

## *Tooth Size Discrepancies among Different Malocclusions in a Bangladeshi Orthodontic population*

Hyder MLA<sup>1</sup> BDS, FCPS, Mamun MSA<sup>2</sup> BDS, FCPS and Hossain MZ<sup>3</sup> BDS, PhD

### ABSTRACT

**Objectives:** To identify the possible sex differences in anterior, posterior, and overall tooth size ratios and to evaluate whether any differences exist in tooth size ratios and distribution of subjects with clinically significant tooth size discrepancies among Angle class I, class II, & class III malocclusion groups in Bangladeshi Orthodontic population.

**Materials and Methods:** Each malocclusion group comprised 40 subjects (20 males and 20 females). The mesiodistal width from first molar to first molar were measured on each pretreatment cast to the nearest 0.01mm using digital calipers, and the anterior, posterior and overall ratios were calculated. Students t-test, Wilcoxon nonparametric test, analysis of variance, and  $\chi^2$ -test were performed for statistical analysis.

**Results:** No statistically significant differences in anterior, posterior, or overall ratios were found among the malocclusion groups. No significant sex differences were found in anterior, posterior, or overall ratio in any group. Significant anterior and overall tooth size discrepancies outside 2 SD from the Bolton's means were found in 31% and 11.6% of all malocclusion subjects respectively.

**Conclusion:** Bolton's values can be used with confidence for the Bangladeshi orthodontic population.

**Key words:** Anterior ratio; Posterior ratio; Overall ratio; Tooth size discrepancy; Malocclusion; Bangladeshi population (Bangladesh Journal of Orthodontics and Dentofacial Orthopedics, Vol. 2, No. 2, April 2012, p 8-17).

### INTRODUCTION

Andrews (1972) studied the dental casts of 120 non orthodontic individuals with normal occlusion and concluded that there are six essential 'keys' required to achieve this normal occlusion<sup>1</sup>. Maclaughlin et al (2001) stated that tooth size should be considered 'seventh key' and that without coordination between the sizes of the upper and lower teeth it would not be possible to obtain a good occlusion during the final stages of orthodontic treatment. The lack of co-ordination is called 'TOOTH SIZE DISCREPANCY' (TSD).

Profit (2007)<sup>2</sup> defined TSD as a disproportion among the sizes of the individual teeth. A correct maxillary to mandibular tooth size ratio is essential for the achievement of correct occlusal interdigitation, overjet, and overbite. Without an appropriate relationship of mesiodistal tooth dimensions of the maxillary and mandibular teeth, coordination of the arches would be difficult with consequences on the final orthodontic treatment result and its stability.<sup>3,4,5</sup>

Bolton(1958)<sup>4</sup> investigated the relationship between the mesiodistal crown diameters of the upper and lower teeth and developed an analysis. This analysis was carried out by measuring the mesiodistal width of each permanent tooth. In the calculation of a possible TSD the sum of the diameters of the mandibular teeth is divided by that of maxillary teeth and the

result multiplied by 100. For evaluation of the two sets of 12 opposing teeth, the term 'overall ratio' is used and for the two sets six anterior teeth, the term 'anterior ratio'. Bolton stated that for a good interdigitation and occlusion, overall ratio should be  $91.3 \pm 1.91$  and anterior ratio  $77.2 \pm 1.65$ . Clinical application of the analysis has been described by Bolton(1962).<sup>5</sup>

In Bangladesh two studies have been conducted on "Bolton's anterior tooth size discrepancies in different malocclusion groups". No studies have yet been conducted on posterior and overall tooth size discrepancies in Bangladeshi Orthodontic population. Therefore this study focused on anterior, posterior and overall TSD in different malocclusion groups in Bangladeshi Orthodontic population. This study is the first of its nature to be conducted to establish a norm of TSD in Bangladesh using electronic digital caliper.

### MATERIALS & METHODS

The sample for this study consisted of 120 subjects subdivided into three types of malocclusion according to the Angle classification classes I, II and III. All the subjects were from Bangladeshi Orthodontic population and were between 12 to 24 years of age. The subjects with varying malocclusions were selected from the Orthodontic patients who had received treatment in the Department of Orthodontics, Dhaka Dental College and Hospital, Dhaka.

**Selection criteria**

Inclusion criteria:

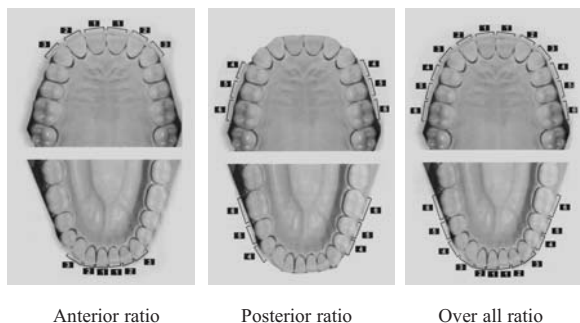
1. Good quality of pretreatment models.
2. Complete permanent dentition from 6 to 6.
3. Absence of mesiodistal and occlusal abrasions or caries or classII fillings.
4. Absence of dental prosthesis
5. Absence of tooth anomalies such as form, structure, and development, whereas the less objectionable anomalies such as microdontia and macrodontia were included. Cases of fusion of teeth and germination were excluded because it was not possible to analyse the specific size of teeth, whereas the presence of conical teeth was not considered an exclusion criteria because it represented the morphological identity of these teeth.

**Exclusion criteria**

1. Gross restorations, buildups, crowns, onlays, class II amalgams or composite restorations that affect the tooth's mesiodistal diameter.
2. Congenital defects or deformed teeth.
3. Obvious interproximal or occlusal wear of teeth.

The mesiodistal dimensions of all teeth on each cast from first molar to first molar were measured with digital callipers accurate to 0.01mm. The Mesiodistal dimension of each tooth was measured according to the method described by Moorrees et al.(1957)<sup>8</sup>, from its mesial contact point to its distal contact point at its greatest interproximal distance. All measurements, carried out under natural light and were performed by the same investigator, who did not exceed more than seven casts per day in order to avoid eye fatigue and to minimize the possibility of subjective error.

Diagram to show areas where Anterior, Posterior and Over all ratios have been measured



**Data measuring Instrument**

This digital Caliper have been used to measure the mesiodistal tooth dimension of upper and lower jaw.



Example of mesio-distal tooth measurement with digital caliper

Bolton's analysis was performed on each set of models, when the teeth of all subjects had been measured. The anterior, posterior and overall tooth size ratios were determined using the following formula;

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

$$\frac{\text{Sum of mandibular 654-456}}{\text{Sum of maxillary 654-456}} \times 100 = \text{posterior ratio}$$

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

Bolton normal range values were used in the classification of normal and malocclusion groups. According to the Bolton analysis, a significant discrepancy was defined as one whose value was outside of 2SD from Bolton mean and approximately 95% of Bolton cases were within this range. Therefore, for the overall "12" ratio, a significant discrepancy is defined as a ratio below 87.5 or above 95.1, with ratio in-between falling within 2SD of Bolton mean. Similarly, any ratio below 73.9 or above 80.5 is considered to be a significant discrepancy for the anterior "6" ratio.

**STATISTICAL ANALYSIS**

The subjects were divided by gender and by Angles malocclusion classes. Statistical analysis were carried out using the Soft ware STATA(International standard) version 9. The results are summarized in different tables. To determine whether there was gender dimorphism in the incidence of tooth size discrepancies a student's t-test was performed. For each malocclusion group, the level of significance was set at 0.005. In order to compare inter maxillary tooth size discrepancies among different malocclusion groups, one way analysis of variance (ANOVA) was performed. In order to determine the percentage of tooth size discrepancies in the different malocclusion groups, each group was compared with the results from Bolton's study. Measurements outside 2 SD were defined as exhibiting a clinically significant tooth size discrepancy.

**RESULTS**

**Analysis of error**

To ensure measurement accuracy, one month later 30 pairs of dental casts were randomly selected (ten from each malocclusion group) and the mesiodistal tooth widths were again measured by the same investigator. The overall ratios for each malocclusion group was calculated using the same method. A Non-parametric Wilcoxon Statistical test was applied to the first and second measurements. No statistically significant differences were found between the first and second measurement.

Table:- 1 Analysis of error for all measurements submitted to Non-parametric Wilcoxon statistical testing demonstrating no significant (p>0.05) difference between the two sets of measurements

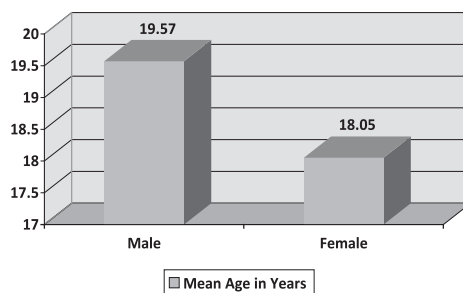
| Class     | Measure | n  | Minimum | Maximum | Mean  | SD   | P-value      |
|-----------|---------|----|---------|---------|-------|------|--------------|
| Class I   | 1       | 10 | 86.86   | 93.62   | 90.15 | 1.75 | 0.8956 (1=2) |
|           | 2       | 10 | 87.0    | 93.44   | 90.05 | 1.70 |              |
| Class II  | 1       | 10 | 87.13   | 97.38   | 91.91 | 3.27 | 0.9815 (1=2) |
|           | 2       | 10 | 86.96   | 97.38   | 91.87 | 3.38 |              |
| Class III | 1       | 10 | 88.14   | 94.43   | 91.38 | 2.00 | 0.9619(1=2)  |
|           | 2       | 10 | 88.2    | 94.50   | 91.43 | 2.05 |              |

Significance p>0.005

Table:-2: number and percentage distributions of the subjects among the different malocclusion with the mean age of the sample

|           | N (Males) | N (Females) | N (M+F) | %    | Mean age (Years) | SD   |
|-----------|-----------|-------------|---------|------|------------------|------|
| Class-I   | 20        | 20          | 40      | 33.3 | 20.0             | 4.29 |
| Class-II  | 20        | 20          | 40      | 33.3 | 18.7             | 3.59 |
| Class-III | 20        | 20          | 40      | 33.3 | 17.6             | 3.59 |
| Overall   | 60        | 60          | 120     | 100  | 18.8             | 3.93 |

Figure-1: Mean age of male and female



**TOOTH MEASUREMENT-**

The mean, SD and statistical comparisons of the mesiodistal tooth measurements for males and females are shown in Table 3. There were significant differences between genders for most of the teeth measured ( $p < 0.05$ )

Mesio-distal dimensions of lower teeth in class III group has become larger when comparing with the class I and class II group.

Table:3 The mean standard deviation (SD) and statistical comparison of mesiodistal tooth measurement for male and female

|            |                 | Male n=60 |      | Female n=60 |      | P-value |
|------------|-----------------|-----------|------|-------------|------|---------|
|            |                 | Mean      | SD   | Mean        | SD   |         |
| Maxillary  | Central incisor | 8.82      | 0.54 | 8.69        | 0.58 | 0.2113  |
|            | Lateral incisor | 7.15      | 0.56 | 6.98        | 0.76 | 0.1568  |
|            | Canine          | 8.09      | 0.46 | 7.74        | 0.45 | 0.0001* |
|            | 1st premolar    | 7.30      | 0.48 | 7.11        | 0.47 | 0.0384  |
|            | 2nd premolar    | 6.71      | 0.41 | 6.76        | 0.41 | 0.4883  |
|            | 1st molar       | 10.75     | 0.53 | 10.45       | 0.62 | 0.0063* |
| Mandibular | Central incisor | 5.57      | 0.41 | 5.46        | 0.38 | 0.1167  |
|            | Lateral incisor | 6.18      | 0.44 | 6.01        | 0.37 | 0.0262  |
|            | Canine          | 7.10      | 0.44 | 6.80        | 0.41 | 0.0003* |
|            | 1st premolar    | 7.24      | 0.44 | 7.15        | 0.48 | 0.2862  |
|            | 2nd premolar    | 7.22      | 0.49 | 7.10        | 0.49 | 0.1654  |
|            | 1st molar       | 11.18     | 0.60 | 10.85       | 0.61 | 0.0034* |

\*Significance  $p < 0.005$

Table:-4 Statistical comparison of the mesiodistal tooth measurement between Class III and Class I malocclusion

|            |                 | Class I n=40 |      | Class III n=40 |      | P-value |
|------------|-----------------|--------------|------|----------------|------|---------|
|            |                 | Mean         | SD   | Mean           | SD   |         |
| Maxillary  | Central incisor | 8.90         | 0.53 | 8.78           | 0.60 | 0.3367  |
|            | Lateral incisor | 7.15         | 0.49 | 7.05           | 0.68 | 0.4597  |
|            | Canine          | 8.02         | 0.39 | 7.99           | 0.56 | 0.7565  |
|            | 1st premolar    | 7.28         | 0.33 | 7.33           | 0.54 | 0.5961  |
|            | 2nd premolar    | 6.72         | 0.36 | 6.82           | 0.35 | 0.2427  |
|            | 1st molar       | 10.67        | 0.58 | 10.70          | 0.61 | 0.7903  |
| Mandibular | Central incisor | 5.52         | 0.37 | 5.53           | 0.45 | 0.8775  |
|            | Lateral incisor | 6.15         | 0.34 | 6.13           | 0.46 | 0.7786  |
|            | Canine          | 7.02         | 0.38 | 7.04           | 0.46 | 0.8211  |
|            | 1st premolar    | 7.21         | 0.33 | 7.35           | 0.54 | 0.1691  |
|            | 2nd premolar    | 7.24         | 0.43 | 7.30           | 0.43 | 0.6081  |
|            | 1st molar       | 11.06        | 0.58 | 11.15          | 0.57 | 0.4871  |

Not in Significance  $p > 0.005$

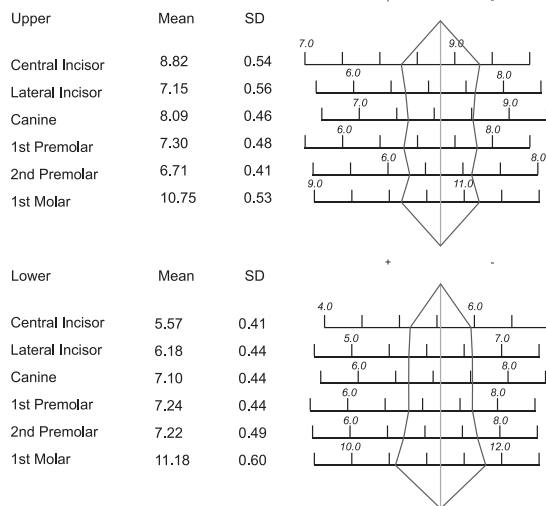
Table:-5 Statistical comparison of the mesiodistal tooth measurement between Class III and Class II malocclusion

|            |                 | Class III n=40 |      | Class II n=40 |      | P-value |
|------------|-----------------|----------------|------|---------------|------|---------|
|            |                 | Mean           | SD   | Mean          | SD   |         |
| Maxillary  | Central incisor | 8.78           | 0.60 | 8.58          | 0.52 | 0.1172  |
|            | Lateral incisor | 7.05           | 0.68 | 6.99          | 0.81 | 0.6966  |
|            | Canine          | 7.99           | 0.56 | 7.74          | 0.44 | 0.0287  |
|            | 1st premolar    | 7.33           | 0.54 | 7.01          | 0.50 | 0.0089* |
|            | 2nd premolar    | 6.82           | 0.35 | 6.65          | 0.50 | 0.0900  |
|            | 1st molar       | 10.70          | 0.61 | 10.44         | 0.57 | 0.0535  |
| Mandibular | Central incisor | 5.53           | 0.45 | 5.50          | 0.37 | 0.6983  |
|            | Lateral incisor | 6.13           | 0.46 | 6.00          | 0.42 | 0.2141  |
|            | Canine          | 7.04           | 0.46 | 6.80          | 0.49 | 0.0321  |
|            | 1st premolar    | 7.35           | 0.54 | 7.03          | 0.4  | 0.0053* |
|            | 2nd premolar    | 7.30           | 0.43 | 6.93          | 0.54 | 0.0015* |
|            | 1st molar       | 11.15          | 0.57 | 10.85         | 0.69 | 0.0413  |

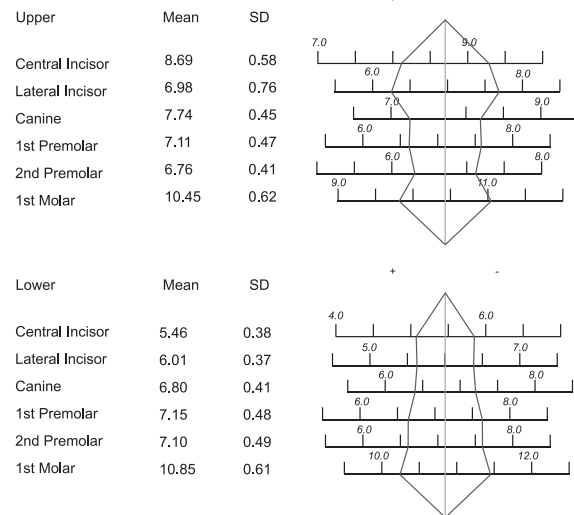
\*Significance p<0.005

Polygonic portrayal of cast analysis (Mesiodistal tooth diameter)

Polygonic Distribution of Cast Analysis Mesiodistal Tooth Diameter (Bangladeshi Male)



Polygonic Distribution of Cast Analysis Mesiodistal Tooth Diameter (Bangladeshi Female)



## TSD AND GENDER-

Anterior, posterior and overall ratios for TSD for males and females are presented in table 6. There were no statistically significant differences between males and females for the anterior ratios, posterior ratio and over all ratios. Although the TSD ratios were larger for males, the differences were not significant.

Table:-6 Anterior, posterior and overall tooth size ratios (%) by sex and malocclusion form

|                 | Male   |      |      |               | Female |      |      |               | P-value |
|-----------------|--------|------|------|---------------|--------|------|------|---------------|---------|
|                 | Mean   | SD   | SE   | Range         | Mean   | SD   | SE   | Range         |         |
| Anterior ratio  |        |      |      |               |        |      |      |               |         |
| Class I         | 77.92  | 2.80 | 0.62 | 76.61-79.23   | 77.49  | 2.87 | 0.64 | 76.14-78.83   | 0.6320  |
| Class II        | 78.70  | 3.88 | 0.86 | 76.88-80.51   | 78.37  | 4.08 | 0.91 | 76.46-80.28   | 0.7951  |
| Class III       | 78.70  | 3.28 | 0.73 | 77.16-80.24   | 78.43  | 3.09 | 0.69 | 76.98-79.88   | 0.7919  |
| Posterior ratio |        |      |      |               |        |      |      |               |         |
| Class I         | 102.96 | 2.90 | 0.65 | 101.60-104.32 | 103.74 | 3.65 | 0.81 | 102.03-105.45 | 0.4584  |
| Class II        | 103.81 | 2.55 | 0.57 | 102.62-105.01 | 102.09 | 4.18 | 0.93 | 100.13-104.04 | 0.1230  |
| Class III       | 103.61 | 3.70 | 0.82 | 101.88-105.34 | 103.60 | 2.97 | 0.66 | 102.20-104.99 | 0.9888  |
| Over all ratio  |        |      |      |               |        |      |      |               |         |
| Class I         | 89.82  | 3.06 | 0.68 | 88.39-91.25   | 91.06  | 2.18 | 0.48 | 90.03-92.08   | 0.1505  |
| Class II        | 91.31  | 2.25 | 0.50 | 90.26-92.37   | 90.56  | 3.25 | 0.72 | 89.04-92.09   | 0.4039  |
| Class III       | 91.58  | 2.62 | 0.58 | 90.36-92.81   | 91.28  | 2.60 | 0.58 | 90.06-92.50   | 0.7201  |

Not in Significance  $p > 0.005$

## TSD AND BOLTON'S STANDARD

No statistically significant differences were found in anterior and overall ratios for every malocclusion group when comparing with the Bolton's standard. As there is no standard available for posterior ratio so it could not be compared. The table also shows that there were no significant differences in anterior ratio, posterior ratio or overall ratios among the malocclusion groups by ANOVA test.

Table:-7 Tooth size ratio of each malocclusion group compared with Bolton's figure

|                 | Mean  | SD   | SE   | Range        | t-test | ANOVA |
|-----------------|-------|------|------|--------------|--------|-------|
| Anterior ratio  |       |      |      |              |        |       |
| Bolton          | 77.2  | 1.65 | 0.22 | 74.5-80.4    |        |       |
| Class I         | 77.7  | 2.81 | 0.44 | 70.8-81.86   | 3.519  |       |
| Class II        | 78.5  | 3.93 | 0.62 | 71.53-91.75  | 1.142  | 0.428 |
| Class III       | 78.5  | 3.15 | 0.49 | 70.00-84.31  | 2.147  |       |
| Posterior ratio |       |      |      |              |        |       |
| Class I         | 103.3 | 3.28 | 0.51 | 96.82-110.13 |        |       |
| Class II        | 102.9 | 3.53 | 0.55 | 93.72-108.06 |        | 0.683 |
| Class III       | 103.6 | 3.31 | 0.52 | 96.64-110.53 |        |       |
| Over all ratio  |       |      |      |              |        |       |
| Bolton          | 91.3  | 1.91 | 0.26 | 87.5-94.8    |        |       |
| Class I         | 90.4  | 2.69 | 0.42 | 80.04-95.59  | 1.45   |       |
| Class II        | 90.9  | 2.79 | 0.44 | 84.51-97.38  | 2.006  | 0.260 |
| Class III       | 91.4  | 2.58 | 0.40 | 83.97-98.62  | 0.810  |       |

Not in Significance  $p > 0.005$

**PREVALANCE OF TOOTH SIZE DISCREPANCY**

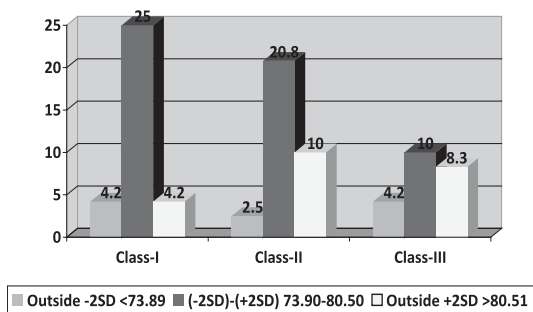
Significance anterior and overall tooth size discrepancies outside two standard deviation from the Bolton means were found in 31% and 11.6% of all the malocclusion subjects respectively. The chi square tests demonstrated no significant differences in the distribution of subjects with anterior or overall tooth size discrepancies among the malocclusion groups.

Table:-8 Distribution of subjects with anterior and overall tooth size discrepancies

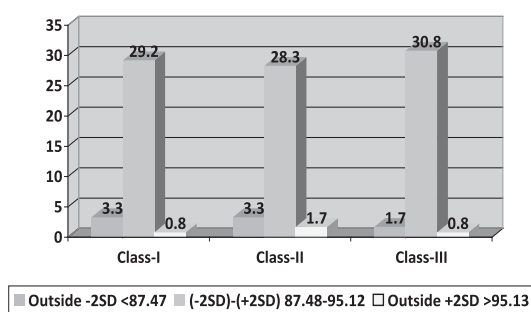
|           | Outside-2SD<br><73.89 | Anterior ratio No (%)<br>(-2SD)-(+2SD)<br>73.90-80.50 | Outside +SD<br>>80.51 | P-value |
|-----------|-----------------------|---|-----------------------|---------|
| Class-I   | 5(4.2)                | 30(25.0)  | 5(4.2)                | 0.097   |
| Class-II  | 3(2.5)                | 25(20.8)  | 12(10.0)              |         |
| Class-III | 2(1.7)                | 28(23.3)  | 10(8.3)               |         |
|           | Outside-2SD<br><87.47 | Overall ratio No (%)<br>(-2SD)-(+2SD)<br>87.48-95.12  | Outside +SD<br>>95.13 |         |
| Class-I   | 4(3.3)                | 35(29.2)  | 1(0.8)                | 0.510   |
| Class-II  | 4(3.3)                | 34(28.3)  | 2(1.7)                |         |
| Class-III | 2(1.7)                | 37(30.8)  | 1(0.8)                |         |

Not in Significance p>0.005

Title:- Bar diagram of subjects with anterior tooth size discrepancies



Title:- Bar diagram of subjects with overall tooth size discrepancies



**TSD IN BANGLADESHI ORTHODONTIC POPULATION**

Table 9 Shows the mean anterior, posterior and overall tooth size ratios of Bangladeshi population

| Group           | Mean   | SD   | SE   | Range        |
|-----------------|--------|------|------|--------------|
| Anterior Ratio  | 78.2   | 3.33 | 0.30 | 70-91.75     |
| Posterior ratio | 103.30 | 3.36 | 0.30 | 93.72-110.53 |
| Overall Ratio   | 90.94  | 2.70 | 0.24 | 80.04-98.62  |

**Table-10 Anterior and overall tooth size ratios in different populations**

| Population      | Author                      | Sample size | Anterior ratio (%) | Overall ratios (%) |
|-----------------|-----------------------------|-------------|--------------------|--------------------|
| White Americans | Bolton (1958)               | 55          | 77.2               | 91.3               |
|                 | Crosby and Alexander (1989) | 109         | 77.5               | 91.4               |
|                 | Smith et al. (2000)         | 108         | 79.6               | 92.1               |
| Black Americans | Smith et al. (2000)         | 60          | 79.3               | 93.1               |
| Spanish         | Smith et al. (2000)         | 60          | 80.5               | 93.4               |
|                 | Paredes et al. (2006)       | 100         | 78.32              | 91.97              |
| Dominican       | Santoro et al (2000)        | 54          | 78.1               | 91.3               |
| Peruvian        | Bernable et al (2004)       | 200         | 78.09              | 90.79              |
| Brazilian       | Araujo and Souki (2003)     | 300         | 78.18              |                    |
| Chinese         | Ta et al (2001)             | 110         | 77.5               | 90.9               |
|                 | Nie and Lin (1999)          | 300         | 81.52              | 91.27              |
| Saudi Arabian   | Al-Tamini and Hashim (2005) | 65          | 77.4               | 91.4               |
| Turkish         | Uysal et al (2005)          | 710         | 78.26              | 89.88              |
|                 | Akyalein et al (2006)       | 152         | 78.15              | 91.34              |
| Jordanian       | Iyad K Al-Omari (2008)      | 367         | 78.6               | 92.2               |
| Bangladeshi's   | Present study               | 120         | 78.2               | 90.94              |

**DISCUSSION**

In this study mean age for males was 19.57 and for females it was 18.05. This relatively young age group was chosen in accordance with the study of Doris et al.(1981) to minimize the alteration of the MD dimensions due to attrition, restorations or caries. Consequently, the effect of these factors on actual MD tooth widths was minimal. The subjects of this current study were all randomly selected Bangladeshi and thus proportionately representative of malocclusion type.

The results demonstrated a significant difference in mesiodistal tooth width between males and females for most tooth. This is in agreement with result of the study on the Jordanian population which found statistically significant differences between males and females for mesio distal crown diameters (Hattab et al,1996,Iyad k. AL-Omari et al, 2008).Other investigators have found the same sexual dimorphism in tooth size measurements<sup>6</sup>.(Ballard,1944, Lavelle, 1972)

This study found significantly larger mesiodistal dimensions of mandibular tooth in Class III malocclusion subjects when compared with Class I and Class II subjects which supports the study conducted by levelle,1972;<sup>6</sup> Sperry et al,1977,<sup>7</sup> speculated that greater means in Bolton's ratio in these classes might be due to etiological factors that lead to mandibular prognathism and may also be associated with increased MD dimensions of upper anterior teeth in class II subjects that lead to maxillary prognathism. Further studies are needed to clarify wheather a correlation exists between increased growth of the jaws and increased MD dimension of anterior teeth.

Polygonic portrayal of cast analysis of mesiodistal tooth dimension of Bangladeshi population from this study has established the norm for mesiodistal tooth dimension for our male and female population. This is the first attempt to present mesiodistal tooth diameter for upper and lower jaw in polygonic distribution format in Bangladesh. The super imposition also dictate the difference between the mesiodistal diameter of male and



female teeth.

The results of the present investigation showed no statistically significant differences between males and females in anterior ratio, posterior ratio and overall ratio for each malocclusion group. Although the TSD ratios for males are larger, the differences were small. These findings are in agreement with most studies on TSD<sup>8-12</sup> Other research, however, has shown a statistically significant difference in tooth size ratios for both genders.<sup>6,13,14</sup>

Studies conducted in Bangladesh on anterior tooth size discrepancies by Rahman M M,<sup>2007</sup>;<sup>15</sup> Ali Wazed M, 2008<sup>16</sup> in the Department of Orthodontics and Dentofacial Orthopedics, Dhaka Dental college and Hospital, Dhaka, and by Hasan Nazmul M,<sup>2010</sup>;<sup>17</sup> in the Department of orthodontics, BSMMU, Dhaka. They also did not find any significant difference in anterior ratio between gender and with the Bolton standard. The larger standard deviations of both anterior and overall ratios of the present study than for Bolton's study might have been caused by the fact that all of our subjects had malocclusions and Bolton's subject had excellent occlusion.

The results of this study support the findings of Uysal et al,<sup>18</sup> who also found no significant differences in anterior or overall ratio when comparing class I, class II division 1, class II division 2 and class III malocclusion subjects with the corresponding ANB angles. Crosby and Alexander(1989),<sup>19</sup> and Akyalcin et al (2006)<sup>12</sup> showed no significant differences in anterior and overall ratio among malocclusion groups, as confirmed in this study.

Our result are in disagreement with Nie and Lin, (1999)<sup>8</sup> Araujo and Souki,(2003)<sup>10</sup> and Fattahi et al, (2006)<sup>14</sup> who reported statistically significant differences in tooth size ratios among different Angle malocclusion groups. They showed a tendency toward greater tooth size ratios among subjects with class III malocclusion than among those with other classes of malocclusion in Chinese, Brazilian, and Iranian population. The probable reason for these different results might be population and malocclusion specific.

When comparing the anterior and overall tooth size ratios of the present study with the Bolton's standard no statistically significant difference have been found between the malocclusion groups. The means of the tooth size ratios were similar to Bolton's measurement as well as with those of Crosby and Alexander (1989),<sup>19</sup> The only difference was in the higher SD in the present study as compared with Bolton's standards that could be attributed to the difference in sample size.

Few studies have been conducted on posterior tooth size discrepancy<sup>14</sup> on Iranian and Croatian population respectively. They did not find any statistically significant gender difference which is similar to our study. The means of the posterior ratio for Iranian population were 104.12 with SD 3.40 and for Croatian population it was 104.88with SD 3.06 which is nearly close to our findings of posterior ratio 103.30 with SD 3.36.

The majority of investigations on TSD have chosen value outside 2SD as an indication of a clinically significant TSD. In the present study, the percentages of clinically significant TSD of the anterior and overall ratio were 31 and 11.6 percent respectively which is similar in rate with the study conducted by Freeman et al (1996) (30%)<sup>20</sup> and Barbara et al(2010) (31.2%)<sup>21</sup> for anterior ratio and Freeman et al(1996) (13%) and Santoro et al (2000) (11%)<sup>22</sup> and Barbara et al (2010) (10.2%)<sup>21</sup> for overall ratio.

Results of clinically significant TSD for anterior ratio was 34.5 per cent and 36.23 per cent in two previous studies done on our population<sup>16,17</sup> But they have chosen values outside 1 SD from Bolton mean.

Our findings of lower prevalence rates of clinically significant discrepancy for the overall ratio than for the anterior ratio are supported by studies conducted by Freeman et al(1996)<sup>20</sup> and Santoro et al (2000)<sup>22</sup> and Barbara et al (2010)<sup>21</sup> and may be explained by the fact that anterior teeth have much greater tooth size deviation, especially in the subjects with malocclusion.

## CONCLUSION

On the basis of the results of this investigation, following conclusion can be drawn

1. No statistically significant sex differences were found in anterior, posterior and overall ratios in each malocclusion groups.
2. Statistically significant differences were found comparing the mesiodistal dimensions of tooth in maxilla and mandible for males and females.
3. No significant differences in anterior, posterior and overall ratio were found among the malocclusion groups when comparing with Bolton's standard.
4. Bolton's values can be used with confidence in a Bangladeshi Orthodontic population.
5. Prevalence of clinically significant intermaxillary TSD is 31% and 11.6% in anterior ratio and overall ratios respectively.

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**Correspondence:**

**Lt Col Dr MD Liakat Ali Hyder**  
BDS, FCPS  
Graded Specialist in Orthodontics,  
CMH, Chittagong Cantt.  
Mobile : +880-01715921910  
E mail liakathyder@gmail.com