

# Orthodontic Treatment Complexity and Need in a Nigerian Teaching Hospital

Ifeoma Linda Utomi<sup>1</sup>, Chukwudi Ochi Onyeaso<sup>2</sup>

<sup>1</sup>Senior Lecturer in Orthodontics/Consultant Orthodontist, Department of Child Dental Health, Faculty of Dentistry, College of Medicine, University of Lagos/University of Lagos Teaching Hospital (LUTH), Lagos, Nigeria. <sup>2</sup>Professor of Orthodontics/Consultant Orthodontist, Department of Child Dental Health, Faculty of Dentistry, College of Health Sciences, University of Port Harcourt/University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Nigeria.

## Abstract

**Objective:** The aim of this study was to assess the orthodontic treatment need and complexity in a major referral orthodontic centre in Lagos, Nigeria.

**Method:** Pre-treatment dental casts of 150 consecutive patients were assessed using the Index of Complexity, Outcome and Need (ICON).

**Results:** Fifty-seven (38%) of the population needed orthodontic treatment. Twenty-five (16.7%) cases were classified as difficult or very difficult, 14.7% moderate and 68.6% belonged to the easy/mild categories. The overall mean ICON score was  $43 \pm 17.8$  SD. There were no significant age or gender differences in the pre-treatment ICON score. There was a significant association ( $p < 0.05$ ) between treatment need and social class: more subjects from the lower social class needed orthodontic treatment than subjects from the higher social class.

**Conclusions:** More than one third of the population had a need for orthodontic treatment, of which close to one fifth were in the difficult to very difficult category. Patients in the lower socio-economic class had greater need for orthodontic treatment than those from the higher class.

*Key words:* Orthodontic treatment needs, complexity, teaching hospital, Nigeria.

## Introduction

A systematic and well organized orthodontic service for any target population requires an assessment of the orthodontic treatment need and complexity. This is necessary for the planning of orthodontic services and training programmes for specialists. Occlusal indices have enabled quantification of treatment need and are also useful for research, audit, practice management and quality assurance in orthodontics [1]. Occlusal indices such as the Index of Orthodontic Treatment Need (IOTN) [2], Dental Aesthetic Index [3] have been used successfully in various countries such as the United Kingdom [4], Senegal [5], Iran [6] and Nigeria [7-15] to provide useful information on orthodontic treatment need and provision of orthodontic services. However, they are not always comparable [16,17].

Complexity or difficulty has been used in the orthodontic literature to indicate the degree of effort associated with achieving normal or ideal occlusion [18]. Richmond et al. [19] stated that difficulty and complexity are synonymous and is a measure of effort or skill, while severity is a measure of how far a malocclusion deviates from normal. According to Casinelli et al. [20], complexity or difficulty is related to the severity of the malocclusion. Prior to the development of the index of complexity, Outcome and Need (ICON) [21], complexity of orthodontic cases was difficult to assess due to lack of an internationally accepted index.

The Index of Complexity, Outcome and Need (ICON) [21] was developed from the subjective judgment of an international panel of 97 orthodontists from 9 countries. It is a single, internationally accepted method of assessing orthodontic treatment complexity, outcome and need. It incorporates facets of need, complexity, improvement and

acceptability [22]. The ICON consists of five components: the Aesthetic Component (AC), upper and lower crowding/spacing assessment, presence of cross bite, degree of incisor open bite/overbite, and the antero-posterior buccal relationship. Each component can be measured on study casts as well as patients [22].

Nigeria is the most populous country in Africa with over 140 million people. Lagos, the former capital of Nigeria, is the most populated cosmopolitan urban city in Nigeria. The practice and teaching of orthodontics in Nigeria started at the Lagos University Teaching Hospital (LUTH). It is a major referral center and provides dental care (including orthodontic care) for patients from all socio-economic groups.

In Nigeria, several studies have been carried out to assess treatment need using the Index of Orthodontic Treatment Need (IOTN) and the Dental Aesthetic Index [7-15]. Furthermore, the Index of Complexity Outcome and Need (ICON) have similarly been used to assess orthodontic treatment need and complexity in Nigeria [13,23-27]. However, to the best knowledge of the authors, no such study has previously been conducted in Lagos, Nigeria with a major orthodontic referral center.

The ICON has been shown to be validated for the Nigerian population [13,24] and is a single tool useful for assessment of different aspects of orthodontic provision. Information on orthodontic treatment need and complexity using the index of Complexity, Outcome and Need (ICON) would be useful for planning of orthodontic services, training programmes for specialists and for national health planning. It would also enable a valid international comparison of the data and services.

Corresponding author: Dr. I L Utomi, Senior Lecturer in Orthodontics/Consultant Orthodontist, Department of Child Dental Health, Faculty of Dentistry, College of Medicine, University of Lagos/University of Lagos Teaching Hospital (LUTH), Lagos, Nigeria; e-mail: ifeomautomi@yahoo.com

Therefore, the aim of this study was to assess the orthodontic treatment complexity and need of orthodontic patients (pretreatment) presenting at the referral orthodontic clinic of the Lagos University Teaching Hospital, Lagos, Nigeria.

## Materials and Methods

This prospective study was carried out at the Orthodontic Unit of the Lagos University Teaching Hospital, Lagos, Nigeria. The study population consisted of 150 consecutive patients who were scheduled for treatment at the Orthodontic clinic of the Lagos University Teaching Hospital between June, 2011 and December, 2012. The study casts of the patients were used for the assessments. The ICON was used to score the 150 pre-treatment dental casts for assessment of complexity and need by one trained and calibrated examiner (ILU). The need for orthodontic treatment was defined as an ICON score of 43 and above while complexity was graded into easy (<29), mild (25-29), moderate (51-63), difficult (64-77), and very difficult (>77) in line with ICON guidelines.

The subjects were classified into two social classes using the Standard Occupational Classification as previously used by Onyeaso [11].

Intra-examiner reliability was assessed by repeating the examination of fifteen randomly selected pre-treatment casts 4 weeks after the initial examination. The two examinations were evaluated statistically. The reproducibility of the ICON

scores was assessed using Spearman Rank Correlation Coefficient ( $P=0.98$ ), and excellent agreement was found. Intra-examiner consistency for the categorization of treatment need into need and no need was expressed as the kappa reliability coefficient with a value of 0.93 indicating strong agreement, whilst the reliability of the complexity grades was also evaluated using the W Kendall test with a value of 0.78.

## Statistical analysis

The data was analyzed statistically using the SPSS statistical package (Statistical Package for the Social Sciences Version 17.0 for window 2009 (SPSS Inc., Chicago, Ill, U.S.A.

The qualitative variables were described using frequencies and percentages. For the quantitative variable ICON score, mean for central tendency and standard deviation were used. For ordinal variables, ICON categorization of treatment complexity, frequencies and percentages were used for descriptive statistics. Gender differences with respect to ICON score were tested using student t-test. Chi square test was used to test for association between gender and complexity grades. The significance level was set at 0.05.

## Results

Table 1 shows the age and gender distribution of the sample. The mean age of the sample was  $17.1 \pm 7.8$  years. Majority of the patients were in the 6-10 and 11-15 age groups and the overall female to male ratio of the sample was 1.6:1.

Table 1: Age and gender distribution of study sample.

Age Range (Yr)	Male N (%)	Female N (%)	Total N (%)
<11	21 (53.8)	18 (46.2)	39 (100)
11 - 15	18 (43.9)	23 (56.1)	41 (100)
16 - 20	6 (31.6)	13 (68.4)	19 (100)
21 - 25	5 (19.2)	21 (80.8)	26 (100)
26 - 30	6 (37.5)	10 (62.5)	16 (100)
>30	2 (22.2)	7 (77.8)	9 (100)
Total	58 (38.7)	92 (61.3)	150 (100)

## Orthodontic treatment need

About 38% of the studied population had a need for orthodontic treatment while sixty two percent (62%) with ICON score of less than 43 had no need for orthodontic treatment.

The mean ICON score of the study population was  $43 \pm 17.8$ . There were no statistically significant gender differences in the mean ICON score ( $p>0.05$ ). Similarly, there were no statistically significant differences in the mean ICON score between the age groups ( $p>0.05$ ) as shown in Table 2. There was a significant association between the pretreatment ICON score and social class ( $p<0.05$ ). More subjects from the lower

social classes needed orthodontic treatment (56.3%) than subjects from the higher social classes (33.1%) (Table 3).

## Orthodontic treatment complexity

The grades of orthodontic treatment complexity are shown in Figure 1. Easy complexity was found in 21.3% of the subjects, 47.3% had mild complexity, 14.7% moderate complexity, while 12.7% and 4.0% had difficult and very difficult grades of complexity, respectively.

There was no significant difference in complexity grades between males and females ( $p>0.05$ ). Similarly, there were no significant differences in complexity grades between the age groups and by social class (Table 4).

Table 2: Mean ICON score across age group and gender.

	Mean (SD)	n	F statistics	P value
<b>Age Group (yr)</b>				
<11	41.8 (16.2)	39	0.9	0.467
11 - 15	44.8 (19.3)	41		
16 - 20	40.1 (20.1)	19		
21 - 25	48.9 (17.3)	26		
26 -30	42.5 (14.0)	16		
>30	37.1 (21.1)	9		
<b>Sex</b>			<b>T statistics</b>	
Male	44.3 (17.9)	58	0.6	0.543
Female	42.5 (17.9)	92		

Table 3: Association between pretreatment ICON score and social class ( $P<0.05$ ).

	ICON Pretreatment need	ICON Pretreatment need	Total		P value
<b>Social Class</b>	<43	≥ 43			
I	14 (43.8)	18 (56.3)	32 (100)	5.8	0.016
II	79 (66.9)	39 (33.1)	118 (100)		
Total	93 (62.0)	57 (38.0)	150 (100)		

Table 4: Relationship between age, gender, social class and pretreatment complexity grade.

Age Group	Complexity Grade					Total
	Easy	Mild	Moderate	Difficult	Very difficult	
<11	7 (17.9)	24 (61.5)	3 (7.7)	4 (10.3)	1 (2.6)	39 (100)
11 - 15	7 (17.1)	18 (43.9)	8 (19.5)	5 (12.2)	3 (7.3)	41 (100)
16 - 20	8 (42.1)	6 (31.6)	2 (10.5)	2 (10.5)	1 (5.3)	19 (100)
21 - 25	4 (15.4)	12 (46.2)	4 (15.4)	5 (19.2)	1 (3.8)	26 (100)
26 -30	2 (12.5)	9 (56.3)	4 (25.0)	1 (6.3)	0 (0.0)	16 (100)
>30	4 (44.4)	2 (22.2)	1 (11.1)	2 (22.2)	0 (0.0)	9 (100)
Total	32 (21.3)	71 (47.3)	22 (14.7)	19 (12.7)	6 (4.0)	150 (100)
	X <sup>2</sup> =20.0, P value=0.455					
<b>Sex</b>						
Male	13 (22.4)	26 (44.8)	8 (13.8)	9 (15.5)	2 (3.4)	58 (100)
Female	19 (20.7)	45 (48.9)	14 (15.2)	10 (10.9)	4 (4.3)	92 (100)
Total	32 (21.3)	71 (47.3)	22 (14.7)	19 (12.7)	6 (4.0)	150 (100)
	X <sup>2</sup> =0.9, P value=0.930					
<b>Respondents' Social Class</b>						
I	6 (18.8)	10 (31.3)	8 (25.0)	6 (18.8)	2 (6.3)	32 (100)
II	26 (22.0)	61 (51.7)	14 (11.9)	13 (11.0)	4 (3.4)	118 (100)
Total	32 (21.3)	71 (47.3)	22 (14.7)	19 (12.7)	6 (4.0)	150 (100)

	X <sup>2</sup> =17.5, P value=0.352	
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Table 5: Association between orthodontic treatment need and complexity.

Treatment need	Complexity Grade					Total
	Easy	Mild	Moderate	Difficult	Very difficult	
ICON Score						
<43	32 (34.4)	61 (65.6)	0 (0.0)	0 (0.0)	0 (0.0)	93 (100)
43 and above	0 (0.0)	10 (17.5)	22 (38.6)	19 (33.3)	6 (10.5)	57 (100)
Total	32 (21.3)	71 (47.3)	22 (14.7)	19 (12.7)	6 (4.0)	150 (100)
	X <sup>2</sup> =113.5, P value=0.000					

The increase in the level of complexity of the malocclusion was associated with a corresponding increase in treatment need (Table 5).

Of the subjects assessed to have a need for treatment (38%), none of them was found to have malocclusions of easy complexity while the subject without a treatment need did not have malocclusion that was categorized as moderate, difficult or very difficult to treat.

## Discussion

Orthodontic treatment complexity and need could differ from one population to another depending on various factors which could influence the demand for orthodontic care such as social and cultural conditions, awareness and attitudes to orthodontic care, referral factors and dentists awareness [28].

The mean ICON score obtained in this study was  $43.0 \pm 17.8$  which is much lower than that obtained in a study conducted in an orthodontic population in Nigeria [24] ( $67.4 + 19.63$ ), though this earlier study was conducted in a different city (Ibadan) in Nigeria. Similarly, the mean ICON score in the present study is also lower than 72.5 and 69.0 reported for clinic-based studies in Sweden and Greece, respectively [29,30]. These differences could be due to variation in availability of orthodontic services, in referral pattern and inappropriate referrals [31]. The mean ICON score of this study is however comparable to the values  $39.7 \pm 25.3$  and  $(41.93 \pm 15.38)$  obtained in prevalence studies in 12-18 year olds in South-South Nigeria [27] and Western Nigeria [25] respectively. It is also close to that obtained in 12- and 13-year olds in Latvia (42.05) and Senegal (42.31 - 44.46) [5,32].

In this study, there were no significant gender or age differences in the mean ICON score. This is consistent with previous studies that assessed orthodontic treatment need using ICON, IOTN and DAI conducted in Nigeria [10,12,33], Senegal [5], Latvia [32] and Iran [34]. These findings are however inconsistent with the report of Burden et al. [35] and Aikins et al. [27] and also at variance with that of Onyeaso [11] in a clinic-based study in Southwest Nigeria where clinical research has shown that more females recognize a need for orthodontic treatment more than males.

Slightly more than a third of the study population was found to have a need for orthodontic treatment according to the ICON (38%). This compares well with the value (38.16%) obtained in an epidemiological survey of adolescents in

South-South Nigeria [27], 35.3% obtained for children in Latvia [32] but is lower than 42% obtained for adolescents in Western Nigeria [13], and 44.1% in Senegal [5] and 46.6 % documented for 11-14 year-old Iranian school children [34]. It is, however, higher than the 26.9% reported for Southern Chinese children [36].

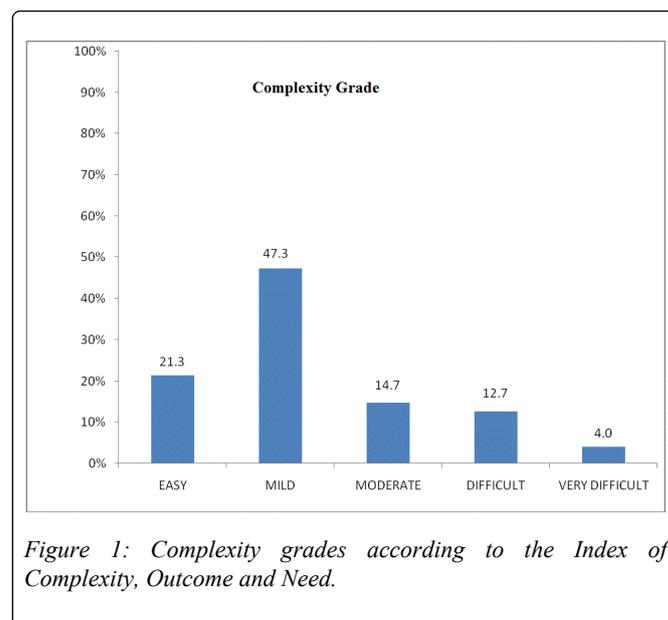


Figure 1: Complexity grades according to the Index of Complexity, Outcome and Need.

In studies conducted among orthodontic patients, Richmond et al. indicated that 94% were considered by the ICON score as needing treatment at the start of the intervention in Greece [30] and 97.0% in Sweden [29]. The relatively lower need for treatment in the Nigerian population could be due to higher prevalence of crowding believed to be present among Caucasians than Nigerians [7,37].

The need for orthodontic treatment obtained in the present study (38.1%) is much lower than that (83.9%) reported in a previous Nigerian clinic-based study [23]. This earlier study was, however, conducted in a different city (Ibadan) in Nigeria. A possible reason for this difference could be due the higher metropolitan nature of Lagos with people from different areas of Nigeria and beyond seeking treatment. Both perceived need and demand vary with social and cultural conditions [38]. It has been suggested that the public's assessment of dental irregularity and perception of psychological and sociological implications of malocclusion become more critical when orthodontic services are readily

available [39]. In Lagos orthodontic services have been available for more than three decades with services provided by public hospitals and private clinics with a corresponding increase in awareness and demand for treatment in comparison to other cities in Nigeria where services have been available for much shorter period. A recent report from this study centre (Lagos University Teaching Hospital) showed that that 2/3rd of patients was self-referred [40]. The finding of this study suggests that patients probably had perceived need for treatment that did not correspond with the objectively assessed need.

Regarding complexity of orthodontic treatment, close to one-fifth of the subjects belonged to the difficult and very difficult categories of treatment need (16.7%). This is much lower than the values obtained in Iranian school children (26%) [36] but contrasts markedly with that obtained among adolescents in Western Nigeria (9.9%) [13] and 10% in Latvia [32]. It is noteworthy that much higher values were obtained in previous clinic-based studies [29,30,39]. In their report, Richmond et al. showed 61% belonging to the difficult and very difficult categories in Greece [30] and 74% in Sweden [29] and United States [41] (60%). However, it is interesting to note the marked differences in the value obtained in the present study (16.7%) and that (60.7%) obtained in a previous clinic-based study in Western Nigeria [23], though this earlier study was conducted in a different city in Nigeria.

In this study, moderately complex cases accounted for 14.7% which is much higher than that 7.5% obtained in a recent Nigerian epidemiological report [27]. It is comparable with that obtained (16.1%) in other prevalence studies in Nigeria [13], 14.1% in Latvia [32] and 15.1% in Iran [36]. It also compares well with that obtained in a clinic-based study in Nigeria 14.3% [24], but is however lower than values obtained in clinic-based studies in Sweden [29] 18%, Greece 23% [20].

The present study indicated 68.6% as belonging to the easy and mild categories which is comparable to the 70.9% obtained in South-South Nigeria [27], 75% obtained in Western Nigeria [24] and 76% obtained in Latvia [32] but contrasts sharply with values obtained in Greece 16% [30] and United States 22% [41].

In this study, there was a highly significant association between the orthodontic treatment complexity and need. The higher the complexity grade the higher the degree of treatment need and the greater the severity of the malocclusion. Similar findings have been reported in both epidemiological studies and in orthodontic patient populations in earlier studies in Ibadan, Nigeria using the ICON and DAI [13,24]. The complexity or difficulty of orthodontic cases indicates the level and appropriateness of expertise required to adequately undertake the treatment. It further highlights the need for the skills of specialist for adequate treatment.

The study by Cassinelli et al. [20] showed that the complexity or difficulty in achieving an ideal occlusion increases as the severity of the initial malocclusion increases. Richmond et al. [19,30], as well as Onyeaso and BeGole [28] found the pretreatment ICON score to be a good indicator of treatment difficulty.

In this study, there was a significant association between treatment need and social class ( $p < 0.05$ ). More subjects in the lower social class had need for orthodontic treatment than subjects from the higher social class. This is consistent with the finding of Onyeaso [11] using Dental Aesthetic Index on a clinic-based study also. According to Onyeaso, this was because patients from the lower socio-economic class in Nigeria were mainly forced to come for orthodontic care due to the severity of their malocclusions [11].

Currently, there is an increasing demand for orthodontic care in Nigeria. Meanwhile, the present number of orthodontists for the whole country is insufficient to meet the rising demand. Objective assessment of treatment need and complexity using the ICON will be useful for recommending and prioritizing orthodontic treatment in a developing economy like Nigeria with limited resources.

## Conclusions

- In this study, 38% of the population was found to have a need for orthodontic treatment according to the ICON.
- No statistically significant age or gender differences were found in the pretreatment ICON score.
- Subjects (patients) in the lower socioeconomic class have greater need for orthodontic treatment than those from the higher class.
- Most of the subjects fell into the mild grade of complexity while close to one fifth were in the difficult to very difficult category.
- The increase in level of complexity of the malocclusion was associated with a corresponding increase in treatment need.

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