PATTERN OF DENTAL MALOCCLUSION IN ORTHODONTIC PATIENTS IN RWANDA: A RETROSPECTIVE HOSPITAL BASED STUDY

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ABSTRACT

Background: Dental malocclusion is present in all societies but its prevalence varies. Identifying occlusal problems, their incidence and the need for treatment can help to determine the appropriate awareness plans, preventive and interceptive treatment and manpower needed in orthodontics. There is no study of such kind to evaluate the pattern of malocclusion in Rwandese population.
Aim: The aim of the study was to analyze and to provide quantitative information on the pattern of dental malocclusion among orthodontic population in Rwanda.
Methods: Various parameters retrieved from patients' records of 243 selected patients with dental malocclusion who visited Dental Department of King Faisal Hospital, Rwanda, during the period of January 2009 to July 2012 were analyzed in this retrospective study. Chi-square test was used to find the gender difference at $p < 0.05$.
Results: Angle's Class I malocclusion was found to be the most common malocclusion with 60.9 % followed by 28.8 % Angle's class II and 10.3 % Angle's class III. Increased crowding (71.2 %) was the most common problem, followed by increased overjet, deep bite and anterior open bite in that order. No significant gender differences were found except in deep bite.
Conclusion: The results give a pattern of malocclusion in orthodontic patients and may provide a base line data for planning awareness programs, preventive and interceptive orthodontic services & the future studies. There is a strong need of multicentric, epidemiological survey to find out the prevalence & causes of malocclusion in Rwandese population.

Keywords: Angle's classification - pattern of malocclusion - open bite - crowding - orthodontics

RESUME

Fond : Malocclusion dentaire est présent dans toutes les sociétés mais sa prédominance varie. En s'identifiant occlusal les problèmes, leur incidence et le besoin pour le traitement peuvent aider à déterminer les plans de conscience appropriés, le traitement préventif et intéroceptive et la main-d'œuvre nécessaire dans l'orthodontie. Il n'y a aucune étude d'une telle sorte pour évaluer malocclusion dans la population Rwandaise.
But : le but de l'étude était d'analyser et fournir des informations quantitatives sur le dessin de malocclusion dentaire parmi la population orthodontique au Rwanda.
Méthodes : les paramètres malocclusion dentaires différents de 243 patients choisis qui ont visité le Département Dentaire d'Hôpital de Roi Faysal, Kigali, le Rwanda pendant la période de janvier de 2009 jusqu'au juillet de 2012 ont été analysés dans cette étude rétrospective. L'épreuve Chi-carrée a été utilisée pour trouver la différence de genre à $p < 0.05$.
Résultats : la Classe d'Angle de malocclusion qui a été trouvée pour être la plus commune avait 60.9 suivi par la classe d'angle II de 28.8, et 10.3 la classe d'angle III. L'entassant augmenté (71.2) était le problème le plus commun, suivi par augmenté suren jais, mordre profondément et le morceau ouvert antérieur dans cet ordre. Aucune différence de genre significative n'a été trouvée sauf dans le morceau profond.
Conclusion : les résultats donnent un dessin de malocclusion dans les patients orthodontiques et peuvent fournir des données de ligne des bases à planifier des programmes de conscience, les services orthodontiques préventifs et interceptive * les études futures. Il y a un fort besoin d'enquête multicentrale, épidémiologique de découvrir la prédominance * les causes de malocclusion dans la population Rwandaise.

Mots-clés: la classification d'Angle - le dessin de malocclusion - ouvrez le morceau - le fait d'entasser - Orthodontie

INTRODUCTION

Occlusion is defined as the relationship of the maxillary and mandibular teeth as they are brought into functional contact; while malocclusion is the state of any deviation from the normal or ideal occlusion, as defined in the Glossary of Orthodontic Terms [1]. Malocclusion is an appreciable deviation from the ideal occlusion that may be considered aesthetically unsatisfactory (Houston, et al., 1992) [2] thus implying a condition of imbalance in the relative sizes and position of teeth, facial bones and soft tissues (lips, cheek, and tongue). Malocclusion is a common condition in the modern civilization due to adoption of soft food and lack of stimulus of the proper jaw growth, and proximal attrition of teeth, which otherwise helps to accommodation of teeth in dental arches in aligned manner.
The World Health Organization (1987) [3], had included malocclusion under the heading of Handicapping Dento-Facial Anomaly, defined as an anomaly which causes disfigurement or which impedes function, and requiring treatment "if the disfigurement or functional defect was likely to be an obstacle to the patient's physical or emotional well-being".
Malocclusions feature the third highest prevalence among oral pathologies, second only to tooth decay and periodontal disease, and therefore rank third among worldwide Public Health dental disease priorities3. According to the World Health Organization [3], the main oral diseases should be subjected to periodic epidemiological surveys for planning and providing prevention and treatment

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services [4]. Knowledge about the distribution of different malocclusions helps orthodontic practitioners to understand the existent problem in a geographic location and help them in the planning awareness and preventive programs.

REVIEW OF LITERATURE

Dental malocclusion is present in all societies but its prevalence varies in different parts of the world among various populations. Ethnic, genetic and environmental factors lead to development of malocclusion. Many epidemiological studies have been conducted to determine the prevalence of mal-occlusion in different racial and ethnic groups with variable results [5]. Savara (1955), in a study on children aged 14-17, reported the prevalence of normal occlusion, 21.1%; Class I, 50.1%; Class II, 19.4% and Class III, 9.4% [5]. Jackson and Brehm (1961), in their study on 6328 children aged 6-18, found the prevalence of normal occlusion, 16.6%; Class I, 60.1%; Class II, 22.8% and Class III, 0.5% [5]. Mills (1968), in his study on 1337 teenagers aged 13-14, reported the prevalence of normal occlusion, 17.5%; Class I, 72.2%; Class II, 6.6% and Class III, 3.7% [5]. A study on 3289 black American adolescents aged 12-14, yielded the prevalence of normal occlusion, 16.6%; Class I, 67.8%; Class II, 12.1% and Class III, 5% [5] A study on 919 teenagers in Kenya, aged 13-15, reported that the prevalence of malocclusion was as high as 72%. In this study crowding, increased overjet, and open bite were found in 19%, 10%, and 8% of the cases, respectively [6, 7].

A study done in Benin City, Nigeria on 229 males and 212 females of mean age 13.52 years ± 1.83 showed that 15.9% of the subjects had normal occlusion, 80.7% had Angle's class I and 1.1% had Angle's class II div 1, 0.5% had Angle's class II div 2 and 1.8% Angle's class III malocclusion. Increased overjet and overbite was observed in 24.7% and 9.8% respectively. Anterior open bite was present in 4.1%. Crowding in the upper (11.1%) and lower anterior segment (12%) were similar while spacing was more prevalent in the upper (29.9%) than the lower anterior segment (10.7%) with midline diastema present in 19.5%. The occlusal traits were not influenced by gender difference (P>0.05). The survey revealed predominance of Class I malocclusion among Nigerian children in Benin City [8].
On extensive search of literature, no such study could be found depicting the pattern of malocclusion in non-orthodontic Rwandese children; and the Rwandese patients seeking orthodontic treatment. This is the first study of its kind which aims at understanding the pattern of malocclusion & dental irregularities among patients who visited for orthodontic treatment at the Dental and Orthodontic Department of King Faisal Hospital, Kigali, Rwanda, and to find the gender differences if any; and to provide recommendations for future studies.

METHODS

This retrospective study included those patients who visited the Dental Department of King Faisal Hospital, Kigali, Rwanda during the period of January 2009 to June 2012 with chief complaints of irregularity of teeth. The patients were between 8 years to 35 years of age. Clinical examination of 312 patients was performed by an Orthodontist & findings were recorded in the medical record files of each patient, but only 243 patients were included in this study based on the selection criteria. Thus, the study included 124 males and 119 females between the ages of 10 – 30 years.

The following selection criteria were used:
1. The age range of patients between 10 – 30 years
2. Patients had no history of previous orthodontic treatment.
3. They had permanent teeth only.
4. There is no systemic disease, craniofacial deformities or syndrome.
5. All the patients were of Rwandese origin; the patients of Burundi, Uganda and DR Congo were not included.

The following parameters were recorded. The antero-posterior relationships of the maxillary and mandibular first molars in maximum intercuspation by Angle's classification [9]; crowding; spacing; increased overjet (more than 3 mm), increased overbite (more than 3 mm), open bite; deck biss pattern of incisors; and mandibular prognathism as evaluated clinically. The data were obtained through direct clinical examination by an orthodontist. Various classes of malocclusion according to Angle's classification & other parameters studied are as described below [10].

- **Angle's Class I relation**: Mesiobuccal cusp of the maxillary first permanent molar articulates in the mesiobuccal groove of the mandibular first permanent molar.
- **Angle's Class II relation**: The mesiobuccal cusp of maxillary first permanent molar articulates mesial to mesiobuccal groove of mandibular first molars. Angle's Class II Division 1: A class II relation in which maxillary incisors are inclined labially, and increased overjet is present. Angle's Class II Division 2: A class II relation in which maxillary central incisors are inclined lingually, and maxillary lateral incisors have tipped labially and mesially, covering the distal of central incisors. The overjet is reduced, and there is deep bite of partial / complete / traumatic / more than 100% nature.
- **Angle's Class III relation**: The mesiobuccal cusp of maxillary first permanent molar occludes distal to mesiobuccal groove of mandibular first molars. However, subdivisions of Angle's class II & III were not considered during this study.
- **Class IV relation**: When there is Angle's Class II relation on one side & Class III relation on other side of the dental arches in occlusion.
- **Deck biss**: It is the upper incisors arrangement in div 2 pattern while molar relation is Angle's class I.
- **Overjet** was defined as the horizontal distance between the incisal edge of the most prominent maxillary central incisors to the labial surface of corresponding mandibular central incisors. It was measured with a graduated scale and evaluated to the nearest 0.5mm. An overjet greater than 3 mm was considered to be increased.
- **Overbite** is the vertical relationship of the upper and lower incisors. It was recorded as increased when the maxillary central incisors covered the mandibular central

incisors by more than 3 mm.

- **Anterior open bite** was recorded when incisal edges of the maxillary incisors did not overlap the incisal edges of the mandibular incisors.
- **Crowding** was defined as overlapping of erupted teeth due to insufficient space or lack of space for teeth to erupt in the dental arch.
- **Spacing** was recorded to be present when there was no approximal contact between 2 teeth in a dental arch. However, no quantitative or qualitative measurement for crowding & spacing was done in any arches. It was just recorded as either present or absent in either of the dental arch. No segregation was done for upper or lower arch.

RESULTS

The results were presented in a descriptive fashion using absolute numbers & the percentage of different types of conditions for both sexes separately. Pooled data was also evaluated for finding the distribution of various conditions. Statistical significance for any sexual dimorphism between different parameters was evaluated with the chi-square test and $p<0.05$ was regarded as significant. Results have been presented in Tables 1, and 2; and Charts 1 – 4. There was significant difference between occurrence of the 3 classes of Angle's malocclusions (Table 1, chi square test, at $P < 0.01$). There were no significant gender differences among all the parameters studies except deep bite (Table 2, chi square test, at $P < 0.05$) which was found to be more in males as compared to females.

Table 1: Showing pooled data and frequency distribution; Charts 1 & 2

S. No.	Parameters	Total N = males + females = 243	Frequency %
1.	Angle's class I	148	60.9**
2.	Angle's class II	70	28.8**
3.	Angle's class III	25	10.3**
4.	Crowding	173	71.2
5.	Spacing	24	9.9
6.	Open bite	59	24.3
7.	Deep bite	77	31.7
8.	Increased overjet	108	44.4
9.	Mandibular prognathism	10	4.1

Table 2: Showing data divided according to sex and their frequency distribution; Charts 3, & 4

S. No.	Parameters	Males, N = 124		Females, N = 119	
		N	%	N	%
1.	Angle's class I	70	56.5	78	65.5
2.	Angle's class II, total	42	33.9	28	23.5
3.	Angle's class II, div 1	41	33	28	23.5
4.	Angle's class II, div 2	1	0.8	0	0
5.	Angle's class III	12	9.7	13	11
6.	Class IV	0	0	1	0.85
7.	Deck biss	1	0.8	0	0
8.	Crowding	82	66.1	91	76.5
9.	Spacing	11	8.9	13	10.9
10.	Open bite	28	22.6	31	26
11.	Deep bite	49	39.5	28	23.5*
12.	Increased overjet	60	48.4	48	40.3
13.	Mandibular prognathism	5	4	5	4.2

* significant at $p < 0.05$, chi square test

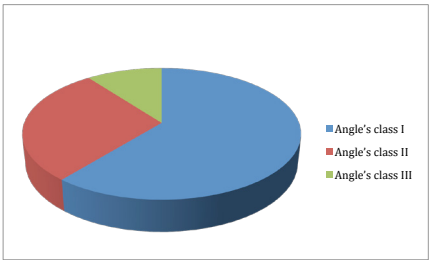

Figure 1: showing frequency distribution of Angle's class I, II & III malocclusions.

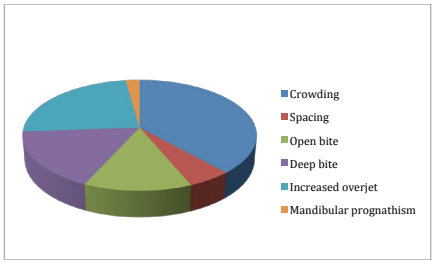

Figure 2: Showing frequency distribution of crowding, spacing, open bite, deep bite, overjet and mandibular prognathism conditions.

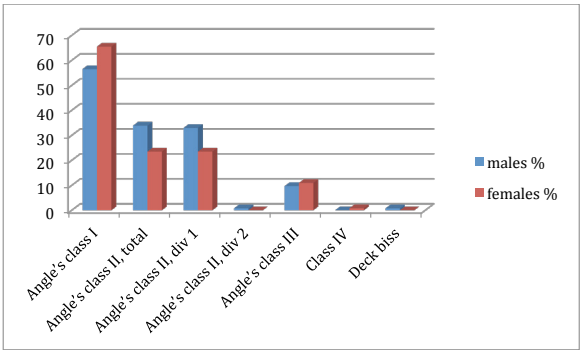

Figure 3: Showing gender distribution of different classes of malocclusion & conditions

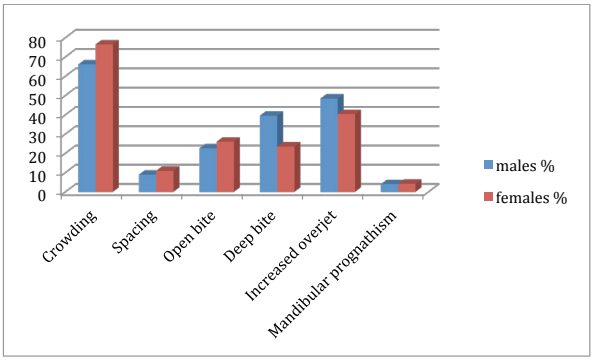

Figure 4: Showing gender distribution of different conditions of malocclusion

DISCUSSION

The reported prevalence of malocclusion in different parts of the world varies from 39% to 93% [11]. The evaluation of orthodontic patients may give valuable information for planning orthodontic treatment. The prevalence of malocclusion varies from one geographical area to another and differs from one country to another country and even from one city to another city. Angle's classification [15] is useful for easy documentation and provides a common channel of communication among dental professionals. It is an easy and rather accurate way to categorize malocclusions, and is globally used in dental profession.

In the present study, Angle's Class I malocclusion was found to be the most common malocclusion with 60.9 % followed by 28.8 % Angle's class II and 10.3 % Angle's class III among the orthodontic patients examined. This finding is consistent with other studies. Proffit et al [12] found in untreated White Americans of 8 - 50 years age, the Angle's Class I malocclusions was most prevalent, i.e., 52.2%, while 42.4% were Angle's Class II and less than 5% were Angle's Class III malocclusions. Another study on the pattern of malocclusion in Africa (Nigeria) [13] showed Angle's Class I at 76.5%, Class II 15.5% and Class III 8.0%.

IN the present study, Angle's class II division 1 malocclusion was at 28 %, which is very high as compared to studies reported from Nigeria by Ajayi [8], who reported only 1.5 %.

In our study, Angle's class II division 2 malocclusion was very low, (1 out of 243 subjects). A study by DaCosta [14] found only 1.7% children in Northern Nigerian had Angle's class II division 2 malocclusion, while Ajayi8 found it at 0.5 % level in his study. However a study in the British population shows higher prevalence rates ranging from 8 - 27% [15-17].
The frequency of Angle's class III malocclusion of 10.3 % in our sample, but it is different from the low prevalence reported in Nigerian children [18-19] and of 1% in Tanzanian children [20]. However, Garner & Butt 1985 [21] in their study on Kenyan children found higher prevalence of 16.8% of Class III.
Deck biss and Class IV relation each were also found in 1 out of 243 cases only, which is quite negligible. These features have not been evaluated in any other studies done on African children.

Increased crowding (71.2 %) in the sample studies was very high and thus the causes of crowding should be looked into in the future studies, so that proper preventive actions could be taken by creating awareness campaigns. Although frequency of crowding was more in females as compared to males, but the difference was not statistically significant. Drummonds [22] found only 40 % children having crowding in the study done in South Africa. The high percentage of crowding may be partly explained by the frequent occurrence of caries and molar extractions, which favors the migration of first permanent molars, inclinations and rotations [11]. Genetics and racial differences controlling the growth of jaws; evolutionary trends in jaw growth; premature extractions of baby teeth without any space maintenance; unrestored caries and space loss; Ibyinyo (a type of oral mutilation i.e. a traditional practice in some parts of Rwanda and Africa where the tooth buds of certain baby teeth are gouged out in early age to prevent GIT infections in a child); iatrogenic malocclusion created by extraction of certain permanent teeth by non – orthodontists & other dentists etc can be some of the factors which may have contributed to increased crowding, which should be looked into in future studies. In the posterior segments, these events are associated with the early loss of deciduous molars and, consequently, loss of space. On the other hand, spacing was found to be present in only 9.9 % cases, thus showing the general trend worldwide that crowding is more prevalent than spacing due to evolutionary trends and dietary habits. However, the presence of spacing needs to be studied in depth to find out the related causes.
High percentage of open bite 24.3 % is consistent with some studies in African children (Kenya 11.4%; Nigeria 7 – 10.2 %; Tanzania 8 %) [23-28] which can be due to heredity and racial differences as compared to White population. In a dissertation study done by Drummonds in 200322 in South Africa, he found the anterior open bite at 7.7 %, he also found that the open bite was more prevalent among Blacks as compared to Whites & Asians; and females were more affected than males. Otuyemi et al [29] in a study in Nigeria found 10.2 % prevalence of open bite.

Several factors have a role in the pattern of different kinds of malocclusion among populations. These contributing factors could be considered as the time of the study. Eg

the causes of open bite may be due to chronic nasal allergy and mouth breathing habits in Rwandese children which should be explored in further studies with the collaboration of ENT surgeon.

An increased overjet 44.4 % was found in the present study. In a dissertation study done by Drummonds in 2003 [28] in South Africa, he found the approx 32 % subjects had increased overjet, in which Blacks had less prevalence as compared to Whites; and boys were more than girls. In the present study, we found high percentage of overjet, with no sexual dimorphism. It may be due to racial and genetic differences, and may also be associated with mouth breathing habit which leads to downward & backward mandibular rotation, increased anterior facial height, and convexity of profile, which also needs to be explored in future studies. Studies done in Nigeria show that there, the normal overjet is more frequent while only 25 % showed increased overjet. Isiekwe [30-31] also reported that 58% subjects had normal overjet, and he attributed it to the possibility of bimaxillary protrusion which is prevalent in Black race.
Deep bite was found to be in approx 32 % cases in our study. It is very high as compared to studies done in Nigerian where normal overbite relation was found to be more [32-35] Only 9.8 % patients were having deep bite in the study done by Ajayi in Nigeria [8]. The difference may be due to differences in facial growth pattern and racial differences. There was significant gender difference in deep bite which was found to be more in males as compared to females in our sample.

CONCLUSION

In this retrospective, preliminary, hospital based study, the frequency of Angle's Class I, Class II and Class III malocclusion was found to be 60.9%, 28.8% and 10.3% respectively. Out of all the problems studied, crowding was found to be the most common feature, followed by increased overjet, deep bite and anterior open bite in that order. Identifying occlusal problems, their incidence and the need for treatment can help to determine the appropriate treatment plan and manpower needed in orthodontics. Such epidemiological surveys are extremely important as they can help in finding the factors leading to malocclusion, and thus help in planning the preventive and interceptive actions and awareness programs for the population. The results may also provide a base line data for planning orthodontic services but cannot be representative of the whole of the population. Also, in view of the biased nature of the sample, the data of this orthodontic population cannot be extrapolated to the whole of the Rwanda population. There is a strong need of analyzing the prevalence of malocclusion in Rwanda.

In view of findings of the current study, following recommendations can be enumerated:

- There is a strong need to conduct epidemiological studies on the population of Rwanda to find out the prevalence of malocclusion.
- Additional criteria should be used in future studies involving large number of subjects with random sampling, countrywide, multi-centric studies should be conducted.
- The causative factors of the irregularity of teeth and other malpositions should also be evaluated simultaneously so that preventive and interceptive measure could be planned.
- The ENT surgeon needs to be associated in the study to evaluate the patients for chronic nasal allergy and mouth breathing habits to associate their relation with the open bite etc.
- Proper awareness programs should be started to educate the masses and the school children to avoid the causative factors leading to malocclusion e.g. prevention of caries, trauma etc.
- The dental health manpower should be educated and trained so that they can manage the space left after premature extraction of baby teeth, or they should be sensitized to refer such patients to specialist for space management.
- The resources for minor and major orthodontic treatments; space maintainers and other preventive therapies should be made available in the hospitals and clinical settings.
- Since the early treatment can be done for some of these conditions so that their severity does not increase with age, it shows the importance of having children assessed during the mixed dentition. Early treatment is also recommended in severe cases of excessive overjet to prevent dental trauma and improve lip function and breathing, esthetics and psychological well being of the children.
- The insurance providers should be educated & sensitized that they should not insist that orthodontic intervention can only be done in permanent teeth. There are certain conditions which need to be treated during mixed dentition period also to prevent the future development of skeletal, functional and esthetic problems.

REFERENCES

1. John Daskalogiannakis: Glossary of Orthodontic Terms. Publisher: Quintessence, 2000, 1st Ed.
2. Houston W, Stephens C, Tulley W. A textbook of orthodontics. Bristol: Wright Pub Co, 1992.
3. Organização Mundial Da Saúde. Levantamento epidemiológico básico de saúde bucal: manual de instruções. 3. ed. São Paulo: Ed. Santos, 1991. Cited from Daniel Ibrahim BritoI; Patricia Fernanda DiasI; Rogerio GleiserII Prevalence of malocclusion in children aged 9 to 12 years old in the city of Nova Friburgo, Rio de Janeiro State, Brazil. R Dental Press Ortodon Ortop Facial 118 Maringá, v. 14, n. 6, p. 118-124, Nov./Dez. 2009
4. Pinto VG. Planejamento. In: Saúde bucal: Odontologia social e preventiva. 3. ed. São Paulo: Ed. Santos, 1992. cap. 3, p. 21-40. Cited from Daniel Ibrahim BritoI; Patricia Fernanda DiasI; Rogerio GleiserII Prevalence of malocclusion in children aged 9 to 12 years old in the city of Nova Friburgo, Rio de Janeiro State, Brazil. R Dental Press Ortodon Ortop Facial 118 Maringá, v. 14, n. 6, p. 118-124, nov./dez. 2009
5. Staley NR. Etiology and Prevalence of Malocclusion. In: Bishara SE. Textbook of Orthodontics. Philadelphia: Saunders; 2001: 84-104.
6. Ng'ang'a PM, Ohito F, Ogaard B, Valderhaug J. The prevalence of malocclusion in 13 to 15 year-old children in Nairobi, Kenya. Acta Scand 1996; 54:126-30.

7. Ng'ang'a PM. A study of occlusion anomalies and teeth loss in children aged 13-15 in Nairobi. E Afr Med J 1991; 68:980-988.

8. O. Ajayi E: Prevalence of Malocclusion Among School Children in Benin City, Nigeria. Journal of Medicine and Biomedical Research, Vol. 7, No. 1 & 2, December 2008, pp. 58-65

9. Angle EH: Classification of malocclusion, Dental Cosmos, vol. 41, pp. 248–264, 1899.

10. Moyers RE: handbook of orthodontics. 4th edition. Chicago: year book medical publisher; 1988.

11. Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogota, Colombia. An epidemiological study related to different stages of dental development. Eur J Orthod. 2001; 23:153–167.

12. Proffit WR, Fields HW Jr, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. Int J Adult Orthodon Orthognath Surg. 1998; 13:97–106.

13. Onyeaso CO, Aderinokun GA, and Arowojolu,MO: The pattern of malocclusion among orthodontic patients seen in Dental Centre, University College Hospital, Ibadan, Nigeria. African Journal ofMedicine and Medical Sciences, vol. 31, no. 3, pp. 207–211, 2002.

14. Da Costa OO: The prevalence of malocclusion among a population of northern Nigeria school children. West Afr J Med 1999; 18: 91-6.

15. Gardiner JH. A survey of malocclusion and some aetiological factors in 1000 Sheffield school children. Dent Practit1956;6:187-201.

16. Foster TD, Day AJW. A survey of malocclusion and the need for orthodontic treatment in a Shropshire school population. Br J Orthod 1974; 1: 73-8.

17. Haynes S. The prevalence of malocclusion in English school children aged 11-12 years. Eur Orthod Soc Trans 1970: 89 -98.

18. Otuyemi OD, Abidoye RO. Malocclusion in 12-year-old suburban and rural Nigerian children. Community Dent Health. 1993; 10:375–380.

19. Otuyemi OD, Ogunyinka A, Dosumu O, Cons NC, Jenny J. Malocclusion and orthodontic treatment need of secondary school students in Nigeria according to the dental aesthetic index (DAI). Int Dent J. 1999; 49:203–210.

20. Kerusuo H., Laine T., Kerosuo E., Ngassapa D., Honkala E. Occlusion among a group of Tanzanian urban school children. Community Dent Oral Epidemiol 1988; 16: 306-9.

21. Garner LD, Butt MH. Malocclusion in Black Americans and Nyeri Kenyans. An epidemiologic study. Angle Orthod. 1985; 55:139–146.

22. Drummond, RJ. Orthodontic status and treatment need of 12-year-old children in South Africa: An epidemiological study using the Dental Aesthetic Index. 2003. 128 f. Dissertação (Mestrado em Odontologia)-School of Dentistry, University of Pretoria, Pretoria, 2003.

23. Maliu AN, Mutena A, Kaimenyi JT, Nganga P. The nature of malocclusion of patients attending the Orthodontic Department of the University of Nairobi: A retrospective study. Tropical Dent J 1994;17:13-7.

24. Richardson A., Ana RR. Occlusion and malocclusion in Lagos. J Dent 1973; 1: 134-9.

25. Isiekwe, MC, Logan WW. An analysis of the first 100 orthodontic patients treated in Lagos University Hospital. Nig Dent J 1981; 2: 1-5.

26. Isiekwe MC. Malocclusion in Lagos. Community Dent Oral Epidemiol 1983; 11:59-62.

27. Kerosuo H, Laine T, Kerosuo E, Ngassapa D, Honkala E. Occlusion among a group of Tanzanian urban schoolchildren. Community Dent Oral Epi- demiol 1988;16:306-09.

28. Mugonzibwa EA, Mumghamba E., Rugarabamu P., Kimaro S. Occlusal and space characteristics among 12year-old school children in Bukoba and Moshi, Tanzania. Afr Dent J 1990; 4: 6-10.

29. Otuyemi OD, Ogunyinka A, Dosumu O, Cons NC, Jenny J. Malocclusion and orthodontic treatment need of secondary school students in Nigeria according to the dental aesthetic index (DAI). Int Dent J. 1999; 49:203–210.

30. Isiekwe MC. Distribution of overjet values in Negro population in Nigeria. Comm Dent H 1986; 3: 61-4.

31. Isiekwe MC. Malocclusion in Lagos, Nigeria. Community Dent Oral Epidemiol 1983; 11: 53-62.

32. Aggarwal SP., Odusanya SA. Orthodontic status of school children in Ile-Ife, Nigeria. Acta Odontol Paediatr 1985; 6: 9-12.

33. Otuyemi OD., Abidoye RO. Malocclusion in 12-year-old suburban and rural Nigerian children. Comm Dent H 1993; 10: 375-80.

34. Sanu OO. The Epidemiology of malocclusion in Nigerians of Yoruba ethnic group. F.M.C.D.S. Thesis, Lagos University Teaching Hospital, 1994.

35. Onyeaso CO. Prevalence of malocclusion among adolescents in Ibadan, Nigeria. Am J Orthod Dentofacial Orthop 2004; 126: 604-7.