Prevalence of Tooth Size Discrepancies among a Nigerian Population.

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Abstract

Background: **To assess the proportion of the population of Nigerian adolescents that possess a clinically significant tooth size discrepancy, and to determine any gender differences in the prevalence of tooth size discrepancies.**

Methods: **Casts from 372 randomly selected junior secondary school pupils in Lagos state were evaluated for frequency and magnitude of deviation from Bolton's means (Discrepancies outside of 2 SD were considered clinically significant, enough to affect treatment planning or treatment outcome). Chi-test was performed to determine differences in the prevalence of tooth size discrepancies between the sexes.**

Results: A total of 32.2% and 14% of the subjects had a clinically significant anterior and overall tooth size discrepancy respectively. No significant difference in prevalence was demonstrated between the sexes.

Conclusions: **Clinically significant anterior tooth size discrepancies were determined in about a third of a general population of adolescents. Therefore, the problem of tooth size may be larger than the subjective view of clinicians, and it may be wise to include a tooth size analysis in the initial case work-up.**

Key words: **Tooth size discrepancies, Overall ratio, Anterior Ratio.**

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Introduction.

Tooth size has been described as the seventh key of occlusion, [1] and so the presence of a significant tooth size discrepancy may jeopardize the quality of orthodontic outcome achievable at the end of treatment.[2]. In 1958, Bolton,[3] from his study on tooth size ratios, studied 55 patients with normal occlusion, and computed two tooth size ratios: the Anterior ratio, and the Overall ratios, with their respective mean values. He further demonstrated the clinical importance and effectiveness of these ratios in the diagnosis of problems associated with tooth size, and suggested that standard deviations from his original sample be used to determine the need for reduction of tooth tissue by inter-dental striping or the addition of tooth tissue by restorative techniques. [4] A clinically significant tooth size discrepancy is one that is large enough to affect treatment planning, and adversely affect treatment outcome if left untreated. It has generally been defined as two standard deviations outside the Bolton's mean ratios[5-7] and translates to 2-3mm of discrepancy per segment, an amount great enough to be clinically relevant.[5] Recently, several investigators have reported the prevalence of clinically significant tooth size discrepancies as ranging from 17.4% to 37.9 % anteriorly, [2, 5, - 13] and from 5% to 13.5% overall.[6, - 9, 11, 12.] .In spite of these reports, the problem of tooth size has received scant attention from clinicians, and the widespread view of many is that it is an infrequent problem in clinical practice.[14]

The aims of this study were therefore to determine the prevalence of clinically significant tooth size discrepancies, and investigate gender differences in tooth size discrepancies among a Nigerian population.

Materials and Methods

The sample comprised of 372 junior secondary school students, aged between 12 and 16 years, from Lagos state, Nigeria. Ethical approval was obtained from the Lagos State Universal Basic Education Board (SUPEB). Written informed consent was also obtained from parents/ guardians.

These subjects were selected via multi-stage sampling using the following criteria:

- Both parents are of Nigerian Origin.
- Complete and fully erupted permanent

dentition, excluding 2nd, 3rd molars
- No prosthetic tooth replacements or crowns
- No interproximal caries or restoration
- No dental anomalies
- No evidence of tooth wear, such as attrition

Upper and lower alginate impressions were taken for each subject, from which stone models were poured. Mesio-distal width of each tooth (excluding 2nd and 3rd molars) was measured from the casts, and the anterior and overall ratios were computed for each subject as follows:

$$\text{Anterior ratio} = \frac{\text{Sum of mandibular 3-3}}{\text{Sum of maxillary 3-3}} \times 100$$

$$\text{Overall ratio} = \frac{\text{Sum of mandibular 6-6}}{\text{Sum of maxillary 6-6}} \times 100$$

Data was analyzed using the Statistical package for Social Sciences Software (SPSS®). Mean, range and standard deviation of both the Anterior and Overall Ratios for this study were determined. The prevalence of clinically significant tooth size discrepancies was determined as the proportion of subjects with tooth size ratios outside of 2 SD from Bolton's means. A Chi-square test was used to compare differences between the sexes.

Measurement Error.

The study models of 30 subjects were randomly selected and re- measured after a 2 week interval from the first measurements by the same examiner.

Measurement errors were calculated according to Houston [17] thus:

The Standard deviation of the mean difference between the initial and repeated measurements was calculated as an estimate of random error. Systematic error was determined using the paired t test.

No significant systematic errors were determined between the first and repeat measurements shown by p values 0.05. Correlations between both sets of measurements were high, with values ranging between 0.82 and 0.99 in both the maxilla and mandible.

Results

The sample comprised of 178 males and 194 females, with mean ages of 13.29±1.21years and 13.42±1.23 years respectively. (Table I).

Table I: Age and sex distribution of sample.

Age (years)	Male No(%)	Female No(%)	Total No(%)
12	59 (33.1)	56 (28.9)	115 (30.9)
13	50(28.1)	54 (27.9)	104 (28.0)
14	36(20.2)	45 (23.2)	81 (21.8)
15	24(13.5)	25 (12.9)	49 (13.2)
16	9(5.1)	14 (7.2)	23 (6.2)
Total	**178(47.8)**	**194 (52.2)**	**372 (100)**

Mean tooth size ratios were determined as 78.59±3.73% and 92.09±2.73% for the Anterior and Overall ratios respectively (Table II).

Table II: Tooth size ratios of subjects.

Anterior ratio	Male(178)	Female(194)	Total(372)
Mean(mm)	78.22	78.94	78.59
sd(mm)	3.38	3.99	3.73
Range	76.34-82.10	74.95-82.93	69.82-100.57
t=1.88, p=0.06			
	Overall ratio		
Mean(mm)	91.68	92.45	92.09
Sd	2.44	2.93	2.73
Range	89.24-84.12	89.52-95.38	79.22-101.43
t=2.79, p=0.01*			

Significant; sd standard deviation

The prevalence of clinically significant tooth size discrepancies was determined as the proportion of subjects falling outside of two standard deviations from the Bolton's means. Using the above criteria, subjects with anterior ratios between 75.55% and 78.85% had tooth size ratios within the normal range (36.3%), while those with anterior ratios lower than 73.89%, (i.e.> mean -2sd), together with those with ratios greater than 80.5 (i.e. < mean+2sd), a total of 32.2% had clinically significant

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anterior tooth size discrepancies. Similarly, subjects with overall ratios between 89.39% and 93.21%, (**53.8%)** had tooth size ratios within the normal range, while those with overall ratios less than 87.49% or greater than 95.12%, a total of **14%** had clinically significant overall tooth size discrepancies (Table III).

Table III: Prevalence of tooth size discrepancies

Anterior ratio	Frequency	Percent
-2sd	25	6.7
-2sd to -1sd	46	12.4
-1sd to +1sd	135	**36.3**
+1sd to+2sd	71	**19.1**
+2sd	95	**25.5**
Total	**372**	**100**

Overall ratio		
	Frequency	**Percent**
-2sd	13	**3.5**
-2sd to -1sd	36	**9.7**
-1sd to+1sd	199	**53.5**
+1sdto+2sd	85	**22.8**
+2sd	39	**10.5**
Total	**372**	**100**

Among male subjects, 29.8% had clinically significant anterior tooth size discrepancies, while 26.4% had clinically significant overall tooth size discrepancies. Similarly, among the females, 34.6% and 25.8% had clinically significant anterior and overall tooth size discrepancies respectively. There were no significant differences in the prevalence of clinically significant anterior and overall tooth size discrepancies between males and females, x^2 =1.10, p=0.29 and x^2=0.43, p =0.51 for anterior and overall ratios respectively. (Figures 1, 2.)

Discussion

In the present study, values outside 2 SD were chosen as an indication of clinically

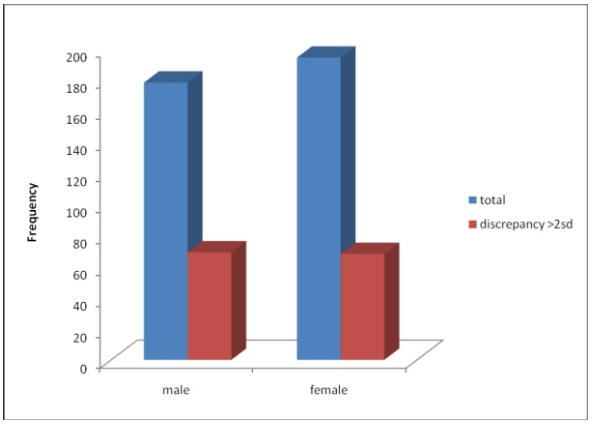

Figure 1: Prevalence of clinically significant anterior tooth size discrepancies by sex.

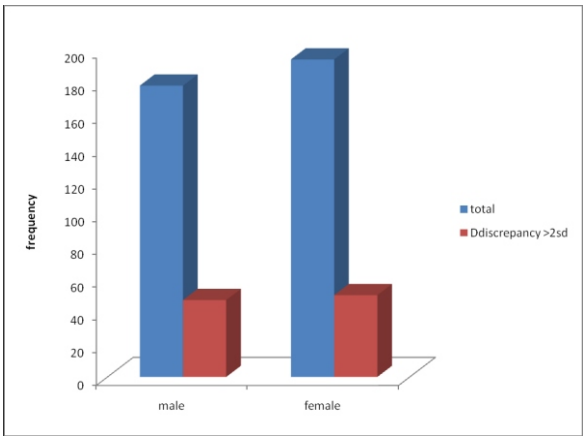

Figure 2: Prevalence of clinically significant overall tooth size discrepancies by sex.

significant tooth size discrepancy. Though Bolton originally suggested that ratios greater than 1 standard deviation from his means be used as an indication for the need for a diagnostic consideration,[3] it has subsequently been defined as, and generally accepted as 2 standard deviations.[5-7]

Going by this definition, a total of 32.2%, and 14% of this sample possessed clinically significant anterior and overall tooth size discrepancies respectively. These prevalence values are similar to those reported for Americans[5] (30.6%), the Polish[24] (31.2%), and Dominican Americans[7] (20.8%) for anterior ratios, and 13.5% for Overall ratios in Americans.[5] It is however lower than the 37.9 %reported among Irish Patients[2] (Table IV).

Table IV: Comparisons of studies of the prevalence of Tooth Size Discrepancy (TSD)

Author	Sample size	Anterior TSD%	Overall TSD%
Crosby and Alexander[6] (1989)	109	22.9	-
Freeman et al[14] (1996)	157	30.6	13.5
Santoro et al[15] (2000)	54	28.0	11.0
Araujo and Souki[3](2003)	300	22.7	-
Bernabe et al[24](2004)	200	20.5	5.4
Endo et al[11](2007)	60	21.6	8.3
Othman and Harradine[8] (2007)	150	17.4	5.4
Nasibi et al[12](2008)	300	23	9
Szulc et al[13] (2010)	600	31.2	-
Mahony GO[2] (2011)	850	37.9	-
Present study	372	32.2	14

This higher prevalence rate among the Irish may be due to differences in sample selection. The Irish sample was selected from pre-treatment casts of patients at a University clinic- a referral centre. This sample probably represents patients with complex malocclusions that might have been referred by other dentists, while the sample in this study was taken from a general population of school children. But nevertheless, we the authors find it quite alarming that a third of the general population of school children will require some form of intervention ranging from interproximal stripping to composite build -ups to address their tooth size problems, to be able to achieve a good finish at the end of treatment. Regrettably, these problems only become apparent during the finishing stages of treatment (except a tooth size analysis was done at the diagnosis stage) when a lot of these treatment options may no longer be available.

The prevalence of anterior tooth size discrepancies was higher than that for the Overall ratio. This trend is comparable to a majority of publications on tooth size ratios, [14, 15, 19-21] and may probably be due to the fact that the anterior teeth, especially the maxillary central and lateral incisors, followed by the mandibular incisors have been known to have a much higher incidence of variability in tooth size, when compared with the others.[22, 23] This was also evident in this study by the co-efficient of variability of these teeth among our subjects (data not shown). These findings suggest that a large number of people posses a tooth size discrepancy, especially in the anterior region, that may influence treatment goals and results. It is well known that majority of patients seeking orthodontic care are mainly concerned with the appearance of their anterior teeth, [24] and so it may be prudent for clinicians to routinely perform a tooth size analysis.

Between the sexes, there were no significant differences in the prevalence of clinically significant anterior and overall tooth size discrepancies respectively. This is in agreement with reports from studies on Brazilians[10] and the Irish.[2] Though tooth size in males has been shown to be larger than those in females among Nigerians, [25] absolute tooth size does not appear to affect the incidence of tooth size discrepancies. If the teeth are consistently larger in both the upper and lower jaws, a favorable tooth size ratio can still exist between the jaws.

This study therefore emphasizes the magnitude of tooth size discrepancy problems and the need for clinicians to routinely perform a tooth size analysis during diagnosis. Though it may be time consuming, the benefits of a more efficient diagnosis, more specificity in treatment planning, and a higher success rate in achieving optimal occlusions would seem to outweigh any inconveniences.

Conclusion

The study concluded that the prevalence of clinically significant tooth size discrepancies was 32.2% and 14% anteriorly and overall respectively among this present sample of Nigerians.

Anterior tooth size discrepancies are more common than overall tooth size discrepancies, and no statistically significant differences existed between the sexes.

Contributors

Victor-Osho O.O, was responsible for conceptualization of research topic, data collection, statistical analysis.

Isiekwe M.C, was responsible for critical review and editing.

daCosta O.O, was responsible for literature review and interpretation of results.

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