Applicability of bolton's analysis: a study on Bhopal population

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Abstract

Introduction: The ratios of maxillary and mandibular tooth sizes represent an important aspect in the diagnosis and treatment planning of an individual. Because different tooth sizes have been associated with different ethnic groups, it is logical to expect that differences in tooth widths can directly affect tooth-widths ratios.

Aims and Objectives: The aim of the study was to determine whether the mean overall and anterior ratio of Bhopal population would significantly differ from Caucasian (Bolton's) values.

Material and Methods: The study was conducted on Bhopal (Madhya Pradesh, India) population. Subjects included randomly selected 70 Orthodontic patients, with age range of 12 to 18 years. Measurements obtained from the models included the maximum mesiodistal (MD) tooth sizes of all permanent teeth except second and third molars. The data collected was analyzed statistically. The total and anterior ratios were determined by Bolton's formula.

Results: No statistically significant differences were found among males and females for the anterior and overall ratios. The anterior ratio was significantly higher from Bolton's standard while the overall ratio was not significantly different.

Keywords: Mesio-distal tooth width, Bolton's ratio

Introduction

In Orthodontics disproportionately sized teeth in either arch can make it difficult to obtain good occlusion, satisfactory masticatory efficiency, facial esthetics and alignment of the dental arch. Therefore, the maxillary and mandibular teeth must be proportional in size and knowledge of tooth size is important to predict the post treatment occlusal outcome mathematically[1,2,3].

The ratios of maxillary and mandibular tooth sizes represent an important aspect in the diagnosis and treatment planning of an individual. Any discrepancy in the tooth size ratios can dictate the treatment plan as to whether extractions are required or reproximation can suffice. A good post-treatment occlusion depends on an appropriate relationship of the maxillary and mandibular teeth. Because different tooth sizes have been associated with different ethnic groups, it is logical to expect that differences in tooth widths can directly affect tooth-widths ratios.

Pioneer investigation on tooth sizes were conducted by Black in 1902[4] and Neff [5,6], these studies were followed by classic work of Dr Wayne bolton 1958 [7,8] who selected 55 cases of Caucasian population with optimal occlusion and compared the sums of mesiodistal widths of the maxillary and mandibular teeth, including first molars. An overall ratio of 91.3% & anterior ratio of 77.2% obtained. Objective of the study was to determine the prevalence of tooth size discrepancy (TSD) in a reprehensive orthodontic population. The aim of the study was to determine whether the mean overall and anterior ratio of Bhopal population would significantly differ from Caucasian (Bolton) values.

Materials and Method

The study was conducted on Bhopal (Madhya Pradesh, India) population. Subjects included randomly selected 70 Orthodontic patients, with age range of 12 to 18 years, from the Department of Orthodontics, Mansarovar dental college and hospital, Bhopal. The subjects were divided into 2 group comprising 35 males and 35 females in each group.

The inclusion criterias were as follows: resident of Bhopal city from birth, permanent dentition completely erupted except the third molars, age range between 12 to 18 years, subjects with no prior orthodontic treatment done, Angle Class I molar and canine relationship, and models undamaged in areas of measurement.

Measurements obtained from the models included the maximum mesiodistal (MD) tooth sizes of all permanent teeth except second and third molars. All measurements were made by a single examiner, by means of a sliding digital caliper to the nearest 0.01 mm, from right first molar to left first molar in each arch. To eliminate error, all measurements were repeated in each arch. When first and second measurements differ by more than 0.2 mm, all measurements were repeated once again. If the difference between first and second measurement is less than 0.2 mm, then the first measurement was registered. The data collected was analyzed statistically. The total and anterior ratios were determined by Bolton's formula

(Sum mandibular 12 / Sum maxillary 12) × 100 = overall ratio (%)
(Sum mandibular 6 / Sum maxillary 6) × 100 = anterior ratio (%)

Student t-test was used to test for statistical difference between means.

Observations and Results

No statistically significant differences were found among males and females for the anterior and overall ratios. The combined male and female anterior and overall ratios were 78.48±2.81% and 91.12±2.09% respectively (Table 1 & 2). The anterior ratio was significantly higher from Bolton's standard while the overall ratio was not significantly different (Table 3 & 4).

Table 1: **Bolton's "Anterior Ratio" – Bhopal population**

Parameter	Male	Female	Combined
Sample Size	35	35	70
Mean	78.84	78.12	78.48
Range	70.54-84.61	72.33-85.71	70.54-85.71
S.D	2.57	3.02	2.81

Table 2: Bolton's "Overall Ratio" – Bhopal population

Parameter	Male	Female	Combined
Sample Size	35	35	70
Mean	91.20	91.04	91.12
Range	87.54-94.32	86.75-97.69	86.75-97.70
S.D	1.66	2.47	2.09

Table 3: Statistical comparison between Bhopal population versus Caucasians groups "Anterior ratio

Parameter	North East Indian sample	Bolton's Study[13] (Caucasians)
Sample Size	70	55
Mean	78.48	77.2
Range	70.54-85.71	74.5-80.4
S.D	2.81	1.65
Coefficient of variation	7.87	2.14
Standard Error	0.34	0.22
t-test		3.83
Remark (p value)		0.00
		p<0.001

Table 4: Statistical comparison between Bhopal populations versus Caucasians groups "Overall Ratio

Parameter	North East Indian sample	Bolton's Study[13] (Caucasians)
Sample Size	70	55
Mean	91.12	91.3
Range	86.75-97.70	87.5-94.8
S.D	2.09	1,91
Coefficient of variation	4.37	2.09
Standard Error	0.25	0.26
t-test		-0.72
Remark (p value)		0.48
		N.S.

Discussion

In the present study, it was found that there was no statistically significant difference between males and females in the North East Indian sample. This result is similar to some previous studies in other population groups[9,10]. In other studies,[11-12] however, there was a sex difference in the overall ratio among different populations which suggests that sexual dimorphism in the tooth size ratio may be population specific.

Since no sexual dimorphism was noted between males and females in this study, the samples were pooled to give a combined sample (n=70) with an anterior ratio of 78.48±2.81 and an overall ratio of 91.12±2.09. The results of the present study are compared with the norms accepted for Caucasians.

In the present study the mean overall ratio is 91.12%±2.09 and range 86.75% - 97.70% (Table 3). To compare the ratios, students 't' test was done. Although the overall ratio in the Bhopal Population sample is slightly higher than Bolton's study, the overall value did not differ significantly as p value > 0.05 (Table 4). The mean and S.D of the anterior ratio in the Bhopal population (78.48%±2.81) is higher than Bolton's study[13] (Table 3). The t value was 3.83 and statistically significant as p value < 0.001. Thus, when compared to Bolton's original Caucasian sample, the Bhopal population shows a significantly higher anterior ratio.

In the present study, the anterior ratio in the Bhopal population is significantly higher than the Caucasian samples. However, the overall ratio in Bhopal population was not found to be significantly different from the Caucasian population. (Table 4)

Summary and conclusion

a. No sexual dimorphism i.e. no significant difference between males and females were found in either the anterior or overall ratio.

b. The combined male and female anterior ratio in the Bhopal population was 78.48±2.81% and the overall ratio was 91.12±2.09%.
c. The combined male and female anterior ratio was significantly higher in the Bhopal population in comparison with Bolton's study and other studies on Caucasian populations, whereas the overall ratio showed no statistically significant difference.
d. Mesiodistal tooth size of maxillary and mandibular second premolar, maxillary lateral incisors were found to have the greatest influence on the variation in both the anterior and overall ratios in the Bhopal population.
e. The Bolton anterior ratio is not applicable to the Bhopal population and specific standard tooth size ratios are needed for the Bhopal population.

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