A Study on Bolton Anterior Tooth Size Discrepancies among Different Malocclusion Groups

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ABSTRACT

Aim: To investigate the correlation between anterior tooth size discrepancies among Angle's Class l, ll, lll malocclusions and corresponding normal occlusion, as well as their prevalence in Bangladeshi population. This study would act as a reference for diagnosis, treatment planning and assessment of prognosis in some orthodontic cases.

Methods: This cross sectional study was conducted in the Department of Orthodontics & Dentofacial Orthopedics, Dhaka Dental College & Hospital. A total number of 200 subjects were selected in Angle's Class l, ll, lll and corresponding normal group. Each group had 50 subjects with males and females. A chi-square test was performed to statistically compare the prevalence of anterior tooth size discrepancies among Angle's Class l, ll, lll malocclusions and corresponding normal occlusion and two genders. Analysis of variance was used to compare the mean Bolton anterior tooth size ratios as a function of angle classification and gender. Statistical differences were determined at the 95% confidence level ($p < 0.05$).

Results: No significant difference was observed in the mean Bolton anterior ratio between normal group and class-I malocclusion group ($p = 0.343$). Significant differences were observed between Class-II malocclusion and normal group ($p=0.001$), and also between Class-III malocclusion and normal group ($p = 0.001$). Individuals with Angle Class lll and Class ll malocclusions showed significantly greater prevalence of tooth size discrepancy than Class l malocclusion and corresponding normal group.

Conclusion: The great diversity and ethnic mix of Bangladeshi population should alert our orthodontist to use Bolton analysis as an important diagnostic tool and become aware of the moderate variations that may be present and treated. It may somehow guide planning of this type of study in future. (Ban J Orthod & Dentofac Orthop, April 2011; Vol-1, No. 2, 1-4)

INTRODUCTION

A tooth size discrepancy is defined as a disproportion among the sizes of individual teeth.[2] The Bolton tooth-size analysis is an intermaxillary ratio analysis designed for the purpose of localizing differences in tooth size.[1] First advocated by Dr. Wayne Bolton in 1958, he believed that the correct maxillary and mandibular mesiodistal tooth size relationship is important in the achievement of proper occlusal interdigitation in the finishing stages of orthodontic treatment . Having this in mind, he computed for the specific ratios of the mesiodistal widths that exist between maxillary and mandibular teeth from both canine to canine and first molar to first molar so as to achieve optimum occlusion. Without the proper mesiodistal tooth size ratio between the maxillary and mandibular teeth, correct coordination of arches have been difficult.[3]

It has been established that orthodontic treatment comprises different phases, and each segment presents unique characteristics and challenges. The orthodontic "finishing" phase is recognized for the multitude of details necessary to achieve an excellent result. In some cases, finishing-phase difficulties arise because of tooth size imbalances that could have been detected and considered during initial diagnosis and treatment planning.

The present study is designed to investigate the relationship of anterior tooth size between normal occlusion and in Angle's Class I, II, and III malocclusions in a Bangladeshi population; and comparison between normal occlusion with other malocclusions.

OBJECTIVES OF THE STUDY

1. To find out the prevalence of anterior tooth size discrepancies in normal and in three Angle's malocclusion groups as a function of gender.
2. To compare anterior tooth size discrepancy between normal occlusion among Angle class-l, ll and lll malocclusion groups.
3. These results will guide the selective treatment procedure of various types of malocclusion in Bangladeshi population.

MATERIALS AND METHODS

The eligible samples for all three Angle's malocclusion subjects, were obtained from the records of post graduate and undergraduate program in the department of Orthodontics & Dentofacial Orthopedics, Dhaka Dental College and Hospital. But the samples for the normal occlusion group were selected from the final year students of Dhaka Dental College & Hospital. The sample size was 200; of them each group had 50 samples having almost equal numder of males and females.

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The inclusion criteria

1. Equivalent dental classifications.
2. All anterior permanent teeth presented in the upper and lower arches.
3. Good quality study casts.
4. Absence of tooth deformity.
5. No record of restoration or stripping of incisor and canine teeth.
6. Age of the subjects within 12 to 25 years.

Methods of data collection

In each sample, canine and incisor tooth were measured at the largest mesiodistal dimension. All data were collected from each sample according to the study procedure.
The anterior tooth size ratios were computed for each subject as described by Bolton[2]:

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

Data processing and analysis

After collection of data, for cross sectional study, the obtained data was checked, verified and edited. The data was then entered in a personal computer using the SPSS (Statistical Package for Social Sciences), where it was cleaned, edited and appropriate statistical tests were done depending on the distribution of data.

RESULTS & DISCUSSION

Among 200 individuals under study 106(53%) were female and 94(47%) were male.

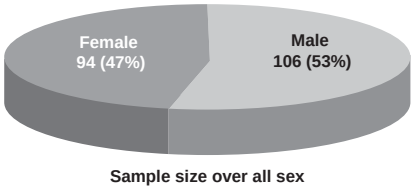

Fig 1: Distribution of sex in the selected sample.

Table 1: Bolton Anterior Ratio in Angle's malocclusion groups and normal occlusion group.

Group Name	Bolton Anterior Ratio		
	Mean	SD (±)	Range
Normal	79.39	3.11	72.89-88.23
Class-I	79.00	2.27	74.51-85.62
Class-II	77.28	2.99	71.37-77.28
Class-III	81.76	3.81	73.71-91.90

Anterior Bolton ratio for normal occlusion group was found 79.39 ± 3.11%.

Table 2: Bolton Anterior Ratios of different Malocclusion Groups and normal group

Group name	Number of subjects	Mean	SD ( )	p value
Normal	50	79.39	3.10	0.343
Class-I	50	79.00	2.27	
Normal	50	79.39	3.10	0.001
Class-II	50	77.28	2.99	
Normal	50	79.39	3.10	0.001
Class-III	50	81.75	3.80	

No significant difference was observed between the normal group and the class I malocclusion group (p = 0.343). Significant differences were observed between Class-II malocclusion and normal group (p=0.001), and also between Class-III malocclusion and normal group (p = 0.001).

Table 3: Mean anterior Bolton ratio in different malocclusion groups in comparison to corresponding normal group

	Groups	Mean
Bolton Anterior Ratio	Normal	79.39
	Class-I	79.00
	Normal	79.39
	Class-II	77.28
	Normal	79.39
	Class-III	81.75

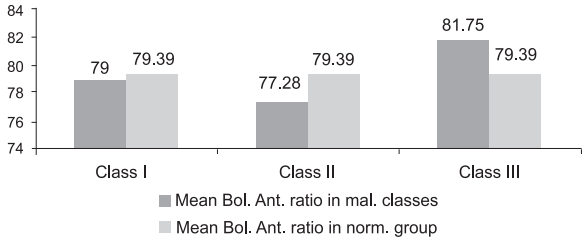

Figure 2: Graphical representation of mean anterior Bolton ratio in different malocclusion groups in comparison to corresponding normal group.

Class-III malocclusion group had the highest mean value of Bolton anterior ratio in comparison to the mean value of the normal group and to the corresponding malocclusion groups. The mean value of Bolton anterior ratio was almost similar between Class I malocclusion group and normal occlusion group. Class II malocclusion group had the lowest mean value of Bolton anterior ratio in comparison to mean value of the normal group and corresponding malocclusion groups.

Table 4: Mean Bolton anterior ratios for all the subjects of malocclusion groups and normal group as a function of gender.

Gender	Sample size (n)	Mean	Standard Deviation (SD)	Range	p value
Male	94	79.40	3.38	72.00-91.90	0.88
Female	106	79.33	3.56	71.37-88.23	

Mean Bolton anterior ratios for all the subjects of malocclusion groups and normal group as a function of gender, was not statistically significant (p=0.888).

Table 5: Combined male and female Bolton anterior ratio for Angle's Class I, Class II and class III patients:

Gender	N	Mean	Std. Deviation	Range
Male	72	79.55	±3.56	72.0-91.90
Female	78	79.17	±3.60	71.37-87.82
Over All	150	79.34	±3.58	71.37-91.90

With the objective of comparing the results of this study with the Bolton anterior ratio found in this study for normal occlusion group, the data was classified as "normal" for Bolton anterior ratios within ±1 SD (79.39±3.11%, found in normal subjects of this study) and "discrepancy" for ratios outside that range.

Table 6: Discrepancy in anterior tooth size for different malocclusion groups and normal group.

Groups	Normal or Discrepancy		Total
	Normal	Discrepancy	
Normal	35(70%)	15(30%)	50
Class-I	43(46%)	07(14%)	50
Class-II	30(60%)	20(40%)	50
Class-III	23(46%)	27(54%)	50
Overall	131(65.5%)	69(34.5%)	200

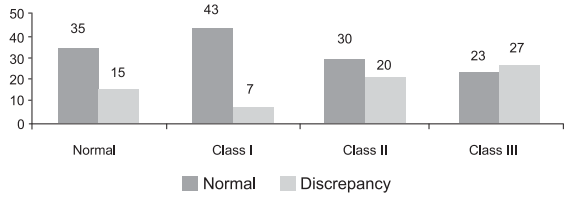

Figure 3: Discrepancy in different groups.

Bolton anterior ratio (Normal=79.39±3.11%)
A total of 34.5% (69 subjects) out of 200 subjects in this study presented Bolton anterior tooth size discrepancies (outside the range of mean ±1 SD of Bolton anterior ratio in normal subjects).

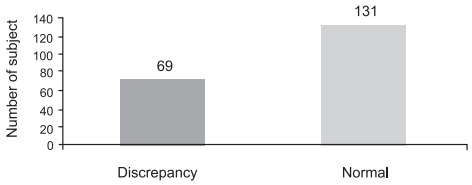

Figure 4: Amount of Bolton anterior tooth size discrepancy in different malocclusion and normal subjects.

Table 7: Prevalence of discrepancy in Bolton anterior ratios for all subjects of different Malocclusion Groups and normal group as a function of gender.

Gender	Normal or Discrepancy		Total	P value
	Normal	Discrepancy		
Male	68(72.3%)	26(27.7%)	94(100%)	
Female	63(59.4%)	43(40.60)	106(100%)	0.05
Overall	131(65.5%)	69(34.5%)	200(100%)	

Results of Chi-square test demonstrating significant association (p=0.05) in the prevalence of ±1 SD Bolton tooth size discrepancy between genders.

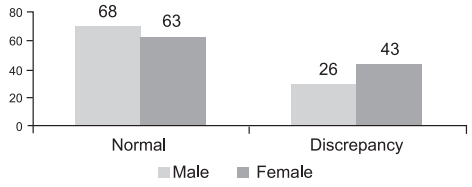

Figure 5: Gender wise discrepancy in all subjects.

DISCUSSION

In 1958, Bolton[2] studied 55 caucasian subjects who had normal occlusion where his their mean anterior ratio value was 77.2 and the mean overall ratio was 91.30. Stifter[3] sample size for Bolton anterior ratio was 34 subjects and the mean value was 77.55. Rahman M.M,2007, in his study in the Department of Orthodontics and Dentofacial Orthopedics, Dhaka Dental College & Hospital among 50 male and 50 female subjects having normal occlusion, found the mean value of anterior ratio in female 79.4% with standard deviation (±) 2.31% and mean value of overall ratio in female 92.64% with standard deviation (±) 2.56%. The maximum and minimum values for anterior ratio was 82.5% and 75.12%. In case of male, the mean anterior ratio was 79.29% with standard deviation (±) 2.58%, the mean overall ratio was 91.64% with standard deviation (±) 2.31%.The maximum and minimum result for anterior ratio were 85.25% and 72.64% respectively.

Of this study in normal subjects, the mean value of anterior ratio in female was79.82% with standard deviation (±) 2.40%, and the mean value of overall ratio in female was 92.53% with standard deviation (±) 2.21%. The maximum and minimum values of anterior ratio were 88.23% and 74.10% respectively. In case of male, the mean anterior ratio was 78.97% with standard deviation (±) 2.79%, and the mean overall ratio was 91.90% with standard deviation (±) 2.06%.The maximum and minimum result for anterior ratio were 84.75% and 72.89% respectively. The results among our population are quite similar but the standard deviation for anterior ratio is higher in comparison to Bolton's Caucasian sample (± 1.65%) probably because of the racial mix in our population.

Lundström studied the relationship between the mandibular and the maxillary anterior sum and named it the anterior index. For an ideal overbite, the optimal ratio was found to be from 73% to 85%, with a mean of 79% for an ideal overbite. In the present study, for the normal occlusion with an ideal overbite, the optimal ratio is found from 72.89% to 88.23%, with a mean of 79.39%. Similar results of these two suggests that the result of the present study is applicable in our population as an important diagnostic tool to achieve excellent orthodontic finishing with optimum overbite and overjet.

Bolton[2] reported tooth size discrepancies greater than ±1 SD in 29% of the patients studied in his private practice, and Richardson and Malhotra[4] reported similar discrepancies in 33.7% of their patients. Results of the present study showed that the tooth size discrepancies greater than ±1 SD is present in 36% patients (54 out of 150 patients).

In the present study the Bolton anterior ratio was greater in Class III patients (81.75%) than in Class II (77.28%)and Class I (79.00%)subjects. The results of the present study also indicate a tendency for Angle Class III individuals to present smaller upper teeth compared with subjects classified as class II or I; or teeth in the lower arch are larger in Class III than in Class II and I, and these obtained results in our population is similar to the results of the study done by Lavelle[6], Sperry et al,[5] and Nie and Lin[8].

In present study, Class III malocclusion group had the highest mean value of Bolton anterior ratio in comparison to mean value of the normal group and corresponding malocclusion groups. The mean value of Bolton anterior ratio was almost similar between Class I malocclusion group and normal occlusion group.Class II malocclusion group had the lowest mean value of Bolton anterior ratio in comparison to the mean value of the normal group and corresponding malocclusion groups.

The prevalence of anterior tooth size discrepancies in this sample was very high and serves as an indicator of how important it is to perform a thorough diagnosis before orthodontic treatment. In the present study, 69 individuals (34.5%) of total sample of 200 presented with an anterior tooth size discrepancies greater than ±1 SD using the Bolton analysis parameter of 79.39 ± 3.11% of normal occlusion group in Bangladeshi sample. Significant differences were observed between Class-II malocclusion and normal group (p=0.001), and also between Class-III malocclusion and normal group (p = 0.001). Class III (54%) and Class II (40%) malocclusion groups showed more anterior tooth size discrepancies than Class I (14%) or normal group (30%).

CONCLUSION

Significant differences of Bolton anterior ratio were observed between Class-II malocclusion and normal group, and also between Class-III malocclusion and normal group . Individuals with Angle Class lll and Class ll malocclusions showed significantly greater prevalence of tooth size discrepancy than Class I malocclusion and corresponding normal group. In conclusion, from reference of the above results, it may be suggested that the great diversity and ethnic mix of Bangladeshi population should alert our orthodontist to use Bolton analysis as an important diagnostic tool and become aware of moderate variations that may be present and treated. The orthodontist who is cognizant and aware of these possible discrepancies will be better prepared to diagnose and plan treatment with a more accurate certainty for patients of varied population mix. These conclusions could greatly influence clinical decision making, and further studies should be undertaken in this field.

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