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Frequency and Pattern of Orthodontic Extractions: A 5 Year Review.

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Abstract

Background: Orthodontic tooth extraction is defined as the removal of one or more permanent teeth excluding the third molars in the course of corrective orthodontics. The frequency of extraction has changed over the years with the evolution of new treatment mechanics.

Aim: To determine the frequency and pattern of orthodontic extraction among orthodontic patients.

Methods: This was a retrospective descriptive study and the study sample comprised of 237 patients who had undergone or were undergoing orthodontic treatment in the Orthodontic Clinic of the Lagos University Teaching Hospital Idi-Araba Lagos Nigeria over a 5 year period. All relevant information required was obtained from the case file of these patients. Basic descriptive statistics, Chi-Square and Student's t-test were used for data analysis. Level of significance was set at $P< 0.05$.

Results

A total of 237 orthodontic patients were recruited for the study; 78 males and 159 females. Angle's Class I malocclusion was the predominant molar relationship. An extraction prevalence of 53.2% was observed with a total of 340 permanent and 44 primary teeth extracted. The upper first premolar was the most frequently extracted tooth, accounting for 72.9% of all permanent teeth extracted (248 teeth), while the primary canine was the most frequently extracted primary tooth. The most common extraction pattern observed in this study was the extraction of all first premolars (28.6%), followed by the extraction of upper first premolars (16.7%). There was no statistically significant difference in the extraction prevalence between males and females (P=0.5).

Conclusion: There was high extraction prevalence in the current study when compared to the Caucasian studies, with the first premolars being the most frequently extracted tooth.

Key words: Extractions; Orthodontics; Malocclusion.

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Introduction

In the management of malocclusion, clinicians are required to make sound orthodontic diagnosis and develop a treatment plan. This often requires several intricate decisions as the clinician makes a choice whether or not extraction will be required to achieve the treatment objective.[1] Tooth extraction in Orthodontics is surrounded by a number of controversies as different orthodontists argue for and against it.[1,2] Orthodontic tooth extraction is defined as the removal of one or more permanent teeth excluding the third molars in the course of corrective orthodontics.[1,3]

The frequency of extraction has varied over the years reaching a peak in the early 19th century where teeth were extracted mainly to relieve crowding.[3, 4] Over time, the introduction of newer techniques and systems such as the use of functional appliances, bonded rather than banded appliance, self-ligating systems, and interproximal stripping as well as arch expanders have played significant roles in the dynamic changes observed in extraction frequency among orthodontic patients.[2,4]

An important factor which comes to the fore in extraction decisions among others include the morphological features of malocclusion.[2] As observed with morphologic features, genetic differences should count for variations among different subjects; with ethnicity playing a significant role in morphologic disparity.[5] Therefore, with respect to craniofacial morphology, different racial and ethnic groups should not be considered to

ORIGINAL ARTICLE

be the same.[6-14] Although not much is reported on the association between race and treatment in orthodontic literature, [2] identifying obvious racial differences are the increased SNA, SNB and ANB cephalometric angles[15] in the Nigerian population as well as greater dental and lip protrusion [16-18] in African populations will affect treatment objectives and plan.
Existing literature have considered extraction frequencies and pattern among different orthodontic populations with varied findings[1-4,19-23] with an obvious data paucity in an African population. It would be noteworthy therefore to assess the prevalence and pattern of orthodontic extractions in Nigeria and verify if the results compare with findings from previous non African studies.

Orthodontic extractions have been reported to be the second most common cause of extraction in a national survey of Nigerian children accounting for 22.8% of all teeth extracted.[24]A similar survey by Adeyemo et al.[25] implicated orthodontic treatment as the third most common cause of tooth loss after caries and periodontal disease and accounted for 2.8% of all teeth extracted. The pattern of teeth extractions was however not reported.

The purpose of this study therefore was to determine the frequency and pattern of extraction among orthodontic patients in Nigeria, and how it compares with the pattern in previous studies from other populations.

ORIGINAL ARTICLE

Materials and Methods

Ethical approval was granted by the Health Research and Ethical Committee, Lagos University Teaching Hospital Idi-Araba, Lagos for use of clinical information from the Orthodontic clinical records before commencement of the study. The study population comprised 237 orthodontic patients who had undergone or were undergoing orthodontic treatment in the Orthodontic Clinic over a 5 period (2009-2013). The information required were obtained from the patients' case file and entered into an information sheet. Information obtained included patients' bio data (age at presentation, sex and nationality) and malocclusion pattern. Also recorded were patients' Angle's molar classifications, tooth size-arch length discrepancy; assessing the presence or
absence of spacing and crowding in the dental arches, and overbite (the vertical relationship between the upper and lower incisors). Information on the need for extractions during orthodontic treatment, prevalence, tooth type and pattern of tooth extraction were also obtained. Inclusion criteria were all patients who started their orthodontic treatment in the Orthodontic clinic of the Lagos University Teaching Hospital and of were of Nigerian ancestry. Subjects with Congenital anomalies e.g. Cleft lip and/or palate, special needs patients and transfer patients who started their treatments from other health institutions were excluded from the study.
Data was analysed using Epi.Info™ for windows (version 3.5.1) statistical software. Descriptive statistics was used for the subjects' demographics. The results were presented in figures, charts and frequency tables. Students t-test was used to assess the significance of the difference between means of 2 sets of data and Chi square test of independence and Fischer's P-exact statistics were used determine the association between categorical variables. The level of significance was set at $P<0.05$ for all statistical analysis.

Results

The subjects' age at the start of treatment ranged from 7-30 years with mean ages of 15.3±6.9 years and 18.1±8.1years in the male and female subjects respectively. A total mean age of 17.2 ±7.9 was observed with approximately 50% of the study population in the 10-19 years age limit. The males were observed to be significantly younger than the female ($p=0.01$) (Table 1).
An assessment of the Angle's molar relationship of the study subjects showed Angle's Class I malocclusion as the most common and observed in 74.3% of the study participants, followed by Angle's class II div I malocclusion (15.2%). Other molar relationships were observed however uncommon (Figure 1).
Evaluating the tooth size -arch length discrepancy among study subjects, 30% and 42.6% had well aligned anterior segments in the upper and lower arches respectively. Spacing malocclusion was more prevalent than crowding and observed to be more common in the upper segment, while crowding was more predominant in the lower arch; observed in 31.7% of the study subjects. A majority of the

patients however had well aligned posterior segments (upper-96.2%, lower-98.7%).

The prevalence of orthodontic extraction observed in this study was 53.2%. A total of 340 permanent and 44 primary teeth were extracted with the upper first premolar being by far the most frequently extracted permanent tooth, and accounting for 248 (72.9%) of all extracted teeth (Table 2). This was followed by the second premolars (21.5%) and supernumerary teeth (2.6%). Less frequently extracted were the central and lateral incisors and the second molars (0.3%). No permanent canine extractions were reported.

Forty-four primary teeth were extracted in the study. The primary canine was the most common primary tooth extracted and accounted for 7% of all teeth extracted and 64% of extracted primary teeth. The extraction of primary incisors and molars was observed to be uncommon (Table 3)

Evaluating the pattern of extractions between sexes and the dental arches, it was observed that tooth extractions were more prevalent in the males (56.4%) compared to the females (53.2%), although statistically insignificant (P=0.48), and for all tooth types. Extraction frequencies were observed more in the maxilla than the mandible, except for the permanent lateral incisor, first and second molars, which were more frequently extracted in the mandible. The first premolar was observed to be the most frequently extracted tooth, followed by the second premolar in both maxillary and mandibular arches. The difference in extraction frequency in the maxilla and mandible was statistically insignificant (P=0.286) (Table 3).

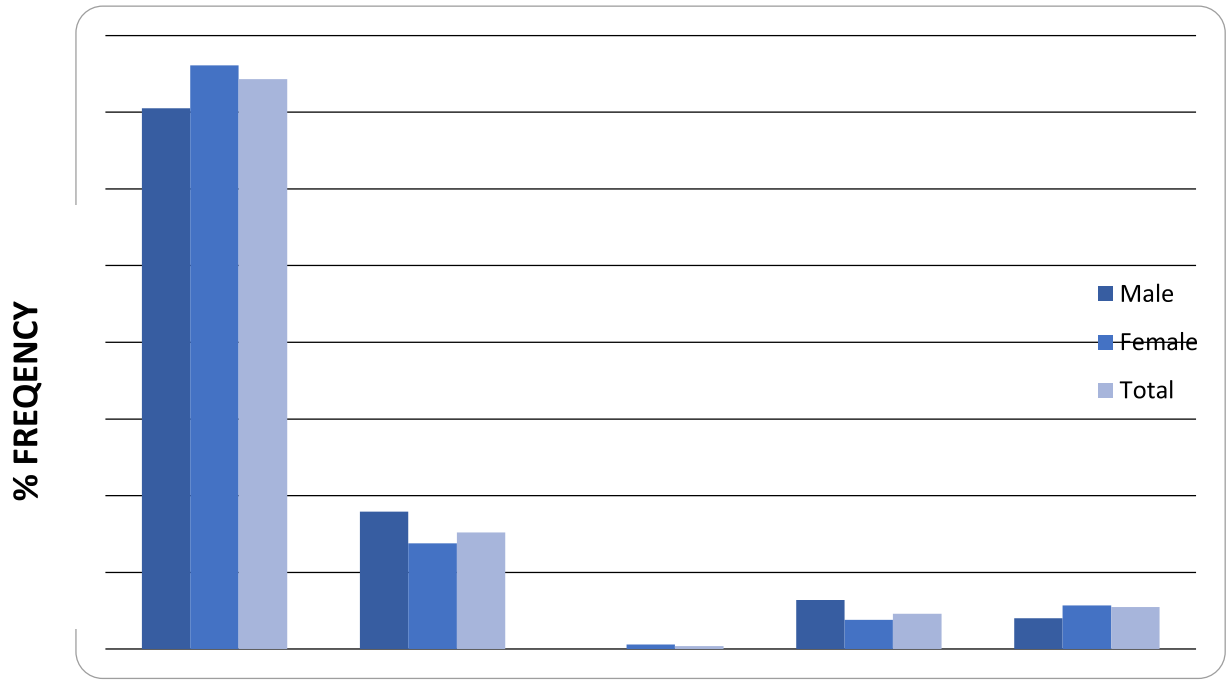
The 4-unit extraction of all first premolars was the most common extraction pattern and comprised 29% of all extractions. This was followed by the extractions of upper first premolars and retained primary teeth in 16.9% and 11.3% of subjects respectively. The extraction of other teeth such as supernumerary teeth, incisors and first molars collectively accounted for 21% of the extractions. Extraction patterns of the upper first and lower second premolars, all second premolars, upper 2nd premolars and lower 1st premolars, lower first premolars only and upper 2nd premolars were infrequently carried out in the management of the study subjects (Table 4, Figure 2).

ORIGINAL ARTICLE

Table 1: Age distribution study participants

Age (year)	Frequency (%)		
	Male (n=78)	Female (n=159)	Total
< 10	12(15.4)	22 (13.8)	34(14.3)
10-19	46 (59.0)	70(44.0)	116(48.9)
20-29	15 (19.2)	56(35.2)	71(30.0)
30	5(6.4)	11(6.9)	16 (6.8)
Total	**78 (100)**	**159(100)**	**237(100)**
Mean age	15.3±6.9	18.1±8.1	17.2±7.9
Student's t statistic =2.59=0.01*			

***Significant**



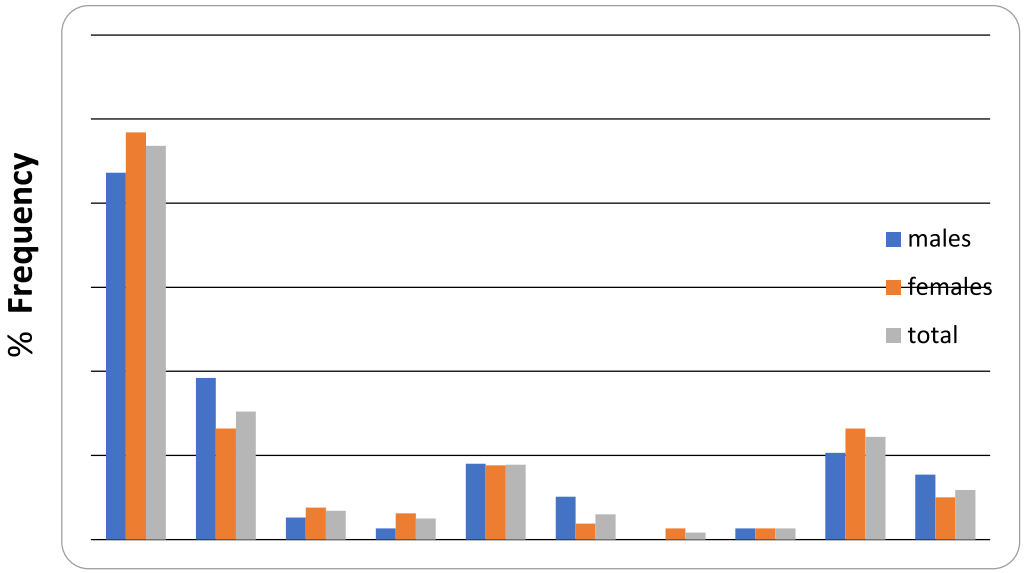
ANGLE'S CLASSIFICATION OF STUDY POPULATION

Figure 1: Angle's molar relationship of study participants

ORIGINAL ARTICLE

Table 2: Tooth Extraction Frequency by Tooth Type

TOOTH TYPE	FREQUENCY %					
	Female		**Male**		**Total**	
	Frequency	%	Frequency	%	Frequency	%
Central Incisors	1	0.5	0	0.0	1	0.3
Lateral Incisors	0	0.0	1	0.8	1	0.3
Canines	0	0.0	0	0.0	0	0.0
First Premolars	151	71.2	97	75.8	248	72.9
Second Premolars	52	24.5	21	16.4	73	21.5
First Molars	6	2.8	1	0.8	7	2.1
Second Premolars	0	0.0	1	0.8	1	0.3
Supernumeraries	2	0.9	7	5.4	9	2.6
TOTAL	**212**	**100.0**	**128**	**100**	**340**	**100.0**



Extraction pattern of study population
FIG 2: Extraction pattern in the study population

Table 3: Distribution of Teeth Extracted

MAXILLA	FEMALE		MALE		TOTAL	
	NO.	%	NO.		NO.	
Central incisor	1	0.4	0	0.0		0.3
Lateral incisor	0	0.0	0	0.0		0.0
Canine	0	0.0	0	0.0		0.0
First premolar	89	35.7	55	27 40.1	144	37.3
Second premolar	27	10.8	11	8.0	38	10.0
First .Molar	3	1.2	0	0.0		
Second Molar	0	0.0	0	0.0		0.0
Supernumerary	2	0.4	6	4.4		1.8
MANDIBLE						
Central incisor	0.0	0.0		0.0		0.0
Lateral incisor		0.0	1	0.7		0.3
Canine		0.0		0.0		0.0
First premolar	62	24.9	42	30.7	104	26.9
Second premolar	25	10.0	10	7.3	35	9.1

ORIGINAL ARTICLE

ORIGINAL ARTICLE

Table 3: Distribution of Teeth Extracted

First Molar		1.2		0.7		1.0
Second Molar		0.0		0.7		0.3
Supernumerary		0.4		0.7		0.5
DECIDUOUS						
MAXILLA						
Central incisor		0.8		0.0		0.5
Lateral incisor		0.8		0.0		0.5
Canine		5.6		3.6	19	4.9
First molar		2.0		0.0		1.3
Second molar		0.8		0.0		0.5
MANDIBLE						
Central incisor		0.4		0.0		0.3
Lateral incisor		0.4		0.0		0.3
Canine		2.0				2.1
First molar		1.6		0.0		1.0
Second molar		0.0		0.0		0.0
TOTAL	249	100.0	137	100.0	386	100.0

Table 4: Tooth extraction pattern and additional extraction according to sex

Variable	Male n = 78		Female n = 159		Total n = 237			
	Freq .	**%**	**Freq .**	**%**	**Freq .**	**%**		
Tooth extraction								
Nil	34	43.6	77	48.4	111	46.8	0.49	0.48
Retained Deciduous	6	7.7	8	5.0	14	5.9	0.67	0.40
Others	8	10.3	21	13.2	29	12.2	0.42	0.52
All 4s	15	19.2	21	13.2	36	15.2	1.47	0.23

Upper 4s Lower 5s	2	2.6	6	3.8	8	3.4	0.23	1.00 I
Upper 5s Lower 4s	1	1.3	5	3.1	6	2.5	0.74	0.67 I
Upper 4s	7	9.0	14	8.8	21	8.9	0.00	1.00
All 5s	4	5.1	3	1.9	7	3.0	1.92	0.22 I
Upper 5s only	0	0	2	1.3	2	0.8	0.99	1.00 I
Lower 4s only	1	1.3	2	1.3	3	1.3	0.00	I.00 I
Total	78	100	159	100	237	100		
Additional extractions								
Nil	73	93.6	146	91.9	219	92.4	0.23	0.63
Superumeraries	5	6.4	3	1.9	8	3.4	3.28	0.12 I
Second permanent molar	0	0	2	1.3	2	0.8	0.99	1.00 I
First permanent molar	0	0	1	0.6	1	0.4	0.49	1.00 I
Deciduous	0	0	7	4.4	7	3.0	3.54	
Total	78	100	159	100	237	100		

ORIGINAL ARTICLE

Discussion

Numerous studies have examined the prevalence of extraction in orthodontic populations worldwide with an obvious paucity of data on the subject matter among African populations. This study is a retrospective study which reviewed extraction frequencies and pattern among orthodontic patients in a Teaching Hospital Orthodontic Clinic in Nigeria, West Africa. It was concerned only with those for whom extractions were done for the purpose of orthodontic correction.

Some justifiable clinical arguments for orthodontic extractions include the need for arch space for resolution of crowding[26, 27] overjet reductions especially in camouflage treatment of Class II and Class III malocclusion[26, 27], correction of vertical discrepancy in reduced bite and anterior open bite cases[28], and in correction of bi-maxillary protrusion. The malocclusion type, patient's aesthetic preferences, racial/ethnic facial morphological differences[26, 29]; clinician's beliefs and philosophy as well as treatment modality are important considerations in extraction treatment. Interplay of these multiple factors has contributed to the complexity of the extraction decision and variation among orthodontic practitioners. Not surprisingly therefore, the frequency reports from previous studies have varied widely ranging from as low as 6.5% to 83.5% [1, 29]. Despite this, Baumarind et al [30] observed a high degree of clinician agreement in the decision to extract or not in their study where 148 cases were assessed by 5 orthodontists.

The socio-demographic characteristics of this study subjects showed a slight female predominance, as has been reported previously among an orthodontic treatment seeking population [1, 26, 29, 31] with a greater extraction

frequency observed in males than females, corroborating the reports from previous literature[24, 26, 27,31] but at variance with Peck and Peck[1]

The prevalence of orthodontic extraction in the current study was 53.2%. This frequency is interestingly higher than the findings of previous recent studies[26, 28, 31] which evaluated extraction rates among orthodontic patients in America, Brazil and South Korea. This may be due to the more convex profile with associated skeletal and labial protrusions established in the African population.[16, 17, 18, 32] A study by daCosta and Utomi et al[20] showed that increased overjet and crowded dental arches were the two most frequently seen occlusal anomalies among Nigerian orthodontic patients, with a need for extractions to resolve malocclusions. Extraction of teeth in the African population therefore, is likely to be carried out with less hesitancy due to the protrusive profile, with an aesthetically acceptable profile post treatment.

The high prevalence of extractions observed in this study corroborates the findings of Jacksons et. al.[26] who observed the odds of extraction to be 4 times more in African Americans when compared to the Caucasians; and potentiating the racial effect in extraction prevalence in orthodontic management. A regression analysis adjusting for confounding variables in same study revealed crowded dental arches, increased overjet, reduced overbite and race to be significant factors which influenced extraction prevalence and pattern in that particular study.[26]

A study by Isiekwe GI et. al [17] on the cephalometric assessment of the lip position in a normal Nigerian adult populations showed upper and lower lip to E- Plane of 3.21mm and 6.76mm respectively, with the males being slightly more protrusive. This is considerably higher than those of previous studies in other populations.[33,34] Against this backdrop therefore, alongside the high prevalence of anterior open bite in the Nigerian population[19, 20, 35, 36], compared to other populations[37-39], may be reasons for the increased extraction frequency observed in this study as it often associated with proclined upper and lower anterior teeth. Here therefore lies important information for the orthodontist when extraction treatment is considered for the Nigerian/African patient.

The prevalence of extraction observed in the current study was however comparable with that reported by Weintraub et al[2] (54%) among orthodontists in America; significantly higher than the findings of more recent studies among the whites. The study subjects included patients treated between years 1947 to 1984 and may be responsible for the high prevalence reported considering the fact that a downward in extraction rates over the years has been observed[29].

Corroborating reports from previous studies[2, 21, 26, 28, 29] the first premolars had the highest proportion of tooth extractions, accounting for over 70% of all extracted teeth in the present study. Further reviewing the pattern of extraction in this study, in agreement with other studies, the extraction all 4 first premolars was found to be most predominant extraction pattern[23,26] however, at variance with some others[28, 29, 31] who reported the extraction of maxillary first premolars to be most predominant. Consequently, therefore extractions were most frequent in patients with Class I malocclusion in the current study.

Following the extraction of all first premolars was 2-unit extraction of the upper first premolars, and thirdly the extraction of mandibular first premolars. The extraction of maxillary premolars preferably 1st premolars is an acceptable protocol in the camouflage treatment of Class II malocclusion with associated reduction in treatment time.[40, 41] Similarly; mandibular premolar extraction is used in the camouflage treatment of Class III malocclusion. The higher prevalence of Class II malocclusion was observed in this study compared to Class III, with attendant treatment protocol and therefore may account for overall higher prevalence of extraction observed in the maxilla compared to the mandible in the current study. The extraction of molars was uncommon in the study, possibly due to a decline in caries occurrence, as caries compromise is usually a strong indicator in the choice of molar extraction in orthodontic management.[42]

Some primary teeth were extracted, with the primary canine being the most commonly extracted tooth in this study, usually as part of an interceptive protocol in the management of crowding in the mixed dentition.

ORIGINAL ARTICLE

This study has provided information on extraction pattern as an adjunct to orthodontic treatment among a population of patients of African descent. As the argument for and against extractions continue, this prevalence study still remains relevant in informed decision making in the management of orthodontic patients. Secondly, cephalometric assessments of parameters such as SNA, SNB, and lip dimensions which affect extraction decisions were not measured. Therefore, further studies are suggested, prospective preferably to determine the extraction pattern in a larger population of Africans taking into consideration the aforementioned limitations.

Conclusions

In this single centre study, we assessed the prevalence of orthodontic extraction from the case files of 340 orthodontic patients over a 5 year period. A prevalence of 52.3% was observed, with Class I malocclusion being the most predominant malocclusion pattern. A total of 384 teeth were extracted with the first premolars being the most frequently extracted teeth, accounting for 72.9% of all extracted permanent teeth. The primary canine was the most common primary tooth extracted. The commonest pattern of extraction observed was the extraction of all first premolars. These results will aid clinicians in making extraction decisions in the management of orthodontic patients of African descent.

Further studies involving cephalometric assessment of the effect of tooth extraction of facial profile should carried out to further determine the effect of extraction of this population.

Contributors

All authors contributed equally

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Conflict of Interest

None declared

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