthodontic treatment (months)			
	≤ 18	99	67.8
	> 18	47	32.2

Table 2: Oral health behaviour detrimental to fixed orthodontic appliance treatment according to gender

Oral habit during treatment		Male(%)	Female(%)	x^2	p-value
Brushing less than twice a day					
	Yes	18(46.2)	54(50.5)		
	No	21(53.8)	53(49.5)	0.21	0.65
Digit sucking					
	Yes	9(12.5)	14(18.9)		
	No	63(87.5)	60(81.1)	1.13	0.29
Finger nail biting					
	Yes	12(16.7)	20(27.0)		
	No	60(83.3)	54(73.0)	2.29	0.13
Tongue thrusting habit					
	Yes	11(15.3)	13(17.6)		
	No	61(84.7)	61(82.4)	0.14	0.72
Biting on pen/pencil					
	Yes	11(15.3)	14(18.9)		
	No	61(84.7)	60(81.1)	0.34	0.56
Frequent chewing of sticky sweets					
	Yes	36(50.0)	50(73.0)		
	No	36(50.0)	24(27.0)	4.65	0.03*
Frequent chewing of gum					
	Yes	36(50.0)	28(37.8)		
	No	36(50.0)	46(62.2)	2.19	0.14

Oral habit during treatment		Male(%)	Female(%)	x^2	p-value
Eating hard food stuff					
	Yes	53(73.6)	54(73.0)		
	No	19(26.4)	20(27.0)	0.01	0.93
Eating in-between meals					
	Yes	52(45.6)	20(62.5)		
	No	62(54.4)	12(37.5)	2.85	0.09
Eating late at night					
	Yes	36(50.0)	39(52.7)		
	No	36(50.0)	35(47.3)	0.11	0.74

* significant p<0.05; **highly significant p<0.01; ***very highly significant p<0.001

Table 3: Negative social behaviour during fixed orthodontic appliance treatment according to gender

Habits during treatment		Male(%)	Female(%)	x^2	p-value
Smoking					
	Yes	3(4.2)	0(0.0)		
	No	69(95.8)	74(100.0)	3.15	0.08
Not keeping appointment					
	Yes	17(23.6)	23(31.1)		
	No	55(76.4)	51(68.9)	1.02	0.31
Play with braces					
	Yes	11(15.3)	20(27.0)		
	No	61(84.7)	54(73.0)	3.01	0.08
Involvement in contact sport					
	Yes	51(70.8)	25(33.8)		
	No	21(29.2)	49(66.2)	20.07	0.00***
Scare/intimidate children with braces					
	Yes	16(22.2)	16(21.6)		
	No	56(77.8)	58(78.4)	0.01	0.93
Brawl/fight with braces					
	Yes	27(37.5)	23(31.1)		
	No	45(62.5)	51(68.9)	0.67	0.41

* significant p<0.05; **highly significant p<0.01; ***very highly significant p<0.001

Table 4: Relationship between compliance during fixed orthodontic appliance treatment and socio-demographic characteristics

Variables	Compliance(%)	Non-compliance(%)	x^2	p-value
Age (years)				
10-15 (young adolescents)	64(59.8)	26(66.7)		
16-19 (older adolescents)	43(40.2)	13(33.3)	0.57	0.45
Gender				
Male	53(49.5)	19(48.7)		
Female	54(50.5)	20(51.3)	0.01	0.93
Number of children in the family				
≤ 3	17(15.9)	12(30.8)		
> 3	90(84.1)	27(69.2)	3.98	0.05

Variables	Compliance(%)	Non-compliance(%)	x^2	p-value
Position in the family				
First	22(20.6)	8(20.5)		
Middle	71(66.4)	21(53.9)	3.45	0.18
Last	14(13.0)	10(25.6)		
Patient educational level				
Primary	3(2.8)	1(2.6)		
Secondary	85(79.4)	28(71.8)	1.12	0.57
Tertiary	19(17.8)	10(25.6)		
Father's educational level				
Primary	2(1.9)	3(7.7)		
Secondary	3(2.8)	3(7.7)	4.85	0.09
Tertiary	102(95.3)	33(84.6)		
Mother's educational level				
Primary	3(2.8)	4(10.3)		
Secondary	3(2.8)	4(10.3)	7.32	0.03*
Tertiary	101(94.4)	31(79.4)		
Location				
Low density population (Ile-Ife)	56(52.3)	6(15.4)		
Medium density population (Ibadan)	17(15.9)	12(30.8)	16.07	0.00***
High density population (Lagos)	34(31.8)	21(53.8)		
Length of orthodontic treatment time (months)				
≤18	78(72.9)	21(53.8)		
>18	29(27.1)	18(46.2)	4.75	0.03*

* significant p<0.05; **highly significant p<0.01; ***very highly significant p<0.001

Table 5: Patient/parent-orthodontist relationship and compliance to fixed orthodontic appliance treatment

Relationship		Compliance(%)	Non-compliance(%)	x^2	p-value
Patient liked the orthodontist					
	Yes	72(67.3)	19(48.7)		
	No	35(32.7)	20(51.3)	4.20	0.04*
Awareness of consequences of poor compliance by patient					
	Yes	107(100.0)	36 (92.3)		
	No	0(0.0)	3(7.7)	8.40	0.00***
Discipline/sanction of patient by parent for poor compliance					
	Yes	59(55.1)	23(59.0)		
	No	48(44.9)	16(41.0)	0.17	0.68
Possible sanction of patient in form of additional charges/fees for poor compliance					
	Yes	45(42.1)	17(43.6)	0.03	0.87
	No	62(57.9)	22(56.4)		
Orthodontist discussed treatment goals with patient before treatment					
	Yes	101(94.4)	34(87.2)	2.14	0.14
	No	6(5.6)	5(12.8)		
Orthodontist discussed treatment goals with parent before treatment					
	Yes	99(92.5)	30(76.9)	6.76	0.00**
	No	8(7.5)	9 (23.1)		

Discussion

Generally, a successful orthodontic treatment outcome requires that patients be guided by recommended instructions, including maintenance of good oral hygiene behaviour, adherence to healthy dietary advice, and compliance with appointment time during the course of treatment. This study primarily set out to assess the oral health behaviour, relationship of stakeholders and socio-demographic factors that may influence compliance to fixed orthodontic appliance therapy and not necessarily the treatment outcome. The findings of this study clearly indicate a very good compliance to fixed orthodontic appliance treatment which is a weak link in the chain between a good treatment plan and a successful treatment outcome. [18]

The non-compliant behaviour of about one-quarter of adolescents in this sample may be as a result of a number of factors which include failure to show up for appointment due to forgetfulness, transportation difficulties and other socio-economic commitments. [19-21]

Normally, the placement of orthodontic appliances can bring about a number of changes in the oral environment leading to high concentrations of acid producing bacteria resulting from the difficulty in performing effective oral hygiene. The deleterious effects on the oral health become pronounced if proper oral health behaviour is not adopted. In this study, various negative oral health practices and social behaviour were reported. As expected, the frequent chewing of sticky sugary sweets by female patients has a tendency to make the teeth prone to dental caries. More male adolescents' involvement in contact sports on the other hand may have a serious damaging effect on the appliances if mouth guards are not used to protect them. In a cultural environment like Nigeria, teenage smoking is uncommon. It is therefore not surprising that the only three reported cases of smoking during fixed appliance treatment in this population were recorded in the male patients. All these practices and oral health behaviour may be socio-culturally related and the social role of gender in this society cannot be over emphasized.

With respect to the role of gender in orthodontic compliance, this present study did not observe any gender predilection. This is consistent with previous studies that found no gender difference in various aspects of orthodontic cooperation. [22-25] However, some other studies have reported more girls' cooperation during orthodontic treatment. [26-28]

Surprisingly, adolescent age grouping in this study did not show any significant difference in orthodontic compliance but generally, adolescents are known to be less compliant than the younger children. [17,23,24] This is probably due to the fact that younger patients are more obedient to their parents than the adolescents. This is however in contrast with other reports that found no association between age and level of orthodontic compliance. [1,6] This lack of association could well be due to the confounding effect of psychological changes and development often associated with adolescent patients.

Again, some of the socio-demographic factors reported in this study did not demonstrate any significant relationship with compliance to orthodontic treatment. Graber, [16] however, found that patients belonging to families in the higher socio-economic category had higher levels of compliance due to the importance they placed on good dental appearance for social and professional achievement. In contrast, Dorsey and Korabik [29] reported that patients belonging to families categorized in the low and middle socio-economic class were more compliant than their counterparts from the high socio-economic status because they had more appreciation of orthodontic treatment, greater social ambition and recognition needs, and better child-parent relationship. Hulka, [30] in a report on compliance in health care found that age, sex, marital status, education, family size, and social class were not significantly related to compliance. Similarly, Sergel et al., [31] in another study reported no relationship between parental occupational status and patient's compliance with orthodontic instructions. Given the inconsistencies reported in literature about these studies, socio-demographic factors such as age, gender, and socio-economic status alone may not be reliable to predict orthodontic compliance. However, some interesting findings in the present study demonstrated that mother's educational level, population density of the city where the dental clinic is located, and the length of treatment time influenced patient compliance to treatment greatly. Albino et al [9] examined the cooperation of 39 adolescent orthodontic patients 8 to 10 months into treatment and at completion. They reported that parents' positive attitude towards treatment significantly predicted patient's compliance. There is no gainsaying that mothers' role, especially the educated ones, contribute significantly to the development of their children, hence, influencing their decision on matters affecting orthodontic treatment.

Compliance to treatment in this study was found to be at its best in the low population density area of Ile-Ife. This may probably be due to much reduced traffic congestion on roads and other transportation difficulties that are often encountered by patients in order to meet regular orthodontic appointments. It was also observed from this study that the longer the length of treatment, the lower the compliance level. Ordinarily, treatment that should last for an average of 18 to 24 months, when prolonged as a result of several factors may lead to frustration for the patient and/ or parent(s), hence reduced compliance, and in some cases leading to non-completion of treatment. In orthodontic literature, it has been reported that the rates of discontinuation of orthodontic treatment vary greatly from 4 to 42 per cent. [32,33]

The impact of interpersonal relationship between patient/parent and the orthodontist cannot be overemphasized. Nanda et al [14] concluded that the relationship between the patient and the orthodontist was a very strong predictor of compliance amongst patients. Therefore, the way the orthodontist perceives his/her relationship with the patient and the establishment of an effective rapport early in the treatment has a beneficial effect on future compliance. [15] The importance of this interaction is further supported by this study. Other interactions between the patient/parent and the orthodontist for the purpose of educating the patients on the consequences of poor compliance and a good discussion on treatment goals with the parents before embarking on orthodontic treatment were found to improve compliance significantly.

Conclusion

In conclusion, this study submits that gender affects oral health behaviour during orthodontic treatment. Mother's level of education, awareness of deleterious effects of treatment, duration of orthodontic treatment, and²patient/parent-orthodontist relationship significantly influence compliance to fixed orthodontic appliance therapy.

Authors' Contributions

Conceived and designed by: ODO. All the other authors contributed substantially to data collection, analysis, and write-up. All authors approved the final manuscript.

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Conflict of Interest

None declared

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Appendix 1

QUESTIONNAIRE ON ORAL HEALTH BEHAVIOUR, LEVEL OF COMPLIANCE WITH PROFESSIONAL ETIQUETTE AMONG PATIENTS UNDERGOING FIXED ORTHODONTIC APPLIANCES TREATMENT. AGE RANGE (10 – 19yrs).

AGE ☐ ***SEX*** ☐ ***FAMILY SIZE*** ☐ ***POSITION IN FAMILY*** ☐

EDUCATIONAL LEVEL: TERTIARY ☐ ***SECONDARY*** ☐ ***PRIMARY*** ☐

EDUCATIONAL LEVEL OF FATHER : TERTIARY ☐ ***SECONDARY*** ☐ ***PRIMARY*** ☐

EDUCATIONAL LEVEL OF MOTHER: TERTIARY ☐ ***SECONDARY*** ☐ ***PRIMARY*** ☐

Mark like this ☑

1. How long have you been on fixed orthodontic appliances treatment? ☐ months.
2. Interaction between you and your dentist concerning your treatment. Good ☐ Poor ☐
3. Interaction between your parents and your dentist concerning your treatment. Good ☐ Poor ☐

ORAL HEALTH BEHAVIOUR S DURING TREATMENT.

4. How many times do you brush in a day? once ☐ twice or more ☐
5. Are you involved in thumb or digit sucking during treatment? Yes ☐ No ☐
6. Are you involved in fingernail biting during treatment? Yes ☐ No ☐
7. Are you involved in tongue thrusting during treatment? Yes ☐ No ☐
8. Do you chew pen/pencil during treatment? Yes ☐ No ☐
9. Do you take sticky sweets during treatment? Yes ☐ No ☐
10. Do you chew gums during treatment? Yes ☐ No ☐
11. Do you always follow your dentist instructions and also come to the clinic at the appointed day and time? Yes ☐ No ☐
12. Have you ever been involved in smoking during treatment? Yes ☐ No ☐
13. Do you eat the following hard foods during treatment? Hard corn ☐ nuts ☐ hard plantain ☐ fried yam ☐ fried meat ☐ Apple ☐ Carrot ☐
14. Do you often play with your braces? Yes ☐ No ☐
15. Are you involved in contact sports during treatment? Yes ☐ No ☐
16. If yes, which of the following do you always play? football Basketball Volleyball Handball Boxing Wrestling
17. Do you show off braces to scarce young children? Yes ☐ No ☐
18. Do you eat in-between meals during treatment? Yes ☐ No ☐
19. Do you eat late at night during treatment? Yes ☐ No ☐
20. Have you ever involved in fight/brawl with your neighbour or a colleague in school during the fixed appliance treatment Yes ☐ No ☐

CONCERNING YOUR DENTIST DURING TREATMENT

21. Do you understand your dentist advice/instructions during the course of the treatment? Yes ☐ No ☐
22. Did your dentist educate you on the consequences of poor compliance to the treatment? Yes No
23. Did your dentist discuss treatment goals with you at the beginning of treatment ? Yes ☐ No ☐
24. Did your dentist discuss treatment goals with your parents? Yes ☐ No ☐
25. Do you personally like the dentist who is currently treating you? Yes ☐ No ☐
26. Are your parents aware of the consequence of poor compliance to treatment? Yes ☐ No ☐
27. Has your parents disciplined or threatened to discipline you for poor cooperation with treatment? Yes ☐ No ☐
28. Has your dentist threatened to sanction you or ever scolded you or charged additional fees for poor compliances? Yes ☐ No ☐

Intra-arch and Inter-arch Relationships in the Primary Dentition of Senegalese School Children aged 5-6 years

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Background: The aim of the present study was to investigate the features of the deciduous dentition in Senegalese school children aged 5-6 years.

Methods: Sociodemographic data were registered and from the dental casts of the children, parameters related to intra-arch and inter-arch relationships were collected (presence/absence of anthropoid spaces, molar and canine relationships, arch perimeter and width of the anthropoid and interincisal spaces in mm).

Results: The sample was made up 201 subjects (96 girls and 105 boys) with analysable study casts. With respect to intra-arch relationships, maxillary and mandibular anthropoid spaces are present in respectively 92.45 and 70.3% of the children. Regarding inter-arch relationships, flush terminal plane predominated followed by mesial step plane. The relationships between the upper and lower canine in the sagittal plane are mostly Class 1 (95%). As for the transverse plane, the majority of subjects (91.7% of the girls, 96.2% of the boys) has normal relationships (p = 0.24). Almost half had a positive overjet > 2mm and reverse overjet accounted for 1 and 2% respectively for girls and boys.

Conclusion: The majority of subjects in this sample display intra-arch and inter-arch relationships favouring normal occlusal relationship of the permanent dentition.

Keywords: Senegalese children, intra-arch relationship, inter-arch relationship.

ORIGINAL ARTICLE

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Keywords: Primary dentition, occlusion, spacing, Terminal plane

Introduction

Intra-arch and inter-arch relationships of the deciduous teeth have been studied extensively in both paedodontic and orthodontic literature[1-7]. A possible link between the occlusal features of the deciduous dentition and that of their subsequent permanent successors have been suggested early in the 1900s by Bogue[8] and Chiavarro[9]. Specific occlusal traits in the primary dentition, predictive of good occlusal relationships in the permanent dentition have been emphasized. For instance, the presence in primary dentition of spaces mesial to the upper canines and distal to the lower canines referred to as Primate or Anthropoid spaces, was reported to be a predictor of good alignment of the permanent incisors[10,11]. Also, interincisal spaces also called secondary or developmental spaces are usually considered favourable to the uncrowded relationships of the permanent incisors. As for inter-arch relationships, the contacts between the deciduous second molars as objectified by the terminal planes determine at least in part, the sagittal relationship of the permanent first molar [10].

Epidemiological data on intra-arch and inter-arch relationships of adults and adolescents are available for many populations[1,12-18]. Also, studies have been published for different populations concerning intra-

arch and inter-arch relationship in the primary dentition[2,19-28]. Data concerning primary dentition of African children are however scarce. The aim of the present study was to investigate the features of the deciduous dentition in school children aged 5-6 years and to document the existence of potential anomalies.

Materials and Methods

Subjects: As part of a comprehensive national epidemiological survey, this cross-sectional observational study was primarily directed towards children aged 5-6 years. At this age Senegalese children attend the first year of primary school with an average attendance rate of 80 %. Senegal is a developing country with a total area of 196,190 km^2 located at the western side of the African continent with a population estimated at 16,000,000.

The sampling design based upon the guidelines of the World Health Organisation (WHO) for Oral health survey was adapted to include 2 randomly chosen primary schools in the capital city, 2 in each of 2 different regional capitals and 2 in ^{3} areas [29]. In each site, 25 subjects were recruited randomly, which gave a total of 200 school children to be included in the study. To be sure that this number would be reached, 1 or 2 more children in each school were added to the previously programmed 25. The study protocol was approved by the local ethical committee and further validated by the health service authorities in each site.

Children were included when the following criteria were met: complete primary dentition with no permanent tooth, age between 5 to 6 years, and absence of caries and proximal restorations. In addition, prior to entry into the study, a consent form was given to the parents, guardian or caregiver explaining the nature of the investigation and requesting authorization to examine the children and take impressions of their teeth.

Alginate impressions of the maxillary and mandibular arches and wax bite registrations in centric occlusion were then obtained from each subject. The impressions were poured in white orthodontic stone, and the casts subsequently trimmed with the back horizontal to the occlusal plane. Study models with broken teeth or large voids were later excluded.

Data collection procedure

The following variables were registered:

1) *Sociodemographic data* including age and gender were obtained directly from the children and their parents and confirmed with the school registers.
2) *Intra-arch and inter-arch relationships of the maxillary and the mandibular teeth* were analysed using the study models. Linear measurements were registered using a digital caliper accurate to 0.01 mm (Mitutoyo Corporation, Tokyo, Japan) held parallel to the occlusal plane.

The following parameters were analysed:

- *Intra-arch relationship*
  - Primate or Anthropoid spaces were assessed dichotomously as present or missing
  - Arch perimeter was measured from the distal surface of second primary molar on one side, to the second primary molar on the other side
  - Width (mm) of the Primate or anthropoid spaces summed together
  - Width (mm) of interincisal spaces also known as Bogue's diastema
  - Total spaces including Primate's and Bogue's diastema and other spaces
- *Inter-arch relationships*
  - *Molar relationships*

In the sagittal plane, the maxillary and mandibular molar relationships were assessed using the terminal plane as described by Chapman.

Flush terminal plane: The distal surfaces of the upper and lower second primary molars in the same vertical plane in centric occlusion.

Distal step plane: The distal surfaces of the lower primary second molar in posterior relationship to the distal surface of the upper second molars in centric occlusion.

Mesial step plane: The distal surfaces of the lower primary second molar in anterior relationship to the distal surface of the upper second molars in centric occlusion.

Crossbite assessed dichotomously as present or absent. Crossbite is deemed to be present if a transverse relation of cusp to cusp or worse exists in the buccal segment

- *Canine relationships*

Canine relationships were assessed as 3 Classes equivalent to the Angle's classification for permanent canines.

Class 1 The tip of the upper primary canine in the same vertical plane as the distal surface of the lower primary canine in centric occlusion.

Class 2 The tip of the upper primary canine in anterior relationship to the distal surface of the lower primary

canine in centric occlusion.
Class 3 The tip of the upper primary canine in posterior relationship to the distal surface of the lower primary canine in centric occlusion.

- *Incisor relationships*

Presence or absence of:

- anterior crossbite,
- Anterior open bite.
- Extent of the overjet
- Extent of the Overbite

All the aforementioned parameters were registered by the same examiner (BC) who underwent a calibration exercise after which kappa value of 0.85 to 1 for the qualitative variables and intraclass correlation coefficient (ICC) = 0.70 to 0.89 for linear measurements were reached.

Data analysis

Qualitative variables were described as number and percentages. As for quantitative variables, their distributions, evaluated on the basis of skewness and kurtosis, were normal. Thus, central tendencies were described by means, and dispersion by standard deviations.
The chi-square test was used to analyse the intensity of the relationships, between qualitative variables. In the case of low frequencies, Fisher's exact test was computed.
Independent sample test was performed to search for any association between the dichotomized qualitative and the quantitative variables.
Statistical analyses were performed using SPSS "Statistical Package for Social Sciences" (SPSS 15.0.1 - November 2006). *P*-values less than 0.05 were interpreted as statistically significant.

Results

In all, 201 children (96 girls and 105 boys) with analysable study cast were included in this study.

Intra-arch relationships

Maxillary and mandibular primate spaces were present in respectively 92.45 and 70.3% of the children. Regarding gender, more girls than boys lack Primate Spaces in both arches (Figure 1). Chi square test was used to compare the influence of gender on the presence of Primate Spaces. It showed a significant difference for the lower arch ($p = 0.03$) but not for the upper arch ($p = 0.42$).
The measurements of both arches' perimeter are displayed in Table 1.
The maxillary and mandibular arch perimeters are larger in boys than in girls, with a mean difference of 2.46 mm and 2.60 mm respectively for the upper and lower arch ($p= 0.0001$).
The width of Primate Spaces ranged from 0 to 7.4 mm in the maxilla and 0 to 5.5 mm for the mandible. The Primate Space was larger in the maxilla than in the mandible but no sexual dimorphism was noticed ($p = 0.68$ and 0.64 respectively for the maxilla and the mandible).
The amount of total space available in the arches ranged between -1.5 to 14.5 mm and -2 mm to 13.25 mm respectively for the maxilla and the mandible. Boys had larger spaces than girls (Table 1).

Inter-arch relationships

Molar relationships

Figure 2 displays the molar relationships in both the sagittal and transverse plane.
In the sagittal plane, flush terminal plane predominates followed by mesial step plane. No subject displayed distal step plane but 10.4 % of the girls and 12.4 % of the boys displayed asymmetrical terminal plane (mesial in 1 side and flush in the other side). No significant gender differences were noted regarding the terminal planes ($p = 0.46$).
As for the transverse plane, the majority of subjects (91.7% of the girls and 96.2% of the boys) have normal relationships ($p = 0.24$).

Canine relationships

The relationships between the upper and lower canine in the sagittal plane are mostly Class 1 (95%). Class 2 relationships are not found in Girls but are found in 1% of the boys. Asymmetrical relationships are found in 3.1 and 1.9 % of girls and boys respectively (Figure 3). There are no gender differences regarding canine relationships ($p = 0.40$).

Incisors relationships

Almost half of the subjects had a positive overjet > 2mm. Edge to edge incisor relationships are found in 2.6 % of the subjects and reverse overjet accounted for 1 and 2% respectively for girls and boys (Figure 4).

Table 1: Measurements of arch perimeters, primate spaces and total spaces for maxillary and mandibular arches in boys and girls of the sample

	Gender	Minimum (mm)	Maximum (mm)	Mean (mm)	Standard deviation (mm)	Test t P value
Maxillary Arch perimeter	Boys Girls	70.44 66.68	85.32 84.64	79.49 77.03	3.02 3.23	< 0.0001
Mandibular Arch perimeter	Boys Girls	66.01 61.85	79.39 78.80	72.68 70.08	2.95 3.11	< 0.0001
Maxillary Primate Spaces	Boys Girls	0.00 0.00	7.40 7.00	2.54 2.45	1.52 1.65	0.68
Mandibular Primate Spaces	Boys Girls	0.00 0.00	5.50 4.00	1.30 1.04	1.22 1.12	0.34
Total maxillary Spaces	Boys Girls	0.00 1.50	14.50 12.69	5.99 5.55	3.26 3.39	0.09
Total mandibular Spaces	Boys Girls	1.52 2.00	13.25 12.00	3.77 3.03	3.20 2.90	0.12

Table 2: Comparison of the maxillary intra-arch relationships found in this study with those published earlier.

Authors/ year	No of subjects Gender/Age	Method of assessment	Arch perimeter	Interincisal diastema		Anthropoid spaces		Total spaces	
				(%)	(mm)	(%)	(mm)	(%)	(mm)
Otuyemi et al., 1997	294 boys 231 girls 3 to 4 years	Clinically from the patient	Not assessed	37.7	Not assessed	46.1	2.8	75.6	Not assessed
Warren et Bishara, 2001	59 boys 53 girls 4 to 5 years	On study casts	Boys : 72 Girls : 69.7	Not asse-ssed	Not assessed	Not asse-ssed	Not assessed	Not asse-ssed	Not assessed
Abu Alhaija et Qudeimat, 2003	48 boys 39 girls 5 to 6 years	On study casts	Boys: 73.7 Girls: 71.55	69.6	Not assessed	70	Not assessed	61.1	Not assessed
	1048 boys et girls 2 to 5 years	Clinically from the patient	Not assessed	69.6	Not assessed	70	Not assessed	61.1	Not assessed
This study	105 boys 96 girls 5 to 6 years	On study casts	Boys: 79.48 Girls: 77.03	Boys: 83.8 Girls: 78.1	Not assessed	Boys: 94.3 Girls: 90.6	Boys: 2.5 Girls: 2.4	Boys: 97.1 Girls: 95.8	Boys: 6 Girls: 5.5

Table 3: Comparison of the mandibular intra-arch relationships found in this study with those published earlier.

Authors/ year	No of subjects Gender/Age	Method of assessment	Arch perimeter mm	Interincisal diastema		Anthropoid spaces		Total spaces	
				(%)	(mm)	Q(%)	(mm)	(%)	(mm)
Otuyemi et al., 1997 (37)	294 boys 231 girls 3 to 4 years	Clinically from the patient	Not assessed	44	Not assessed	56.8	Not assessed	75.6	Not assessed
Warren et Bishara, 2001 (43)	59 boys 53 girls 4 to 5 years	On study casts	Boys : 68.3 Girls : 64.4	Not asse-ssed	Not assessed	Not asse-ssed	Not assessed	Not asse-ssed	Not assessed
Abu Alhaija et Qudeimat, 2003 (2)	48 boys 39 girls 5 to 6 years	On study casts	Boys: 68.7 Girls: 65.39	Not asse-ssed	Not assessed	51.27	Boys: 2.3 Girls: 1.47	78.4	Not assessed
	1048 boys et girls 2 to 5 years	Clinically from the patient	Not assessed	69.6	Not assessed	51.27	Boys: 2.3 Girls: 1.47	78.4	Not assessed
This study	105 boys 96 girls 5 to 6 years	On study casts	Boys: 72.6 Girls: 70.07	Boys: 70.5 Girls: 70.07	Not assessed	Boys: 77.1 Girls: 63.5	Boys: 1.3 Girls: 1.03	Boys: 90.5 Girls: 82.7	Boys: 3.2 Girls: 3.03

Table 4: Comparison of inter-arch relationships found in this study with those published earlier.

Author(s)/ year	Sagittal molar relationships	Sagittal canine relationships	Overjet
Baume (1950)	76% Flush terminal plane 14% Mesial step plane 10% Distal step plane	Not assessed	Not assessed
Farsi et Salama (1996) (**19**)	80% Flush terminal plane 12% Mesial step plane 8% Distal step plane	50% Class1 37.7% Class2 11.8% Class3	**76%:** 0<Overjet≤2mm 2.5%: Overjet>6mm 2% : Overjet<0
Otuyemi et al. (1997) (**37**)	75.5% Flush terminal plane 20.9% Mesial step plane 2.19% Asymmetrical73.3% Class1	3 % Class2 11.7% Class3 8.8% Asymmetrical	68.8%: normal 14.7%: increased 9.7%: reduced 7%: negative
Abu Alhaija et Qudaimat, (2003) (**2**)	37% Flush terminal plane 47.7% Mesial step plane 3.7% Distal step plane 11.6% Asymmetrical	50% Class1 37.6% Class2 11% Class3	Not assessed
This study	61.1% Flush terminal plane 27.4% Mesial step plane 11.4% Asymmetrical	94.5 % Class1 0.5% Class2 2.5% Class3 2.5% Asymmetrical	Overjet<0 =3% Overjet =0 31.8% 0< Overjet <2 = 48.8% Overjet >2 = 16.4%

Figure 1: Anthropoid/Primate spaces comparison based on gender

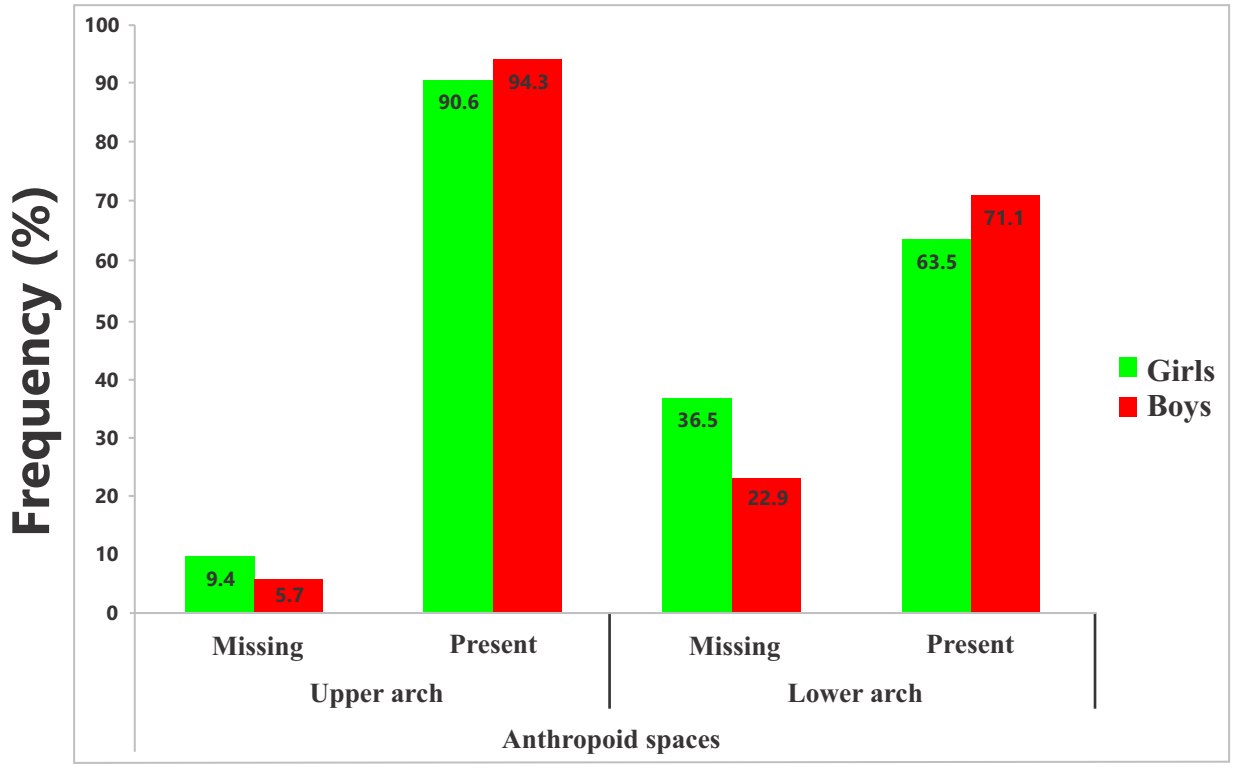


Figure 2: Molar relationships in both the sagittal and transverse plane.

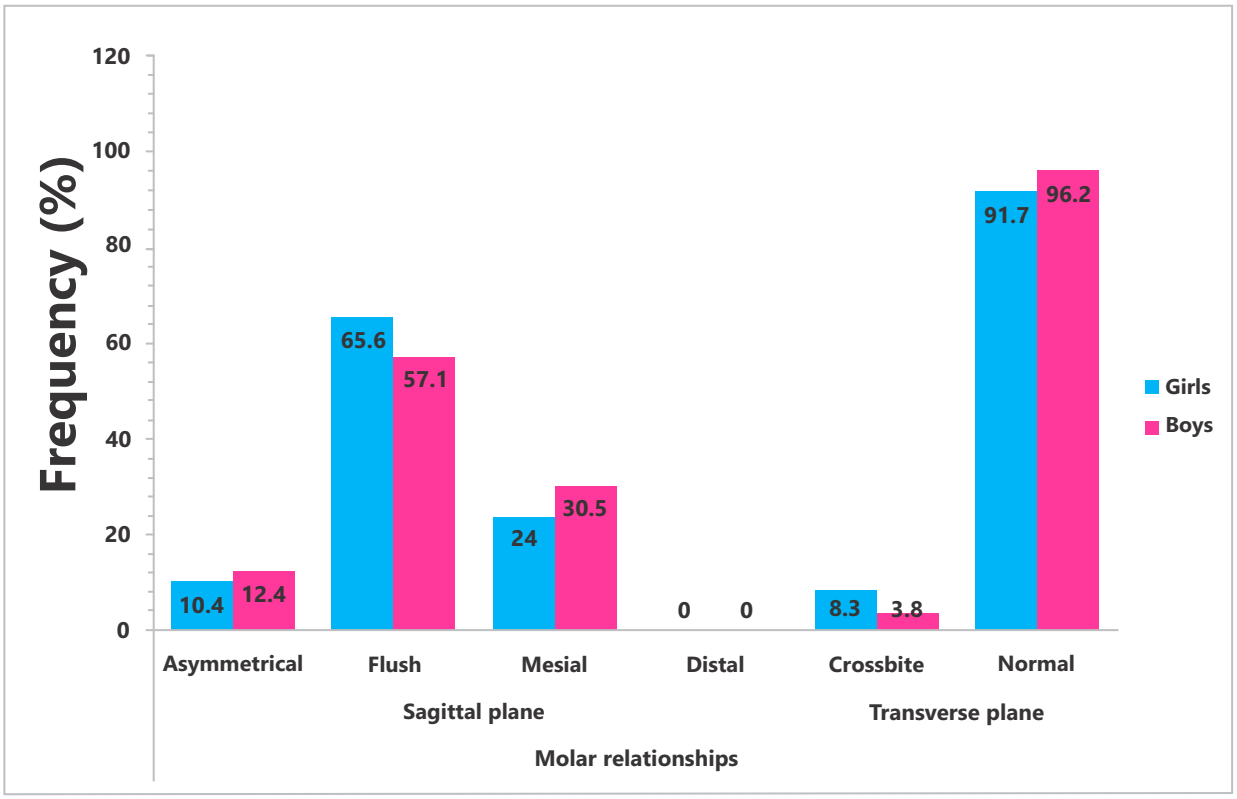


Figure 3: A comparison of canine and asymmetric relationships.

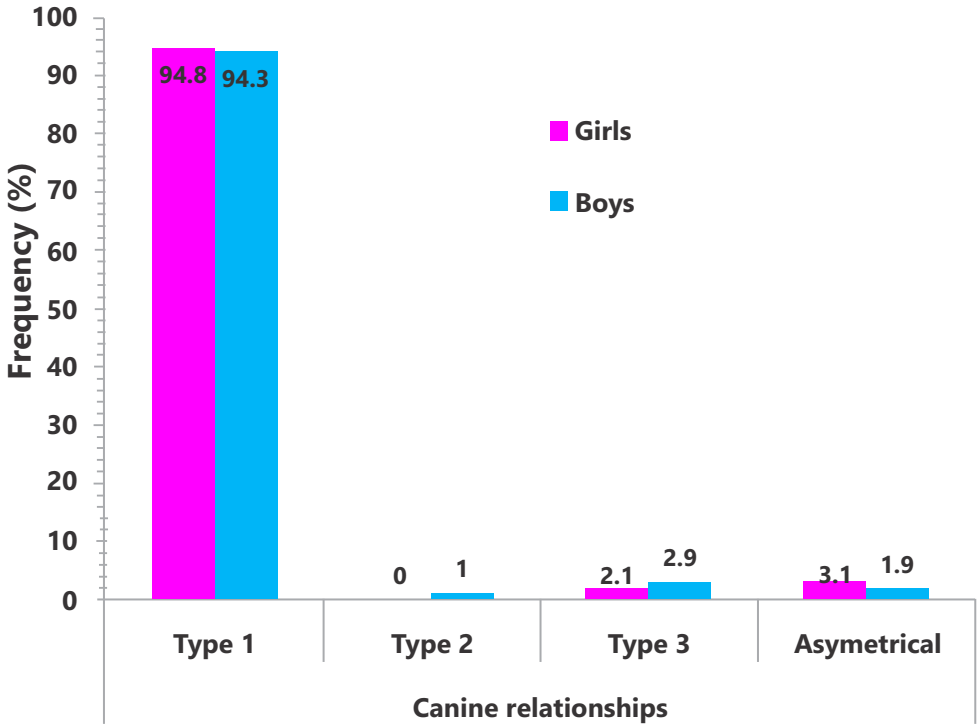
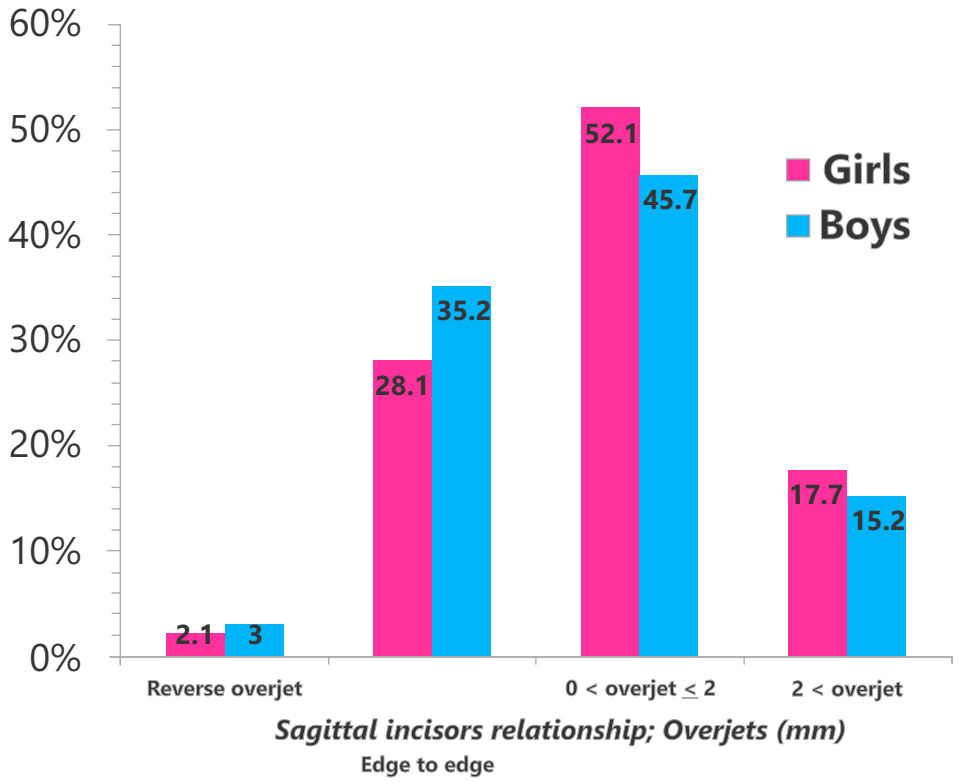


Figure 4: Sagittal incisal relationships



Discussion

Occlusal characteristics of primary dentition can be assessed clinically on the subject's dentition or on study casts obtained from the subjects. Both methods have their advantages and limitations. A direct examination allows inclusion of more subjects and is less expensive but might be less accurate. Information from study cast though more precise are costly and might not be suitable for large epidemiological surveys. In this study, the choice was made to favour the use of study casts in a relatively small but still representative sample.

Tables 2 to 4 display comparison of intra-arch and intra-arch relationships of primary dentition for 3 different ethnic groups as reported in former studies.

The Intra-arch relationships in this sample are characterized by the presence of anthropoid (primate) spaces in 92.45 and 70.3 % of the subjects respectively for the maxilla and the mandible. A smaller rate of anthropoid spaces was observed in Kenyan children aged 3 to 6 years (85%)[30]. Moreover, Abu Alhaija and Qudaimat (2003) reported a prevalence rate of 69.6 % for the maxilla and 51.2 % for the mandible among Jordanian children aged 4 to 5 years[26]. However, in the same study, these reached 70.8 % among children in the age bracket 5-6 years. Otuyemi and coworkers found in Nigerian children aged 3 to 4 years 46.1 % and 56.8 % of anthropoid spaces respectively for the upper and the lower arch [27]. In Caucasian children, Foster et al., reported anthropoid spaces in 70% of children 2.5 to 3 years old [2].

These discrepancies may be related to the age differences among the different samples. In our study, the choice we made was to include only children aged 5/6 years without any permanent tooth. We assume that the characteristics of the primary dentition predictive of good occlusal relationships in the permanent dentition should be present at this age. Their absence might be regarded as some form of abnormality.

Another reason accounting for the larger primate spaces in our sample may be their older age group.

With a mean of 2.54 ± 1.52 mm for boys et 2.45 ± 1.65 mm for girls, the maxillary anthropoid spaces are wider than the mandibular ones (1.30 mm ± 1.22 and 1.04 mm ± 1.12 respectively for boys and girls).

Overall, it appears also that these spaces are larger in boys than in girls.

Concerning interincisal spaces also known as Bogue's diastema, their presence in 78.1% of girls and 83.8% of boys in the maxilla and 74% of girls and 70.5% of boys in the mandible might be considered as positive since they have been associated with lower incisor crowding. In comparison only 40% of children presented these spaces in another West African study[27].

Regarding inter-arch relationships, the majority of children displayed a flush terminal plane which was found in 65.60 % of girls and 57.10 % of boys. Mesial terminal plane was found in 24 % and 30.5 % of girls and boys respectively while an asymmetrical terminal plane was seen in 10.4 of girls and12.4 of boys. Distal terminal plane on both sides was not found in this sample. These results compare well with those reported in Nigerian (74,5 % for flush terminal plane) and Saudi Children (80 % flush terminal plane) but they depart from those reported by Kabue et al., 1995 in Kenyan (53% flush terminal plane, 43% mesial terminal plane and 1% for distal terminal plane), Abu Alhaija and Qudeimat in Jordanians (37% flush terminal plane, 47.7% mesial terminal plane and 1% for distal terminal plane) and Kisling (68%) in Danish children [27,30,31].

Following a study in white, black and Apache Indian children, Infante suggested racial differences regarding inter-arch molar relationships with mesial terminal planes more frequently found in black than in white children [32].

The upper and lower canine relationships were

predominantly of Class 1 (94.55 %). Class 3 accounted for 2.5 % and Class 2 for 1 %. Dissimilar distribution was reported by Farsi and Salama in Saudi children with Class 1 accounting for 86 %, Class 2 for 11 % and Class 3, 33%[22].

With regard to sagittal incisors relationships, almost half of the children of both sex groups had an overjet ranging from 0 to 2 mm. Reverse overjet was found in 2.5 % of the surveyed children. These findings are in line with those reported by Abu Alhaija and Qudeimat with 50% of children in their sample displaying normal overjet[26]. However, they also found crossbite in 11.8% of the subjects. On the other hand, 76% of Saudi children aged 3-5years have been reported to have 0 to 2 mm[22]. In an African sample, normal overjet was retrieved in 68.6 % and reverse overjet in 7 %[27].

Abnormal transverse molar relationships (crossbite) were found in only 2% of girls and 3% of boys in this sample. Comparable frequencies of crossbite were reported in Nigerian (4%) and Saudi children (4.8%)[33,34].

In Caucasian however, a higher prevalence rate was reported. For instance Carvalho et al., in Belgian and Kerosuo et al., in Finnish children found respectively 10 and 13% of crossbite[33, 34].

Overall, occlusal traits in both intra-arch and inter-arch relationships, favourable to normal occlusion in the permanent dentition are mostly displayed in this sample. This contrast highly with our findings in a former study of 42.6% of adolescent 12/13 years old needing orthodontic treatment according to dental health component of IOTN[35]

Conclusion

Overall, occlusal traits in both intra-arch and inter-arch relationships, favourable to normal occlusion in the permanent dentition were mostly displayed in this sample. Significant gender differences were observed in the presence of primate spaces and in the arch perimeters. The girls recorded a significantly lower amount of primate spaces than the boys, while the boys recorded significantly larger maxillary and mandibular arch perimeters. The inter-arch relationships did exhibit any significant gender differences, with most of the participants exhibiting neutrocclusion.

Authors' Contributions

All the other authors contributed substantially to data collection, analysis, and write-up. All authors approved the final manuscript.

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Conflict of Interest

None declared

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Evidence-based Orthodontic Practice among Nigerian Orthodontists and Orthodontic Residents

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Abstract

Background: Evidence-based Orthodontics (EBO) is gradually being recognized as the gold standard for orthodontic care worldwide. It focuses on providing the best level of care, validated by current research findings, in conjunction with clinical experience and the patient's preference. The aim of this study was to assess the awareness, attitude to,[n] and level of practice of EBO among Nigerian Orthodontists and Orthodontic residents.

Methods: This was a cross-sectional study involving Orthodontists and Orthodontic residents attending the 11th Annual Scientific Conference of the Nigerian Association of Orthodontists, which took place in Ile-Ife, Osun State, in September 2017. Data collection was via self-administered questionnaires and data analyses were carried out using SPSS version 19.

Results: The study population consisted of 21 (42%) orthodontic consultants and 29 (58%) orthodontic residents. Forty-four (88%) respondents had previously read or heard about EBOs. A total of 50 respondents participated in the study, comprising 32 (64%) females and 18 (36%) males. Forty-four (88%) respondents had previously read or heard about EBO. Thirty-six (72%) respondents reported that research findings influenced their daily work, while 34(68%) reported that they read peer reviewed journals in Orthodontics, at least monthly. When faced with clinical uncertainties, 25 (50%) reported that they would consult colleagues and 30(60%) would consult the literature, including textbooks.

Conclusion: A large majority of the respondents were aware and interested in EBO and considered it very beneficial to orthodontic practice, however, its practice is still limited among the Nigerian orthodontists and orthodontic residents surveyed.

Key words: Evidence-based Orthodontics, Nigerian Orthodontists, Orthodontic residents

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Introduction

The new paradigm in medical and dental practice worldwide is the 'Evidence based approach.' Evidence-based practice is an approach that emphasizes finding and using the best, current research evidence to help make health-care decisions.[1] An evidence-based approach to clinical decision taking focuses on the integration of good judgment with the best available evidence and patient's values in clinical decision making.[1-3]

Evidence-based dentistry (EBD) is "an approach to oral health care that requires the judicious integration of systemic assessment of clinically relevant scientific evidence relating to the patient's oral and medical condition and history, with the dentist's clinical expertise and patient's treatment needs and preferences.[4]

Evidence-based orthodontics means to be familiar with the best information and data available, be aware of its limitations, and judiciously use it in patient care. It is critical to know which information is available, but it is equally critical to know the limitations of this information.[5] Evidenced-based orthodontic practice is gradually being recognized as the gold standard for orthodontic care worldwide. This is in contrast to 'tradition-based care' which places a high value on the clinician's accumulated knowledge and experience. Using an evidence based approach allows clinicians to monitor and improve clinical performance and routinely upgrade their knowledge base.[1,3]

Nigeria is the largest country in Sub-Saharan Africa with a population of over 200 million people. Orthodontics as a dental specialty in Nigeria has steadily grown over the past few years, however, there are currently only about 60 practicing orthodontists attending to the large population. Considering the large patient to orthodontist ratio and the importance of making the right clinical judgment for each patient, it is important to assess the level of practice of evidence based orthodontics by Nigerian orthodontists and orthodontic residents in training.

Thus, the aim of this study was to assess the awareness, understanding, and current practice of evidence based orthodontics among Nigerian orthodontists and orthodontic residents. It is hoped that the findings from this study will be used as a guide to improve on the current level of orthodontic care and post-graduate orthodontic training in Nigeria

Material and Methods

This was a cross-sectional study involving Orthodontists and Orthodontic residents , attending the Annual Scientific Conference of the Nigerian Association of Orthodontists in Ile-Ife, Osun State, Nigeria, in September, 2017. The study was carried out in accordance with the World Medical Association Declaration of Helsinki.[6]

Data collection was via self-administered questionnaires (Appendix I). The questionnaire assessed the knowledge, awareness, and level of application of evidence based orthodontics by respondents. The questionnaire was modified from that used in a previous study by Madhavji et al.[3] Data analysis was done using SPSS version 19. Results were presented in tables and figures. Fisher's exact was used to test for associations while the level of statistical significance was set at $p<0.05$.

Results

Fifty orthodontists and orthodontic residents in Nigeria made up of 32 (64.0%) females and 18 (36.0%) males participated in this study. The participants (54.0%) were mainly between 31 – 40 years of age and most (58.0%) of them were either post fellowship Senior Residents or Consultants. (Table 1)

Table 2 shows that the majority of participants 36 (72.0%) were currently involved in research or teaching at a university and most (66.0%) of them read peer-reviewed articles weekly/monthly. Majority (66.0%) of them had used PubMed/Medline in the past year to answer a clinical question. However, only some of the overall respondents (40%) had participated in a course about EBO which was considered useful in the day-to-day practice by majority (88.0%) of the participants. About half (54.0%) of them felt that the attitude of their colleagues towards evidence based orthodontics was positive.

The opinion of respondents on different aspects of practice of EBO is presented in Table 3, with about three-quarter of the respondents (74%) reporting that research influenced their daily work. Over 90% (46) of the respondents reported that an evidence based approach improves care, while about 62% (31) felt that they could practice EBO through a careful observation of what does and does not work in their practice. Almost all the respondents reported that they were interested in EBO (96%, 48), although slightly over a third (36%, 18) reported that they had very little knowledge of the concept.

Table 4 shows that a significantly large proportion (83.4%) of the respondents who were currently involved in research/teaching at a university strongly agreed/agreed that research influenced their daily work ($p=0.004$). Furthermore, a significantly high number of participants currently involved in research/teaching at a university, strongly disagreed or disagreed that EBO was only best suited for the younger generation of orthodontists (77.8%, $p=0.038$) and that the benefit to patient treatment was questionable (86.1% $p=0.040$).

Figure 1 shows that half 25(50.0%) of the total respondents reported that when faced with clinical uncertainties, they would consult their colleagues, while only 1 (2.0%) would refer the patient.

Figure 2 shows that more than half of the participants 26 (52.0%) felt that the best method to increase evidence based practice in orthodontics was to

provide evidence based practice guidelines for orthodontists to use. Only 1 (2.0%) felt that evidence based practice should not be promoted.

Figure 3 shows that majority of the participants 29 (58.0%) changed their practice philosophy based primarily on expert advice, while only a few (6.0%) rely on information from conferences to change their practice philosophy.

Table 1: Sociodemographic characteristics of respondents:

	Frequency (50)	Percent (100.0)
Gender		
Female	32	64.0
Male	18	36.0
Age (Years)		
21-30	3	6.0
31-40	27	54.0
41-50	13	26.0
51-60	7	14.0
Level of training		
Orthodontic residents	13	26.0
Orthodontic senior residents	8	16.0
Post fellowship senior residents	8	16.0
Consultant orthodontist (< 10 years post specialist training)	14	28.0
Consultant orthodontist (> 10 years post specialist training)	7	14.0

Table 2: Involvement and attitude towards research/teaching

Involvement in and attitude to research and EBO	Frequency (50)	Percent (100.0)
Current involvement in research/teaching at university		
Involved	36	72.0
Not involved	14	28.0
I read scientific peer-reviewed journals		
Daily	3	4.0
Weekly	13	26.0
Monthly	20	40.0
Rarely	13	26.0
Not at all	1	2.0

I have used PubMed/Medline in the past year to answer a clinical question.		
Yes	33	66.0
No	13	26.0
Uncertain	4	8.0
I have participated in a course about evidence based orthodontics		
No	30	60.0
Yes	20	40.0
The attitudes of my colleagues to evidence based orthodontics:		
Welcoming	27	54.0
Unwelcoming	23	46.0
Evidence based orthodontics in day –to-day practice is:		
Useful	44	88.0
Not useful	61	2.0

Table 3: Opinions of respondents on different aspects of evidenced based orthodontics practice

Opinions of respondents	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Research influences my daily work.	10(20.0)	27(54.0)	10(20.0)	2(4.0)	1(2.0)	50(100.0)
Peer-reviewed journals provide the best current evidence for me to incorporate into my practice.	6(12.0)	32(64.0)	11(22.0)	1(2.0)	0 (0)	50(100.0)
I would be interested in more clinical practice guidelines that help guide treatment decision making.	30(60.0)	18(36.0)	1(2.0)	0(0)	1(2.0)	50(100.0)
The practical demands of work make it difficult for me to keep up to date with current best evidence relating to practice.	3(6.0)	25(50.0)	12(24.0)	10(20.0)	0(0)	50(100.0)
I have previously heard or read about evidence based orthodontics.	14(28.0)	30(60.0)	2(4.0)	3(6.0)	1(2.0)	50(100.0)
An evidence based approach to practice improves patient care.	22(44.0)	24(48.0)	4(8.0)	0(0)	0(0)	50(100.0)
Evidence based orthodontics is more appropriate for research settings not the clinical practice of orthodontics.	5(10.0)	2(4.0)	11(22.0)	24(48.0)	8(16.0)	50(100.0)
Evidence based orthodontics sounds good in theory but it is not practically useful.	0(0)	0(0)	8(16.0)	35(70.0)	7(14.0)	50(100.0)
Evidence based orthodontics is best suited for the next younger, generation of orthodontists.	1(2.0)	11(22.0)	5(10.0)	22(44.0)	11(22.0	)50(100.0)
I can practice evidence based orthodontics through careful observation of what does and does not work in my practice.	6(12.0)	25(50.0)	7(14.0)	11(22.0)	1(2.0)	50(100.0)

The benefit of evidence based orthodontics to patient treatment is questionable.	0 (0)	5(10.0)	7(14.0)	32(64.0)	6(12.0)	50(100.0)
There is no financial gain to practicing evidence based orthodontics.	0 (0)	0(0)	16(32.0)	30(60.0)	4(8.0)	50(100.0)
Evidence based orthodontics is a threat to a clinician's autonomy and experience.	0(0)	9(18.0)	8(16.0)	25(50.0)	8(16.0)	50(100.0)
I am not interested in evidence based orthodontics.	0(0)	0(0)	2(4.0)	38(76.0)	10(20.0)	50(100.0)
I have very little knowledge of evidence based orthodontics.	1(2.0)	17(34.0)	12(24.0)	17(34.0)	3(6.0)	50(100.0)
There are not enough clinical practice guidelines in the literature.	1(2.0)	14(28.0)	13(26.0)	19(38.0)	3(6.0)	50(100.0)
I am satisfied with my current knowledge and practice and feel it is sufficient.	0(0)	6(12.0)	7(14.0)	22(44.0)	15(30.0)	50(100.0)

Table 4: Relationship between being currently involved in research/teaching at a university and opinions concerning research and EBO among respondents.

Current involvement in research/teaching at a university		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total	Fisher's Exact
		Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	
Research influences my daily work.								
	No	0(0.0)	6(42.9)	5(35.7)	2(14.3)	1(7.1)	14(100.0)	0.004*
	Yes	10(27.8)	20(55.6)	6(16.7)	0(0.0)	0(0.0)	36(100.0)	
Peer-reviewed journals provide the best current evidence for me to incorporate into my practice.								
	No	0(0.0)	8(57.1)	5(35.7)	1(7.1)	0(0.0)	14(100.0)	0.093
	Yes	6(16.7)	23(63.9)	7(19.4)	0(0.0)	0(0.0)	36(100.0)	
I would be interested in more clinical practice guidelines that help guide treatment decision making.								
	No	7(50.0)	7(50.0)	0(0.0)	0(0.0)	0(0.0)	14(100.0)	0.655
	Yes	23(63.9)	11(30.6)	1(2.8)	0(0.0)	1(2.8)	36(100.0)	
The practical demands of work make it difficult for me to keep up to date with current best evidence relating to practice.								
	No	0(0.0)	4(28.6)	7(50.0)	3(21.4)	-0(0.0)	14(100.0)	0.146
	Yes	3(8.3)	19(52.8)	7(19.4)	7(19.4)	-0(0.0)	36(100.0)	
I have previously heard or read about EBO.								
	No	5(35.7)	6(42.9)	0(0.0)	2(14.3)	1(7.1)	14(100.0)	0.124
	Yes	9(25.0)	24(66.7)	2(5.6)	1(2.8)	0(0.0)	36(100.0)	
An evidence based approach to practice improves patient care.								
	No	4(28.6)	9(64.3)	1(7.1)	0(0.0)	0(0.0)	14(100.0)	0.315
	Yes	18(50.0)	15(41.7)	3(8.3)	0(0.0)	0(0.0)	36(100.0)	
EBO is more appropriate for research settings not the clinical practice of orthodontics.								
	No	0(0.0)	1(7.1)	3(21.4)	8(57.1)	2(14.3)	14(100.0)	0.616
	Yes	5(13.9)	1(2.8)	8(22.2)	16(44.4)	6(16.7)	36(100.0)	

EBO sounds good in theory but it is not practically useful.							
	No	0(0.0)	0(0.0)	5(35.7)	7(50.0)	2(14.3)	14(100.0)	0.437
	Yes	0(0.0)	0(0.0)	7(19.4)	24(66.7)	5(13.9)	36(100.0)	
EBO is best suited for the next younger, generation of orthodontists							
	No	0(0.0)	4(28.6)	5(35.7)	3(21.4)	2(14.3)	14(100.0)	0.038*
	Yes	1(2.8)	3(8.3)	4(11.1)	19(52.8)	9(25.0)	36(100.0)	
I can practice EBO through careful observation of what does and does not work in my practice.							
	No	0(0.0)	6(42.9)	6(42.9)	2(14.3)	0(0.0)	14(100.0)	0.130
	Yes	6(16.7)	15(41.7)	5(13.9)	9(25.0)	1(2.8)	36(100.0)	
The benefit of EBO to patient treatment is questionable.							
	No	0(0.0)	1(7.1)	6(42.9)	6(42.9)	1(7.1)	14(100.0)	0.040
	Yes	0(0.0)	0(0.0)	5(13.9)	26(72.2)	5(13.9)	36(100.0)	
There is no financial gain to practicing EBO.							
	No	0(0.0)	0(0.0)	7(50.0)	6(42.9)	1(7.1)	14(100.0)	0.788
	Yes	0(0.0)	0(0.0)	13(36.1)	20(55.6)	3(8.3)	36(100.0)	
EBO is a threat to a clinician's autonomy and experience.							
	No	0(0.0)	2(14.3)	6(42.9)	5(35.7)	1(7.1)	14(100.0)	0.145
	Yes	0(0.0)	1(2.8)	8(22.2)	20(55.6)	7(19.4)	36(100.0)	
I am not interested in EBO.							
	No	0(0.0)	0(0.0)	3(21.4)	10(71.4)	1(7.1)	14(100.0)	0.388
	Yes	0(0.0)	0(0.0)	5(13.9)	22(61.1)	9(25.0)	36(100.0)	
I have very little knowledge of EBO.							
	No	1(7.1)	4(28.6)	4(28.6)	4(28.6)	1(7.1)	14(100.0)	0.557
	Yes	0(0.0)	8(22.2)	13(36.1)	13(36.1)	2(5.6)	36(100.0)	
There are not enough clinical practice guidelines in the literature.							
	No	0(0.0)	4(28.6)	7(50.0)	3(21.4)	0(0.0)	14(100.0)	0.275
	Yes	1(2.8)	6(16.7)	10(27.8)	16(44.4)	3(8.3)	36(100.0)	
I am satisfied with my current knowledge and practice and feel it is sufficient.							
	No	0(0.0)	0(0.0)	4(28.6)	7(50.0)	3(21.4)	14(100.0)	0.762
	Yes	0(0.0)	2(5.6)	7(19.4)	15(41.7)	12(33.3)	36(100.0)	

Figure 1: Respondents' Actions When Faced With Clinical Challenges.

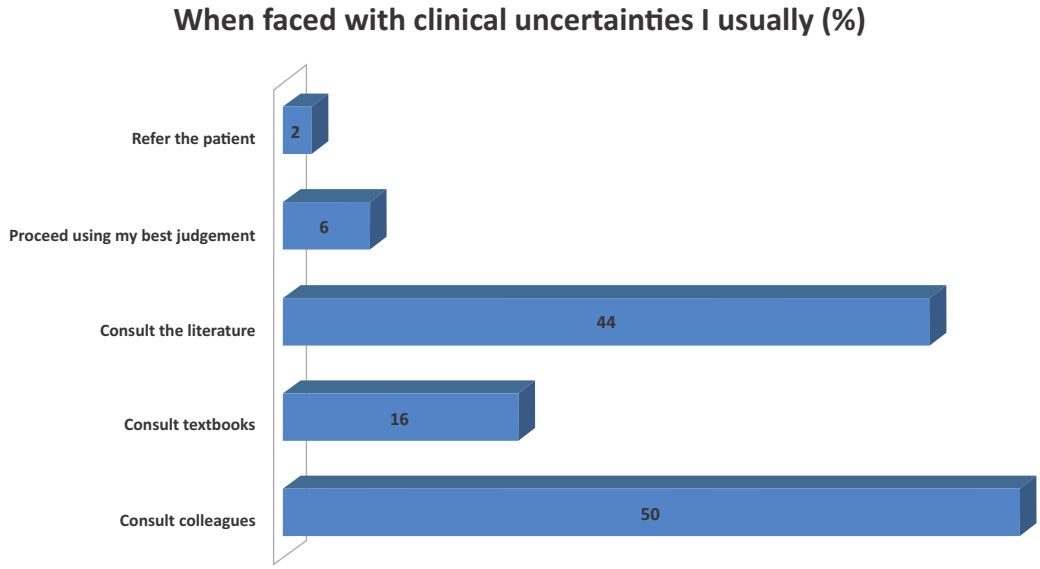


Figure 2: Respondents' perceptions on the best method to increase evidence Based practice.

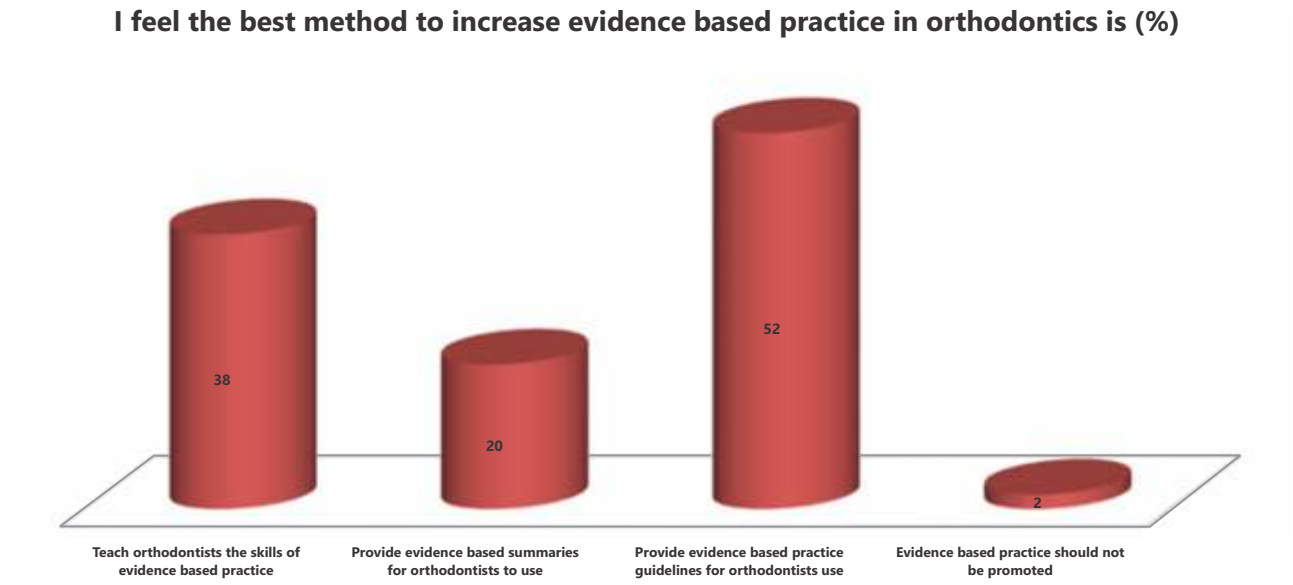
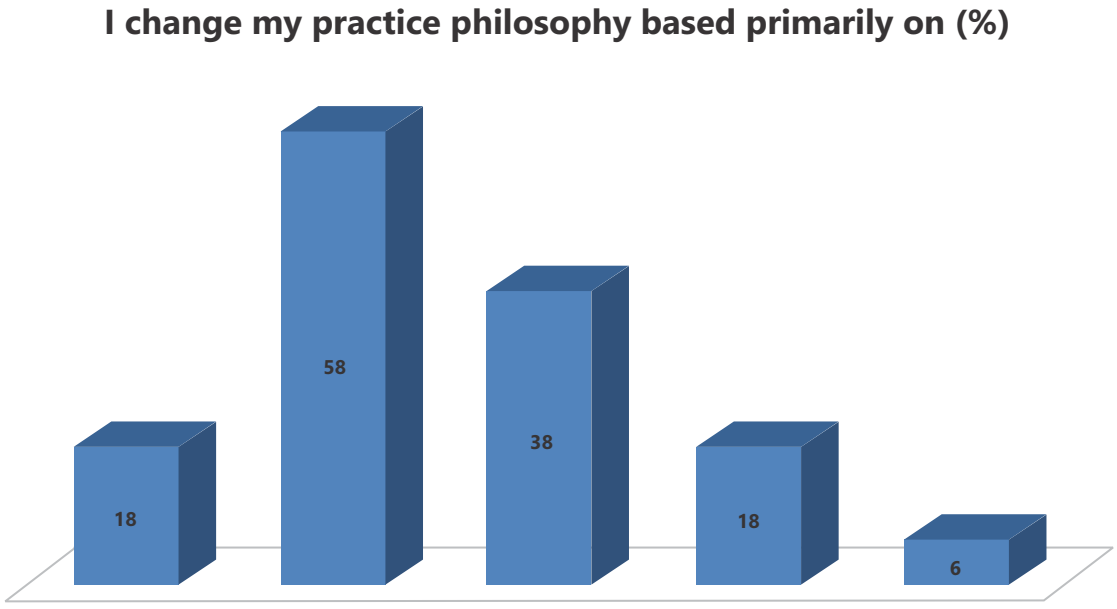


FIGURE 3: Factors that can influence change in practice philosophy.



Discussion

Evidence based orthodontics can be described as one of the key principles required for the successful practice of orthodontics. It can be considered as one of the main contributors to the changing scenario of orthodontic practice in the 21st century.[7] However, one of the major challenges currently facing orthodontists is the integration of accrued scientific evidence into clinical practice.[8,9]

The findings from this study show that a large majority of respondents believe in the practice of evidence based orthodontics. It is interesting to note that over seventy percent of the respondents were currently involved in the research or teaching of orthodontics. This is not surprising as most of them were residents at different stages of training. In addition, a majority of all practicing orthodontists in Nigeria are employed in universities and tertiary

healthcare training institutions. They are therefore involved in training undergraduate dental students and/or postgraduate residents in the specialty of orthodontics.

It is noteworthy that a large majority of respondents read scientific journals at least monthly and had recently consulted Pubmed to answer a scientific question. This is reflective of the fact that 90 per cent of the respondents consider research findings and published literature very important to their practices. This corroborates the findings in a study by Madhavji et al.[3] among American Orthodontists.

An evidence based approach involves using the best available evidence from literature for patient care while also bearing in mind the clinician's expertise and patient's preference.[4] The views of respondents in this study show that almost all of them had previously read about EBO, were interested in practicing it, and felt that the approach would improve patient care. Similar findings were reported in a study carried out among American orthodontists.[3] However, the belief by majority of the respondents that they could practice EBO by observing what works and does not work in their practice implies a limited understanding of what the concept really means. Using information obtained from your practice does not reflect an evidence based approach to practice. The respondents further demonstrated their limited practice of the concept by reporting that they would consult colleagues when faced with a clinical problem, as compared with consulting the literature. A similar finding was reported among orthodontists in the United States[3] and general dental practitioners.[8] The evidence based approach would have been to critically appraise available literature from online data sources such as Pubmed or Cochrane review, to obtain results of systematic reviews, meta-analyses or any other reliable scientific option on the evidence pyramid. This is in order to find the best possible solution to the problem, while also taking into consideration the clinician's expertise and patient's preference.[3,10] However, the practice is also fraught with some challenges, such as the time demands for a thorough literature search, the ambiguity of the literature on certain topics in orthodontics, and limited clinical guidelines.[3] Thus, all these have to be overcome to ensure an evidence based approach is successfully practiced.

The majority of respondents also stated that they depend on 'expert advice' to change their practice philosophy. A similar finding was reported for orthodontists practicing in the United States.[3] Although this is a very convenient method of acquiring information, 'expert advice' ranks very low on the pyramid for evidence based practice and cannot substitute a thorough literature search, and critical appraisal of any subject matter. Indeed, expert opinion actually ranks at the bottom of the list for acceptable evidence, according to Voudrous' Iceberg evidence for viable clinical applications.[11] The concept of EBO evolved as a more reliable scientific alternative to “expert-based”, “eminence-based” or “opinion-based” orthodontics.[12] Thus, although only about a third of the respondents thought that they had a limited knowledge of the concept of EBO, in actual fact, majority of respondents do not fully understand this concept and therefore are not actually practicing it.

It is instructive to note that although most of the respondents reported that research influences their daily work, this response was significantly more among those in teaching and research institutions. This is quite understandable bearing in mind the nature of these institutions and the fact that clinical practice in such institutions is expected to be guided by research findings. Furthermore, respondents involved in teaching or research had significantly more positive belief in the benefit of EBO to patient care, which has also been previously reported.[3] Research forms an important aspect of evidence based approach and respondents from teaching hospitals or academic institutions routinely teach and utilize research findings. Thus, they are more accustomed to the importance of this approach to patient care as they routinely use it in the course of patient management and are more likely to understand the benefit to patient care.

Almost all the respondents reported that they would be interested in having evidence based clinical practice guidelines which would help guide their treatment decisions. This is necessary, in their viewpoint, as they admitted that the practical demands of work make it difficult for them to have time to stay up to date with current literature. The use of guidelines was also recommended by orthodontists in the United States;[3] it will reduce the need for extensive review of literature and thus save the practitioners some time. Also, guidelines will be very helpful for those who may not be inclined towards research, but desire to practice based on the most recently available and validated evidence.

Bearing in mind the very busy clinical nature of orthodontic practice, also alluded to by respondents in this study, these guidelines will help to eliminate some of the barriers to the practice of evidence based approach, as previously reported by Madhavji et al.[3.] Indeed, the need to address the issue of guidelines has led to the development of 'pre-appraised evidence' - the summary of evidence based guidelines obtained from the critical appraisal of literature by experts well versed in evidence based practice. These are then disseminated to practitioners e.g via Orthodontic journals such as the American Journal of Orthodontics and Dentofacial Orthopedics in a simple and clinically usable form.[12, 13]

A number of limitations were encountered in the course of this study. The heterogeneous nature of the study population, which comprised both orthodontists and orthodontic residents may have affected the research findings. However, this population was selected because of the small sample size of both groups and although they have different levels of experience, they share similar professional training and practices. Thus, for the purpose of this study, the respondents were considered a homogenous population and the findings of this study can provide a baseline for future studies in each of the respective groups. Another limitation of the study is the possibility of some bias in respondents' answers to the anonymous questionnaire. Some of the respondents may have recorded a more positive attitude than actually perceived, in order to appear to have a better appreciation of the concept.

Conclusion

The findings of this study show that a vast majority of Nigerian orthodontists and orthodontic residents are aware of EBO and are interested in its practice. They consider it useful in their day to day practice and believe it would positively impact on patient care, particularly those involved in teaching and research. However, there is limited understanding and practice of the concept of EBO among respondents, with the majority of them depending on expert opinion to change their practice philosophy and consulting colleagues when faced with clinical challenges.

Recommendations

There is a need for further training of Nigerian orthodontists and orthodontic residents in the concept of EBO. In particular, the teaching of this concept should form an important part of the postgraduate orthodontic training curriculum for Orthodontic residents in Nigeria. It is also recommended that evidence based clinical guidelines be frequently disseminated and published in local journals such as West African Journal of Orthodontics, to enhance up to date clinical practice among orthodontists in the country.

Authors' Contributions

Isiekwe IG contributed to the conceptualization, study design, literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript review, and was the guarantor.
Umeh OD contributed to the study design, literature search, data acquisition, data analysis, manuscript preparation, and manuscript review.
Adeyemi TE contributed to the literature search, data analysis, statistical analysis, manuscript preparation, and manuscript review.
Aikins EA contributed to the manuscript preparation and manuscript review.

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Conflict of Interests

Nil

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Strategic Advantage for Sustainable Success in Orthodontics

Ernest MA

Abstract

Background: The greatest challenge facing us as Orthodontists is living the new normal life post–COVID-19. How do we deal with our own safety and patient safety? How do we handle possibly low patient load due to economic downturn and the fear of contracting infection in clinics? The cost of using PPE and redesigning our clinics, who bears them? Orthodontic services is almost nonexistent in primary health care and very low in secondary health care facilities in Nigeria. There is also inadequate financing of quality health services and inefficiencies abound in the provision of health care services, particularly in the public sector; paucity of local / international Orthodontic grants. Generally low quality of health services still abound in both public and private health facilities, low coverage and gross inefficiencies in the national health care delivery system. To achieve increasing coverage of Orthodontic services, there is the need to employ improvement planning tools for a turnaround in the next couple of years. These tools are discussed in this review.

Methods: Useful tools for improvement planning discussed in this review include SWOT Analysis, Gap Analysis, Goal setting, Paradigm shift and Six Sigma.

Results anticipated: We expect a shift from Face mask/ Gown to full Personal Protection Equipment (PPE), from Analog record keeping services to Digital services, from long treatment time to contracted treatment time, from low aligner patient load to high aligner patient load and from waiting for Patients to come to us in the hospital to going to them in the communities. A shift is also expected from contracted training programmes to liberalised training, from 'out of pocket' financing to National Health Insurance Scheme, from limited coverage to universal coverage and radical shifts from face-to-face consultation to Tele-Orthodontics.

Conclusion: It is concluded that by employing appropriate tools, Orthodontic practices can be well-positioned now and higher coverage achieved in the immediate future.

Keyword: Post-COVID-19 practice, Improvement Planning, Orthodontic coverage.

ORIGINAL ARTICLE

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Introduction

Sustainable Healthcare is that which contributes to survival and full potential development that can be delivered cheaply to the vast majority of the population, over a long period of time with improving quality and performance. It is "A complex system of interacting approaches to the restoration, management and optimization of human health**.** It has an ecological base that is environmentally, economically, and socially viable. The system works harmoniously with the human body and the non-human environment, and does not result in unfair or disproportionate impacts on any significant contributory element of the healthcare system". [1]

Orthodontic health care services involve clinical services, training, referral, research, career progression, staff welfare and futuristic planning. A sustainable health care system is achieved at the interception of environmental, social, and economic factors as seen in the figure below[2].

Figure 1: Sustainable Health and Care System

Focus

The aim of this article is to define sustainable orthodontic healthcare, review major services in orthodontic healthcare, assess the present status of orthodontic practices in the Nigerian health sector. Another aim is to make a list and discuss major tools needed to achieve sustainable success in Orthodontics care and project future Orthodontic care in ost-COVID Nigeria.

The Current situation

Orthodontic services is almost nonexistent in primary health care and very low in secondary health care facilities in Nigeria [3,4]. There is also inadequate financing of quality health services; paucity of local / international Orthodontic grants, and inefficient provision of health care services, particularly in the public sector . A generally low quality of health care services still abound in both public and private health facilities, as well as low level of coverage in the national health care delivery system[4]. Inefficiencies abound in the Laboratory technology- human and material resources, aligner technology, CAD-CAM. Currently, the greatest challenge facing Orthodontists is living the new normal life post - COVID. How do we deal with our own safety and patients' safety? How do we handle possibly low patient load due to the current economic downturn and fear of contracting infection in our clinics? The cost of using PPE and redesigning our clinics, who bears them? How do we make the transition from analog to digital technology in record keeping and other areas of service? How do we maintain/increase our relevance and keep the cutting edge? These are questions seeking practical answers. There is therefore the need to look at various improvement planning tools and examine how they can be utilized.

Tools for Improvement Planning

Improvement planning can be at different levels; personal, family, community, organizational, national or global. For example; the recently introduced World Orthodontic Health Day is a global awareness day to improve Orthodontic service utilization. Let us take a quick look at some specific tools useful for improvement planning. These tools include SWOT Analysis, Gap Analysis, Goal Setting, Paradigm shift, and Six Sigma. Especially now, with the advent of COVID-19, there is a need for a personal improvement plan to be adopted as Orthodontists.

1. SWOT ANALYSIS

SWOT stands for S-strengths, W-weaknesses, O-opportunities and T-threats. This tool helps to examine each outlined area at either personal or organizational level. In practice, a Quadrant is constructed to host an item list for each area of SWOT as seen in figure 2 below.

S - Strength 1. 2. 3.	W - Weakness 1. 2. 3.
O - Opportunity 1. 2. 3.	T - Threats 1. 2. 3.

The expectation is to visually see and mentally prepare to strengthen the areas of Strength, pay attention to the Weaknesses, take up and utilize the Opportunities and guard against the Threats.

For Orthodontic practice in Nigeria, a strength includes a large market accentuated by a few number of Orthodontists, a weakness is the poor economy that makes people focus on life-threatening illnesses alone, an opportunity is a growing population of young people who are very much concerned about the facial aesthetics, and a threat is the increasing cost of materials due to high foreign exchange rate, and quackery in practice.

2. GAP ANALYSIS

Gap analysis promotes an awareness of Quality Management System among all stakeholders. It brings a culture of continuous improvement to an

organization. At the personal level, it helps to assess where you are and where you want to be and what you need to get there, by itemizing the Gap. The Gap may require attendance at a workshop, conference, or acquiring a new Orthodontic skill e.g. digital technology.

Whereas in the organizational Gap analysis market model, there is the need to evaluate cost-effectiveness by asking how economical the product is?, assess prestige by asking how well-known the product is ?, assess awareness by asking how well-known or 'loud' is the product?

Orthodontists, therefore, need to assess and analyze how to fill gaps such as the knowledge/awareness gap, technology gap, and policy gap, which requires the involvement of the government. Effective internal audit programmes that will allow practitioners to measure themselves against the Standards,5include a periodic assessment of patient load, effectiveness of outreach programmes, periodic assessment of infection control, and staff/ patient safety, especially with the COVID – 19 new normal world. Orthodontists also need to assess availability of resources (space, personnel, supplies, skill) and periodic assessment of treatment outcomes, relapse rate, and research (number of publications, randomized control trials and research grants).

3. GOAL SETTING

Goal setting is the process of determining and writing down one's expectations, developing and carrying out action steps for achieving different stages of the expectations without looking back until done. As an association, orthodontists need to set up a think tank for goal setting in order to remain relevant. Where are we and where do we want to be next? What is our mission statement? What is our vision statement? What are the association's 5 year / 10year goals? They may not be written in stone but must get refined on a continuous basis.

4. PARADIGM SHIFT

Paradigm is defined as a set of rules and regulations that guide a group. It determines success or failure and creates boundaries within which members have to act or behave. Paradigm may also mean the way people see their world. When a paradigm works well, progress or great success can be achieved. When success plummets, then a shift to another paradigm will be necessary to sustain the success or achievement. There is therefore the need for paradigm shift at intervals to keep tract with global best practices and sustain achievements. There is a need to answer such questions as: How do we practise Orthodontics post- COVID-19? What is the new normal for Orthodontic services? What innovation would we like to introduce to Orthodontics in the next 12 months? What is there to stand against us in the next 12 months? How can we overcome and make the needed change?

There is therefore the need for Orthodontic paradigm pioneers and shifters to bring the needed change through brainpower, research findings, and sharing experiences. Possible shifts in the immediate future should therefore include:

- A shift from face mask/gown to full Personal Protection Equipment (PPE)
- A shift from analog record keeping services to digital services
- A shift from long treatment time to contracted treatment time.
- A shift from low aligner patient load to high aligner patient load.
- A shift from waiting for patients to come to us in the hospital to going to them in the communities
- A shift from contracted training programme to liberalised training
- A shift from out of pocket financing to National Health Insurance Scheme (NHIS)
- A shift from limited coverage to universal coverage {Primary Health Care [PHC]}
- A shift from Face to face consultation to Tele-Orthodontics

Developing and sustaining tele-orthodontics in Nigeria requires a multi-sectoral collaboration between health and ICT professionals and intra-professional multi-disciplinary approach 6,7. How to handle the issue of confidentiality, security, privacy, professional responsibilities, medical records and research using patients information, professional commitment and ownership, handling professional resistance, and personnel issues must be well planned. Finance is a major stake in sustainability, as such, funding would have to come from government,

NGOs, bilateral, and multilateral organizations. There is also the need to utilize the principle of private- public partnership. Service users should be made to show financial commitment through taxes, out-of-pocket payment, and pay-as-you-use (PAYU).

SIX SIGMA

This is a tool designed to reduce anything that will cause customer dissatisfaction. It started as a means to reduce production defects to the minimum and promote highest consumer satisfaction. It is based on producing products with minimal defects8. The goal of Six Sigma is better delivery, better quality, satisfied employees, and satisfied customers (patients). One Sigma defect would be 69.1% whereas at Six Sigma defect is reduced to 0.00034% of all the products (Table 2).

Six Sigma (6S)

Sigma	% Good	% Defects	DPMO
1	30.9%	69.1%	691,462
2	69.1%	30.9%	308,538
3	93.3%	6.7%	66,807
4	99.38%	0.62%	6,210
5	99.977%	0.023%	233
6	99.997%	0.00034%	3.4

Table 2: Levels of defect as you improve from One Sigma to Six Sigma8

The Peer Assessment Rating (PAR) index9 was developed to provide a quantitative objective method of measuring malocclusion and efficacy of treatment. Previously published personal audits suggest that, to achieve a good standard of orthodontic treatment, the mean reduction in the PAR score should be greater than 70%. Alternatively, the number of patients falling into the 'Worse or no different' category should ideally be less than 5%. This is a good tool that can be used consistently to assess the quality of finished cases and the improvements made. Excellently finished cases are the products of Orthodontists.

As such, practitioners must aim at:

- Eliminating or reducing relapse
- Finished cases meeting defined criteria.
- Developing treatment techniques that will improve outcomes
- Reducing treatment time to barest minimum
- Reducing wastage- bracket failure due to iatrogenic factors ie poor bonding technique
- Ensuring safety of self, staff, and patient.
- Increasing productivity

Conclusion

The current challenge is the future of Orthodontics in the new normal world. However, post COVID 19 is not the problem but how it is viewed . How do we turn the challenges of COVID 19 around to becoming great opportunities for the profession? Presently, orthodontists are serving less than 1% of the population4. How do we increase coverage? How do we operate Economic - Status based Orthodontic services in order to cover a large percentage of the population? How do we design new treatment models with reduced treatment time? How do we have access to equipment and new technologies that will remove viruses from clinics and keep the air safe to work long hours and perform aerosol generating procedures?

The success game plan of the Orthodontic practice is to move from struggling to surviving and from there to stability which has been achieved. There is a need to now move to the level of good success and ultimately to the level of significance. This will only be achieved by working as a team and being focused on utilizing the improvement plans discussed in this research.

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Conflict of Interest

None declared

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CASE REPORT:
Management of a Severe Gummy Smile with Temporary Anchorage Devices

Yemitan TA

Abstract

A 46-year-old Nigerian woman came for consultation with the chief complaint of gummy smile. The clinical examination showed a convex profile, a protrusive maxilla, a Class II Division 1 malocclusion involving a gummy smile. Temporary anchorage devices (TADs) in the anterior dental region were used as anchorage for the intrusion of her maxillary anterior teeth. Those appliances, combined with retraction of the maxillary anterior teeth, eliminated the severe gummy smile and corrected the canine relationship from Class II to Class I. The treatment was workable and simple, and the active period was 12 months. The patient received a satisfactory occlusion and an attractive smile.

Key words: Malocclusion; Intrusion; gummy smile; Temporary Anchorage Device

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Introduction

Excessive gingival display during smiling, or gummy smile, which may result from a variety of aetiological factors [1,2] is an aesthetic problem for some patients.[3-6] In adults, the gummy smile which may be caused by anterior vertical maxillary excess of skeletal or dentoalveolar origin may present with excessive visibility of upper incisors and excessive display of gingiva on smiling (gummy smile).[7] More than 4 mm of gingival display has been considered excessive and unattractive by patients and general dentists.[8] Gummy smiles are rarely corrected with conventional mechanics and often, orthognathic surgery such as Le Fort impaction or maxillary gingivectomies are often indicated to achieve a good smile.[3,5,9-12]

However, if patients are unwilling to undergo surgical treatment, an alternative method must be considered to treat the gummy smile. Temporary anchorage devices (TADs) have simplified orthodontic treatment by changing the conventional conception of biomechanics and anchorage control with good patient acceptance.[13,14] Successful intrusion of teeth with TADs as anchorage had been demonstrated.[2,7,15-18]

The following clinical case describes the treatment of an adult patient with gummy smile using TADs anchorage.

Presenting complaint

A 46-year-old female patient presented at a private orthodontic clinic in Lagos, Nigeria, with the chief complaint of excessive display of gum on smiling.

Medical and Dental History

There was no significant medical history, but past dental history revealed sequelae of trauma to the maxillary right central incisor treated with

apicectomy followed by post and core crown restoration. In addition, her records showed a history of camouflage treatment for Class II division 1 malocclusion with fixed orthodontic appliance and extraction of maxillary first premolars. The prior orthodontic treatment was completed five years before the present complaint.

Diagnosis

Clinical Assessment

Extraoral findings: Examination showed slightly convex profile with competent lips. When the patient smiled, she showed more than 10 mm of gingival exposure in the incisor region (Fig. 1). No short or hyperactive upper lip. There was vertical maxillary excess which could be the aetiology of the gummy smile.[19,20]

Intraoral findings: Examination showed full complement of permanent dentition except the missing maxillary first premolars, bilateral one unit Angle's Class II malocclusion, deep overbite, overjet of 2mm, mild mandibular arch anterior crowding, retroclined maxillary incisors, and mild maxillary anterior spacing (Fig 2). The clinical examination suggested incisal and canine guidance without prematurity and shift. The patient had no temporomandibular joint symptoms. No deviation and pain during the movement of the mandible were discovered.

Radiographic Assessment

Panoramic findings: This revealed missing maxillary first premolars and no sign of root resorption, caries, or periapical lesion.

Cephalometric findings: The Lateral Cephalometric analysis showed a skeletal Class II relationship, with maxillary excess, excessive overbite, and vertical excess. The radiographic images and tracings are presented in Figure 3 and the cephalometric measurements in Table 1.

Treatment Objectives

The treatment objectives were:

To create a satisfactory occlusion, maintaining a Class II molar relationship but normalize overjet and overbite.

Intrusion of the maxillary anterior teeth was indicated to reduce the exposure of the gingiva.

Limit extrusion of the posterior teeth to prevent a clockwise rotation of the mandible and an increase in lower facial height.

Restoration of maxillary central incisors to improve aesthetics.

Treatment Alternatives

Two alternatives were presented to the patient.

1. Combined surgical and orthodontic treatment to elevate and retrude the anterior maxillary dentoalveolar part to eliminate the gummy smile.
2. Orthodontic treatment and use of TADs to provide absolute anchorage for incisor intrusion to eliminate the gummy smile. The disadvantage was that the prognathic maxilla would not be corrected.

After a review of the risks and benefits of the two options, the patient chose the more conservative method which was the second alternative because of the advantages of being less invasive and requiring a shorter treatment time.

Treatment Progress

Orthodontic treatment began on October 23, 2017, with insertion of two mini-implants (1.6 × 8 mm, Hubit, Korea) between the roots of the right and left maxillary lateral incisors and canines.[21] On the same day, preadjusted 0.022-inch brackets, Roth prescription (Dentaurum, Ispringen, Germany) were bonded, engaged with 0.014-inch nickel-titanium archwire ligated to all maxillary teeth. An intrusive force was applied with an elastomeric chain ligated from the TADs to the archwire in the anterior region (Fig. 4, A). At the recall visit after 3 months, mandibular teeth were bonded.

Both arches were aligned and leveled beginning with 0.014-inch nickel-titanium archwires, with progression up to 0.019 × 0.025-inch stainless steel archwires. With the rectangular 0.019 × 0.025-inch stainless steel archwire, elastomeric chain was used to close spaces in the maxillary arch (Fig. 4, B), and Class II intermaxillary elastics was used for better interdigitation of occlusion (Fig. 4, C).

Before debonding, Gingivectomy was carried out to eliminate gingival hyperplasia. The TADs remained stable during treatment and were removed under topical anesthesia. After debonding, removable vacuum formed thermoplastic retainers were placed in both arches. The total active orthodontic treatment time was 12 months.

The crown restorations on maxillary central incisors were done to improve aesthetics, then a canine-to-canine and lateral incisor-to-lateral incisor lingual retainer was bonded in the mandibular and maxillary arch respectively.

Treatment results

The gummy smile was eliminated, and in full smile view, the patient showed not more than 4mm of gingiva (Fig.5). The post-treatment photographs and dental casts demonstrated Class I canine with Class II molar relationships, normal overbite, and overjet (Figs. 6 and 7).

The post-treatment cephalogram and panoramic radiograph are shown in Figure 8. The cephalometric analysis (Table 1) and superimposition (Fig 8, C) showed that the maxillary incisors were intruded by 7.0 mm with concomitant intrusion of the maxillary molars and autorotation of the lower jaw in anticlockwise direction. However, the final cephalometric analysis (Table 1) showed that the skeletal anteroposterior discrepancy between the maxilla and the mandible remained unchanged. The comparison between the pretreatment and posttreatment panoramic radiographs showed an evidence of mild root resorptions within acceptable parameters compatible with the extent of movement.

A stable occlusal relationship and a harmonious face were maintained for one year follow-up (Fig. 9).

Table 1. Cephalometric data

Measurement	Norm	Pretreatment	Posttreatment	Δ
SNA (°)	85.5 ± 3.5	91	88	-3
SNB (°)	82.7 ± 3	82	79	-3
ANB (°)	2 – 4	9	9	0
LAFH (mm)	60.9 ± 5.0	69	57	-12
U1 to FH (°)	119 – 127	104.5	117	12.5
IMPA (°)	96 – 104	97	99	2
Interincisal angle (°)	108 – 116	137	127	-10

Fig. 1. (A – I) Pretreatment facial and intraoral photographs.

Fig. 2. (A – E) Pretreatment dental casts.

Fig. 3. (A) Initial panoramic radiograph, (B) Initial lateral cephalometric radiograph, and (C) tracing.

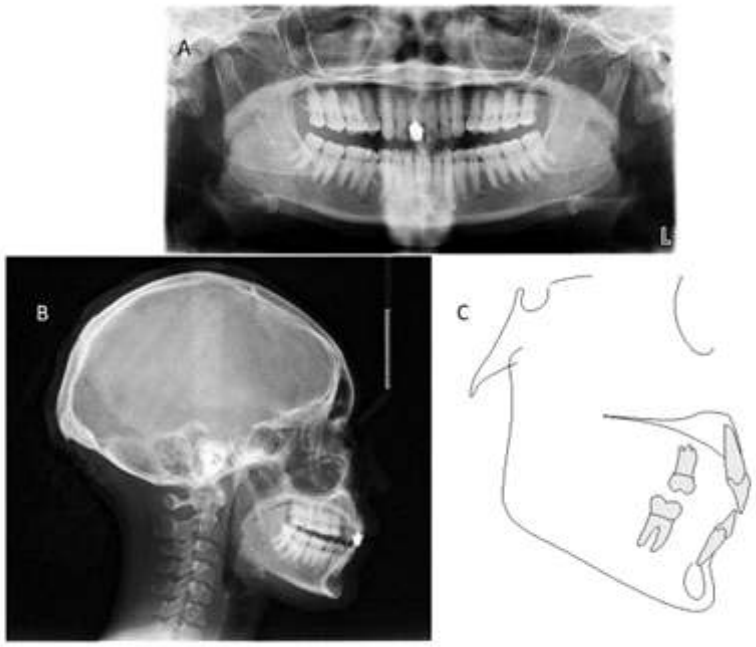

Fig. 4. Treatment progress: (A) intrusive force applied with an elastomeric chain; (B) elastomeric chain to close spaces; and (C) after intermaxillary elastics used for better occlusion.

Fig. 5. Full smile photographs: (A) pretreatment; (B) posttreatment; and (C) 1-year in retention.

Fig. 6. (A – I) Posttreatment facial and intraoral photographs

Fig. 7. (A – E) Posttreatment dental casts.

Fig. 8. (A) Posttreatment panoramic radiograph; (B) cephalogram; and (C) superimposition.

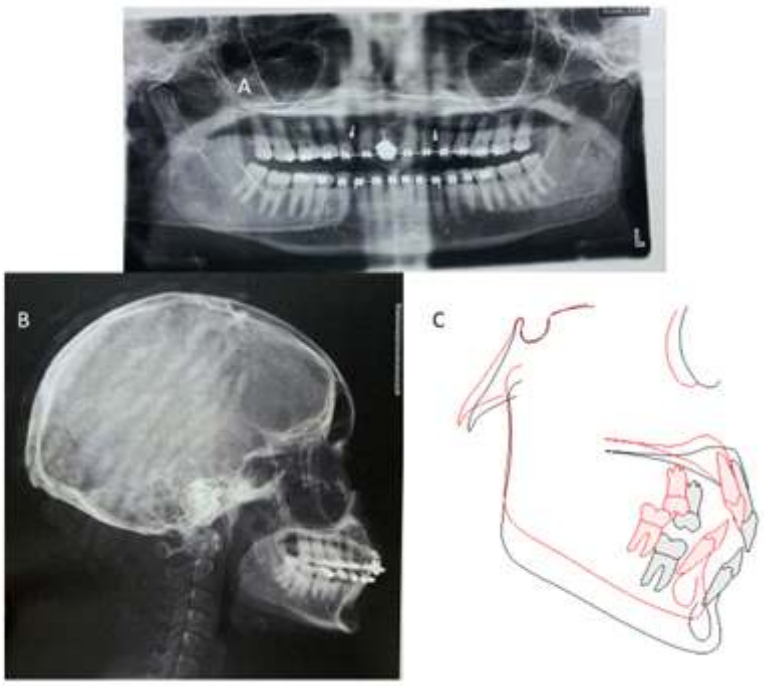

Fig. 9. (A – I) Facial and intraoral photographs after 1-year in retention.

Discussion

Excessive gingival display can be classified by etiology into soft tissue, dentoalveolar, and skeletal types.[7,19,20]

When a gummy smile is found in adults with long-face syndrome caused by excessive vertical maxillary growth, orthognathic surgery is generally required to intrude the maxilla and eliminate the excessive gingival display.[2-4,10,11,22,23] Such increase in vertical facial height may be confirmed by cephalometric analysis.[5] However, in some gummy smiles of dentoalveolar origin, when a gummy smile is derived from protrusion and extrusion of the maxillary anterior dentoalveolar complex, orthognathic surgery could produce decreased anterior dentoalveolar height after surgery, resulting in a low smile and unfavorable result.[24] Although in this patient, the LAFH was 69mm at treatment onset (Table 1), due to the potential risks of jaw surgery which include excessive hemorrhage, infection, loss of tooth vitality, and periodontal loss, as well as risks inherent to anesthesia[2] and high treatment costs, the patient was reluctant to undergo surgery.

In the orthodontic clinic, titanium miniplates and dental implants have also been successfully used for tooth intrusion.[12,25] But, the TADs have the advantage of immediate loading, multiple placement sites, uncomplicated placement and removal procedures, and minimal expense for patients.[26] A mini-implant for orthodontic anchorage should be small enough to place in any areas of alveolar bone, even apical bone, the surgical procedure should be easy enough for an orthodontist or general dentist to perform and minor enough for rapid healing, the implant should be easily removable after orthodontic treatment with minimal patient cooperation requirement, except for good oral hygiene.[25,27,28] In this case, the TADs remained stable during the time of intrusive force application.

Correction of gummy smiles with continuous light intrusion forces on the maxillary anterior dental arch[29] could also be accomplished by extraoral intrusion appliances such as headgear[30] and J-hook.[31] Traditional intrusion techniques, such as utility arches[32] and 1-piece intrusion arches,[33] were optional but not optimal for this patient, because they require anchorage on the molars and produce undesirable moments on the anterior teeth.

Intrusion of posterior teeth in the upper arch was not planned but superimposition of the lateral cephalometric tracings shows some intrusion of upper molars that resulted in anticlockwise rotation of lower jaw (Fig. 8,C). This movement was explained as a result of binding archwire with the brackets and buccal tubes at later stages of incisor's intrusion.[34] There was no major significant change observed in the cephalometric anteroposterior skeletal measurements and the patient remained skeletal class II. However, special consideration was given to the soft tissue aesthetics which was further improved with restoration of crown and gingivectomy after debonding.

Conclusions

TADs were adopted for the treatment of a 46-year-old woman with a gummy smile, and a desirable result was achieved.

The excessively erupted anterior teeth were corrected by intrusion of the anterior dental alveolus; this eliminated the gummy smile.

The appropriate application of TADs to correct a gummy smile must be based on the correct analysis of the etiology.

This appliance was simple and workable for the treatment of a Class malocclusion patient with a gummy smile, and she was satisfied with the result.

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Conflict of Interest

None declared

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

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

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

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

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

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

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Acknowledgements

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