RESEARCH ARTICLE

COMPARISON OF BOLTON'S ANTERIOR TOOTH SIZE DISCREPANCY IN ANGLE'S CLASS I AND CLASS II MALOCCLUSION IN DAKSHINA KANNADA POPULATION

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ABSTRACT

Background: Interarch tooth size relationships differ between populations because differences in tooth sizes are not systematic. Population and gender differences in maxillary tooth size may not be the same as the differences in mandibular tooth size; hence, different interarch relations might be expected. **Objective**: The objective was to compare anterior tooth size discrepancies in Angles Class I and Class II malocclusions with Bolton standards and evaluate its effect on gender in a sample of Dakshina Kannada population who underwent orthodontic treatment. **Methods**: The study sample consisted of 203 pretreatment study casts, which were selected from records of orthodontic patients, who were residents of Dakshina Kannada, Karnataka. Subjects were divided into two groups: Group I (Angle's Class I, n = 108), Group II (Angle's Class II, n = 95) according to Angle's classification of malocclusion. The mesiodistal widths of all maxillary and mandibular teeth from right canine to left canine were measured with a digital caliper to calculate the Bolton ratio. The readings were then used to compute the anterior Bolton ratios. Chi square test was used for the statistical analysis. **Results**: A mean anterior Bolton ratio of 77.78 ± 4.31 for class I malocclusion group and a mean anterior Bolton ratio of 78.3 ± 4.52 for class II malocclusion group were found for the sample, The anterior ratio was found to be statistically insignificant when compared to the Bolton's norm of 77.2 ± 1.65 (P>0.1724). Comparison between gender and the different malocclusion groups for the anterior ratio revealed no statistically significant difference. **Conclusion**: From analyzing the data, it was found that there was no significance between Bolton's norms and type of malocclusion in Dakshina Kannada population. No significant relationship between gender and type of malocclusion was observed.

INTRODUCTION

An excellent orthodontic treatment result with optimal occlusion and ideal intercuspation, overjet, and overbite is often jeopardized by tooth size discrepancies or problematical tooth anatomy (Araujo and Souki, 2003). Specific dimensional relationships must exist between the maxillary and mandibular teeth to ensure proper interdigitation, overbite, and overjet. Because patients with interarch tooth size discrepancies require either removal (eg, interdental stripping) or addition (eg, composite buildups or porcelain veneers) of tooth structure to open or close spaces in the opposite arch, it is important to determine the amount and location of a tooth size discrepancy before starting treatment (Uysal *et al.,* 2005). Bolton, in 1958, analyzed the relationship between the mesiodistal tooth width of maxillary and mandibular teeth by studying 55 Caucasian subjects with excellent occlusion. Using the mesiodistal width of 12 teeth, he obtained an overall ratio of $91.3 \pm 1.91\%$;

using the six anterior teeth, he obtained an anterior ratio of $77.2 \pm 1.65\%$ (Bolton, 1962). Interarch tooth size relationships differ between populations because differences in tooth sizes are not systematic. Population and gender differences in maxillary tooth size may not be the same as the differences in mandibular tooth size; hence, different interarch relations might be expected. Sharma and Lavelle *et al.* (1971), Smith *et al.* (2000), Santoro *et al.* (2000), Bernabé *et al.* (2004), Paredes *et al.* (2006), and several others from their studies reported that tooth size discrepancies vary with different populations. The aim of this study is to compare anterior tooth size discrepancies in Angles Class I and Class II malocclusions with Bolton standards and evaluate its effect on gender in a sample of Dakshina Kannada population who underwent orthodontic treatment.

MATERIALS AND METHODS

The pretreatment casts were selected from records of the patients seeking orthodontic treatment in Department of

Orthodontics, K.V.G Dental College and Hospital, Sullia. A total of 203 patients with permanent teeth from 1st molar to 1st molar were selected. The sample selection procedure was based on dental age. The sample was thus divided into two groups, namely, Class I and Class II based on molar relationship. The whole sample was further subdivided into male and female groups. The patients were included based on the following inclusion criteria:

- Presence of all permanent teeth from the first molar to the first molar in both arches in both arches
- Patients from Dakshina Kannada population
- Absence of caries and restorations which will alter toothsize measurement
- Good quality study models

Patients were excluded from the study when the following conditions were present:

- Presence of dental anomalies such as supernumerary teeth and mesiodens
- Previous history of orthodontic treatment
- Presence of dental prosthesis, crowns, and composite restorations
- Presence of attrition and abrasion
- Presence of congenitally missing or impacted teeth

The sample consisted of 203 models with 108 patients having a Class I, 95 with Class II malocclusion. Measurement of the maxillary and mandibular teeth in all the study models was done using an electronic digital caliper which was calibrated to an accuracy of 0.01 mm. The width of every tooth was measured from its mesial contact point to its distal contact point at its greatest mesiodistal dimension. The caliper was held parallel to the occlusal plane and perpendicular to the long axis of the tooth to make the measurement more accurate. All the measurements were done by a single examiner after the teeth sizes were recorded, the anterior ratio was calculated for each sample using the following formula as proposed by Bolton.

$$\text{Anterior ratio} = \frac{\text{Sum of mandibular 6 teeth}}{\text{Sum of maxillary 6 teeth}} \times 100$$

RESULTS

The mean anterior ratio for all the malocclusion groups is shown in Table 1. The anterior ratio was found to be 78.03± 4.41and was found to be statistically insignificant when compared to the Bolton's norm of 77.2 ± 1.65 (P>0.1724). Mean anterior ratio for the individual malocclusion groups is tabulated in Table 2. The mean anterior ratio for Class I malocclusion group was found to be 77.78 ± 4.31; for Class II, it was 78.3 ± 4.52. Comparison between gender and the different malocclusion groups for the anterior ratio revealed no statistically significant differences (Table 3 and Figure 1). Out of 121 females, 73 had mandibular anterior excess clinically.

Table 1. Comparison of mean anterior ratio between study population and standard Bolton's ratio
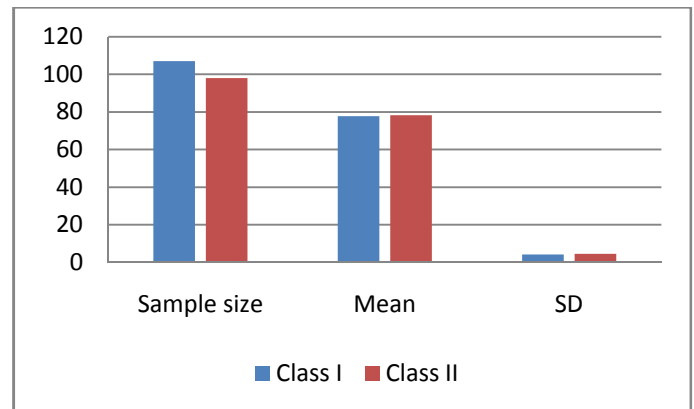
	Study population	Standard ratio	Significance
Sample size	203	55	
Mean	78.03	77.2	P= 0.1724
SD	4.41	1.65	

Table 2. Comparison of mean anterior ratio between different malocclusion groups

Occlusion	Sample size	Mean	SD
CLASS I	108	77.78	4.31
CLASS II	95	78.3	4.52

Table 3. Comparison of mean anterior ratio between malocclusion groups and genders

Class	Gender	Sample size	Mean	SD	P
Class I	Male	44	77.7	5.28	0.8694
	Female	64	77.84	3.55	
Class II	Male	38	77.76	5.11	0.3392
	Female	57	78.67	4.09	

Figure 1. Comparison of mean anterior ratio between different malocclusion groups

DISCUSSION

Comprehensive orthodontic treatment aims at achieving optimal occlusion with ideal overjet and overbite. An intermaxillary tooth size discrepancy is one of the many factors that jeopardize an excellent orthodontic treatment result. A tooth size discrepancy is a disproportion between the sizes of individual teeth. Ideal tooth proportion was studied and reported by Bolton in 1958 who assessed the relationship of maxillary and mandibular dentition and proposed two indices: the anterior ratio and the overall ratio based on a study conducted on 55 American patients with excellent occlusion.[3] Bolton's analysis, however, provides no information with regard to gender, ethnicity, and malocclusion type. Lavelle *et al.* (1971), Smith *et al.* (2000), Santoro *et al.* (2000), Bernabé *et al.* (2004), Paredes *et al.* (2006), Endo *et al.* (2007), Ta *et al.* (2001), and several others from their studies reported that tooth size discrepancies vary with different populations and hence population specific standards are important to achieve optimal orthodontic results. In this study of 203 models with 108 patients having a Angles Class I, 95 with Angles Class II malocclusion were studied. The mean anterior ratio calculated was 78.03%, which is close to Bolton's proposed ideal ratios. No correlation between Angle's classification of malocclusion and Bolton discrepancy was shown by Crosby and Alexander in 1989 (Crosby and Alexander, 1989). Their study included 109 pretreatment models of orthodontic patients of class I, class II Division 1 and class II Division 2 malocclusion. Nie and Lin in 1999 studied 60 cases of normal occlusion and 300 cases of various malocclusion groups for interarch tooth size discrepancy. They found no significant difference between various malocclusion subgroups.

However, class III cases showed the greatest discrepancy in both anterior and overall ratios, followed by class I and then class II. Araujo and Souki in 2003 studied mesio-distal width of six anteriors of 300 samples with different malocclusion who were distributed as Class I, 42 males and 58 females; Class II, 52 males and 48 females; and Class III, 51 males and 49 females. They found that Angle's Class I and Class III show significantly greater prevalence of tooth size discrepancies than Class II and mean anterior tooth size discrepancy for Class III was significantly greater than Class I and Class II subjects. In 2005, Uysal *et al.* (2005) compared interarch tooth size discrepancy in 150 untreated, normal occlusion subjects and 560 patients of four different malocclusion groups. A gender dimorphism was found in the normal subjects. All malocclusion groups showed significantly higher overall ratios than normal occlusion groups (P < 0.001). However, no statistically significant difference was found between the malocclusion groups. Basaran *et al.* in 2006 failed to show any gender dimorphism or statistically significant difference of Bolton's tooth size discrepancy among different malocclusion groups. The sample was of 60 normal occlusion groups. Santoro *et al.* (2000), Araujo and Souki (2003), Freeman *et al.* (1996), Othman and Harradine (2006), Crosby and Alexander (1989), and several other investigators have stated that a tooth size discrepancy of >2 SD or 1.5 mm of the Bolton norm can cause difficulties in tooth alignment and final occlusion. Proffit *et al.* (2013) stated that a discrepancy >1.5 mm can create problems and should be considered during the treatment planning process.

In a study by Ekka *et al.* (2014) done in kerala population boltons anterior mean ratio was found to be 77.32 ± 6.67. They concluded that Bolton's analysis can also be used on Indian or at least Kerala population but with increased standard deviation.A study by Subbarao (2014) showed that the mean anterior ratio for the Indian population is found to be 78.14 with a standard deviation of 2.59. Significant differences were found in anterior ratio for both sexes as compared to Bolton's ratio. According to a study by Heeralal (2016) the mean and S.D of the anterior ratio in the Bhopal population (78.48%±2.81) is higher than Bolton's study. The results of this study shows that no significant difference was found between Bolton's norms and and type of malocclusion for Dakshina Kannada population. But clinically, it was found that there is high tendency mandibular anterior excess for female patients in class II type of malocclusion. A homogenous type of distribution of anterior boltons discrepancy was observed in class I and class II malocclusion groups. Comparison between gender and Bolton's anterior ratio in different malocclusion groups revealed no statistically significant differences.

Conclusion

- No significant difference was found between Bolton's norms and type of malocclusion in Dakshina Kannada population.
- No significant relationship between gender and type of malocclusion.

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