

Evaluation of Bolton's Discrepancy in Un-treated Angles Class I Patients in Pondicherry population: A Cross-Sectional Study

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Abstract:

Background: To compare the tooth size discrepancy of Pondicherry population with Bolton's standard among un-treated angles Class I patients.

Materials and Methods: There were 200 study models of Class I molar relation were selected, and Bolton's ratio was calculated for each model using digital vernier calliper. The results were compared with Bolton's standard ratio. Statistical analysis used: Nonparametric Wilcoxon Statistical testing and one sample *t*-test.

Results: The values of overall and anterior tooth material ratios were compared between Bolton's Standard and Pondicherry population result shown the major difference in the anterior ratio than overall ratio of the total study samples. In this study, clinically significant discrepancies were found in 27.1% of the sample for overall ratio and 40.3% of the sample for the anterior ratio of Bolton's analysis. One sample *t*-test showed statistically significant difference ($P < 0.05$) between the anterior ratio of Bolton's standard and the study sample. The anterior ratios values were larger than the Bolton standards in Pondicherry population.

Conclusion: This study concluded that the overall and anterior ratios are greater than 2 standard deviation, and the differences were statistically significant, which confirms the difference in the size of the tooth materials among different ethnicity and population. Hence, it is suggested to conduct further detailed studies among Pondicherry population to determine more specific and standardized Bolton's tooth material ratio and to evaluate

Bolton's ratio among various types of Malocclusion and to find out gender variation.

Key Words: Bolton's standard, Class I patients, Pondicherry population

Introduction

The clinician should be aware of discrepancies in tooth size should be identified at an early stage of treatment for excellent orthodontic finishing. Tooth size discrepancies are measure thought of a vital variable, particularly in the anterior section. Lavelle¹ stated that although tooth size and proportion have an important role in malocclusion, the study of tooth dimensions has received scant attention by orthodontists for the optimal occlusion the size of the maxillary and mandibular dentition should be in proportion. Increase in the overall ratio may be due to increased lower arch or decreased upper arch size. Variation in their proportion may land up in malocclusion. The major factor in coordinating posterior inter-digitation, overbite, and overjet in a neutro-occlusion, is the relative harmony in the mesiodistal width of the maxillary and mandibular dentitions. The importance of this geometric relationship becomes apparent to orthodontists, especially in the finishing stages of a treated case.

The goal of diagnosis and treatment planning is to achieve the best possible functional and esthetic results for the patient at the end of the treatment. At times, after completion of orthodontic treatment, the patient may have spaces between the teeth, an increased overjet and an increased overbite. These deviations from an ideal occlusion may be a due to tooth size discrepancy between the maxillary and mandibular dental arches.

Black,² in 1902, was one of the first investigators to become interested in the subject of tooth size. He measured large numbers of human teeth and set up tables of mean figures which are still important references today.

Neff,³ in 1949, used 200 cases and measured the mesiodistal diameters of both maxillary and mandibular teeth. He then arrived at an "anterior coefficient" by dividing the mandibular sum into the maxillary sum. The range was 1.17-1.41.

Bolton,⁴ in 1958, analyzed a group of 55 excellent occlusions. He introduced mathematical tooth size ratios, which were supposed to be helpful in diagnosis and treatment planning. Bolton concluded that these ratios should be 2 of the tools

used in orthodontic diagnosis, which provides a better guide for the clinicians to achieve stable and functional occlusion at the end of the orthodontic treatment. His tables for anterior and overall tooth size ratios are still used today.

In a subsequent paper in 1962, Bolton⁵ expanded on the clinical application of his tooth size analysis. Bolton's results provide the information for an orthodontist, whether to reduce the tooth structure by inter-proximal slicing or the addition of tooth tissue by restorative techniques. Variation in mesiodistal width of the maxillary and mandibular dentitions is not same among World population and also is not same for all the sex and the population. Hence, this study aimed to determine the amount of tooth size differences.

Materials and Methods

200 study models were randomly selected from private hospitals in Pondicherry. Each model had Class I molar (Figure 2), Class II (Figure 3), Class III (Figure 4) relationship with no arch discrepancy.

The selection criteria of the casts were (1) dentition contains all the permanent tooth mesial to the first molar, (2) well-

poured and well-polished casts devoid of any surface deformity, (3) no tooth agenesis or extractions, (4) tooth without any restorations, and (5) no teeth with anomalous shapes.

The mesiodistal widths of all teeth from the first molar to first molar of each cast were measured using a digital vernier calliper (Figure 2), accurate to 0.01 mm. The measurement was taken from the greatest point from the mesial and distal proximal contact surfaces. All measurements were done by the same investigator. The sum of maxillary and mandibular anterior tooth size and the sum of all mesiodistal tooth size from the first molar to molar were calculated, and the inter-arch tooth size discrepancy was calculated using Bolton's analysis.

Calculation

$$\text{Overall ratio} = \frac{\left(\frac{\text{Sum of mesiodistal widths of mandibular 12 teeth}}{\text{(first molar-first molar} \times 100)} \right)}{\left(\frac{\text{Sum of mesiodistal widths of maxillary 12 teeth}}{\text{(first molar-first molar)}} \right)}$$

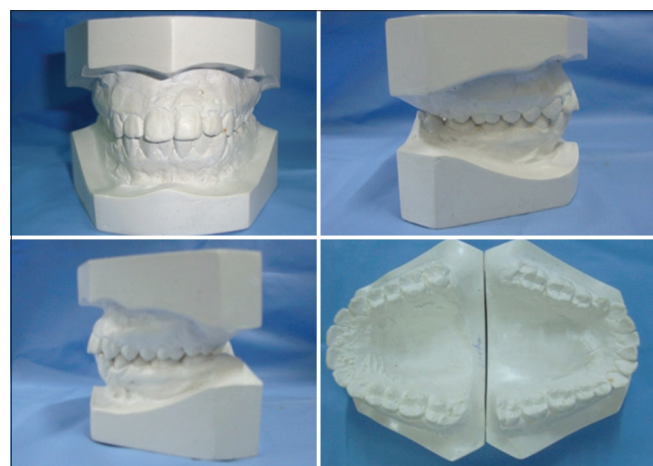


Figure 1: Class I malocclusion models.

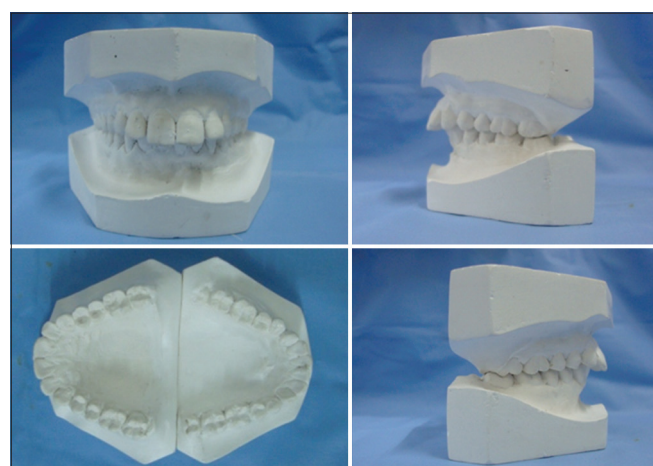


Figure 2: Class II malocclusion models.

Table 1: Analysis of error for all measurements submitted to nonparametric Wilcoxon statistical testing demonstrating no significant ($P>0.05$) difference between the two sets of measurements.						
Measurement	n	Descriptive measurements				P value
		Minimum	Maximum	Mean	SD	
1	30	74.0	82.0	78.2	2.6	0.760
2	30	75.2	83.0	78.4	2.6	

SD: Standard deviation

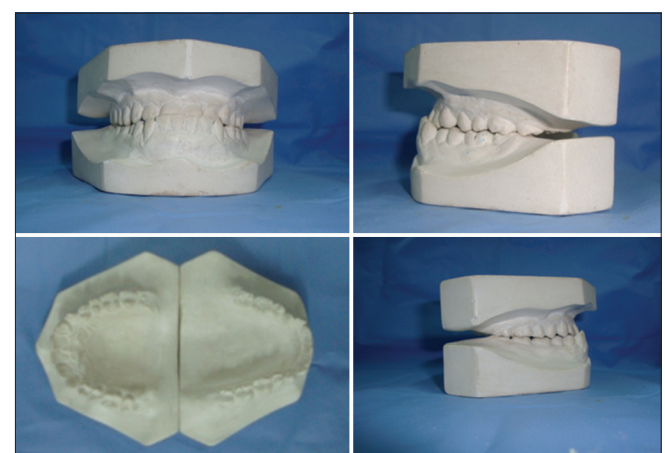


Figure 3: Class III malocclusion models.



Figure 4: Digital calliper.

Table 2: The percentage distribution of anterior tooth size discrepancies outside 1 or 2 SD from Bolton's means.

Sample	Outside 2 SD (%)	2 SD (%)	1 SD (%)	Mean	1 SD (%)	2 SD (%)	Outside 2 SD (%)
	<73.9	73.9-75.4	75.5-77.1	77.2	77.3-78.8	78.9-80.5	>80.5
Pondicherry population	13.2	8.5	20.2	0	13.2	17.8	27.1

40.3% of Class I outside 2 SD. 66.6% of Class I outside 1 SD, SD: Standard deviation

Table 3: The percentage distribution of overall tooth size discrepancies outside 1 or 2 SD from Bolton's means.

Sample	Outside 2 SD (%)	2 SD (%)	1 SD (%)	Mean	1 SD (%)	2 SD (%)	Outside 2 SD (%)
	<87.5	87.5-89.3	89.4-91.2	91.3	91.4-93.2	93.3-95.1	>95.1
Pondicherry population	17.8	14.7	24.8	0.8	20.2	12.4	9.3

27.1% of Class I outside 2 SD. 54.2% of Class I outside 1 SD, SD: Standard deviation

Table 4: Comparison of anterior and overall ratios between Pondicherry population and Bolton standards - one sample t-test demonstrating statistically significant ($P < 0.05$) difference between Bolton's and Pondicherry population mean anterior ratio.

Sample	n	Anterior ratio			Overall ratio		
		Mean	SD	P value	Mean	SD	P value
Bolton	55	77.2	1.65		91.3	1.91	
Pondicherry population	200	78.6	4.8	0.001	90.5	4.2	0.063

SD: Standard deviation

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

Analysis of error, among the total samples arbitrarily 30 models were taken and re-measured by the same investigator twice within a 3-week interval period, and the results shown were insignificant ($P > 0.05$) (Table 1) based on testing using the Wilcoxon nonparametric test.

Results

Comparison of anterior and overall ratios of Pondicherry population and Bolton's standards. The frequency of tooth size discrepancy 1, 2, and more than 2 standard deviation (SD) from Bolton's mean for anterior, and overall ratios are shown in Tables 2 and 3.

A total of 54.2% of the subjects in this study presented Bolton tooth size discrepancies greater than ± 1 SD for overall ratio and 66.6% for the anterior ratio. Tooth size discrepancies greater than ± 2 SD were considered to be clinically significant. In this study, clinically significant discrepancies were found in 27.1% of the sample for overall ratio and 40.3% of the sample for the anterior ratio of Bolton's analysis.

One sample *t*-test revealed a statistically significant difference ($P < 0.05$) between the anterior ratio of Bolton's standard and the study sample. 40.3% of the population had anterior ratio more than 2 SD from the Bolton standards. The values are shown in Tables 2, 3 and 4.

Discussion

The Bolton sample was obtained from 55 models with excellent occlusion, 44 Orthodontically treated and 11 un-treated. In our sample, all models also had normal occlusions-Class I with no arch discrepancy. We did not consider incisor inclination, just

tooth sizes for Bolton ratios. The anterior ratio was larger in this study than in Bolton's. The reason for this finding might be the population of the sample and the ethnic groups.

The values were similar to those reported by Bernabé *et al.*⁶ and Santoro *et al.*⁷ for the anterior ratio and by Bernabé *et al.*⁶ for the overall ratio. The anterior ratios values were larger than the Bolton standards in all of them, but overall ratios were similar to Bolton's standards. If an SD > 2 indicates a significant discrepancy, an anterior ratio $< 73.9\%$ or more than 80.5% , and overall ratio considered as clinically significant factor.

A significant discrepancy in the anterior ratio was found in 40.3% of the Pondicherry patients similar to the samples of Bernabé *et al.*⁶ and Crosby and Alexander,⁸ and lower than those of Santoro *et al.*⁷ and Freeman *et al.*⁹ On the other hand, a discrepancy in the overall ratio was found in 27.1% of the Pondicherry patients. Fernández-Riveiro *et al.*¹⁰ found a greater percentage of anterior and total discrepancies in their study, but they considered values outside 1 SD, not 2 SD, to be significant.

Conclusion

This study cited the anterior and overall ratio of the Pondicherry population.

1. 27.1% of the sample had overall ratio > 2 SD
2. 40.3% of the sampled had anterior ratio > 2 SD.

The differences are statically significant and suggest the need for specific standards for the Pondicherry population.

The relationship between the sizes of the mandibular and maxillary teeth depends on ethnicity and population. Further detailed studies are required, comparing all type of malocclusion and also check for any kind of gender relationship among Pondicherry population.

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