

COMPARISON OF BOLTON RATIO BETWEEN TWO ETHNIC GROUPS REPORTING TO ARMED FORCES INSTITUTE OF DENTISTRY (AFID) RAWALPINDI

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ABSTRACT

Objective: To compare the Bolton ratio between Punjabi and Pathan population reporting to Armed Forces Institute of Dentistry (AFID) Rawalpindi.

Study Design: Comparative study.

Place and Duration of Study: Department of Orthodontics at AFID Rawalpindi from May 2014 till Dec 2014.

Material and Methods: On the basis of inclusion criteria; 107 good quality study casts out of 150 patients were selected. They were divided into Punjabi and Pathan groups. Both the Overall Bolton Ratio and Anterior Bolton Ratio were calculated for both of these groups. For comparison of their means an independent t test was applied. A *p* value was determined for anterior and overall Bolton Ratios at 95% confidence interval.

Results: Our sample consisted of 52.3% females and 47.7% males. The percentage of the Punjabi population was 59.9% (n=64) and Pathan population was 40% (n=43). Our mean Overall Bolton ratio calculated was 90.69%. The mean Anterior Bolton ratio calculation was 78.93%. The mean overall Bolton Ratio for Punjabi population was 90.24 and for Pathan population the Ratio was 91%. The mean anterior ratio for Punjabi population was 78.08 and for Pathan population the ratio was 80.19. The *p* value for overall ratio was .119 while for the anterior ratio the *p* value was .091.

Conclusion: Differences were noted in Bolton Ratio (Overall Bolton Ratio and Anterior Bolton Ratio), but they were statistically insignificant.

Keywords: Anterior Bolton Ratio, Bolton Ratio, Ethnicities, Overall Bolton Ratio, Pathans, Punjabi.

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INTRODUCTION

A proper maxillary to mandibular tooth size relationship is important for proper occlusal interdigitation, overjet, and overbite relationships. Orthodontic treatment should result in appropriate points of contact between neighboring teeth¹. A tooth-size discrepancy can affect the final result of orthodontic treatment and its stability². Many studies have shown a correlation between the mesiodistal tooth widths of the maxillary and mandibular teeth³. However, some discrepancies between tooth sizes are not apparent until the final stages of orthodontic treatment⁴.

Neff⁵ developed the anterior coefficient; a method to compare the widths of the anterior teeth in the upper arch with that of the teeth

in the lower. Bolton⁶ analyzed a group of 55 excellent occlusions. He introduced mathematical tooth size ratios, which were supposed to be helpful in diagnosis and treatment planning. Other rare methods used for determining intra arch tooth size discrepancies include Kesling⁷ diagnostic setup and Howe's canine fossa width to total maxillary tooth width⁸. The Bolton analysis⁹ based on the ratios between the mesiodistal tooth diameter sums of the mandibular and the maxillary dentitions, remains the most recognized and widely used method for detecting interarch tooth size discrepancies.

There is good evidence that populations differ with respect to Interarch tooth size relationships because differences in tooth sizes are not systematic¹⁰⁻¹². For example, in USA blacks have larger maxillary canines, premolars, and first molars than whites even though there are no differences for the

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Received: 17 Feb 2015; revised received: 02 Mar 2015; accepted: 04 Mar 2015

maxillary central or lateral incisors^{13,14}. Various studies addressing the Bolton Ratios have been conducted on Pakistani population¹⁵. Bolton discrepancy was found in greater percentage of the population¹⁶, whereas quantitative measurements were almost comparable to the established norms (over all ratio of 91.54% and anterior ratio of 78.85%)¹⁷.

Pakistan being a culturally divergent nation comprises of different ethnicities namely Punjabi, Pathans, Sindhis, Balochis, Muhajirs and Kashmiris. Evidence is lacking regarding the Bolton discrepancy among different Pakistani ethnicities. The aim of this study was to calculate the Bolton ratio between Punjabi and Pathan population.

MATERIAL AND METHODS

This was a comparative study carried out at the Department of Orthodontics at Armed Forces Institute of Dentistry (AFID) Rawalpindi. Duration of the study was from May 2014 to December 2014. Well prepared pre orthodontic study casts were used only. Class I, Class II and Class III patients were included. The patients chosen were supposed to have sound fully erupted teeth from first permanent molar to the contra lateral first permanent molar in Maxillary and Mandibular arches, free from pathology like carries, periodontal disease and any restoration. Patients with restored, missing, supernumerary, abnormal shape and size of teeth were excluded.

A convenient sampling was done and 107 study casts were selected randomly out of 150 study casts. Ethnicity was determined from the records of orthodontic patients. The analysis was done on study models obtained from conventional alginate impression material poured within 2 minutes to reduce dimensional changes. The study casts were poured in ortho stone plaster. Tooth widths were measured by a vernier caliper. For Overall Bolton ratio, tooth widths from first permanent molar to the first permanent molar on the contra lateral side were measured for both mandibular and maxillary arches separately. For anterior tooth ratio the sum of widths were measured from canine to canine on the contra lateral side. Overall Bolton

Ratio and Anterior Bolton Ratio were determined according to the formula;

Overall Bolton Ratio: (Sum of Mandibular 12 X teeth ÷ Sum of maxillary 12 teeth) X 100

Anterior Bolton Ratio: (Sum of Mandibular 6 X anterior teeth ÷ Sum of Maxillary 6 anterior teeth) X 100

SPSS 22 was used for statistical analysis. Frequency and mean for cast and gender was determined. Independent t test was applied for comparison between the means of Bolton Ratio with a 95% confidence interval. A *p* value of .05 or less was considered to be significant.

RESULTS

Regarding gender the sample consisted of 56 females and 51 males out of a total of 107 patients. The percentage of 52.3% and 47.7% was obtained for males and females respectively. Among the whole of the sample the frequency of Punjabi population was 59.9% (n=64) and Pathan population was 40% (n=43). The minimum age of the sample was 11 years, maximum age was 41 years. The mean age was 16.7 years with an SD of ± 5.31. The results are summarized in tables.

DISCUSSION

This was the first study in Pakistan to calculate the Overall Bolton Ratio and Anterior Bolton Ratio on the basis of different ethnicities. Previously studies had been conducted on the basis of tooth size discrepancy¹⁶ and different skeletal classes¹⁸. Our mean overall Bolton Ratio for the two ethnic groups was 90.69 which is less than the original 91.3 mean overall ratio⁶, as proposed by Bolton, table-1. The minimum overall Anterior Ratio was 81.41 and maximum was 99.44 with a standard deviation of 3.65. According to a study by Batool¹⁸ at AFID the Overall Bolton ratio was 91.1, similarly Ibad¹⁶ et al reported a Bolton ratio of 93 in Pakistani population.

Our mean anterior ratio of 78.93 was different than 77.2 as proposed by Bolton in his article⁶. The minimum Anterior Bolton Ratio was 63.54 and maximum Anterior Bolton Ratio was 95.54, with a standard deviation of 6.33. Batool¹⁸ and Ibad¹⁶ had calculated values of

79.34 and 78.8 for Anterior Bolton Ratio respectively.

Thus our ratios are closer with Batool¹⁸ regarding Overall Bolton Ratio and with Ibad¹⁶ regarding anterior bolton ratio. Regarding differences between different ethnicities, the mean Overall Bolton Ratio in Punjabi population was 90.24, while in Pathan

Internationally only few studies had been done comparing different races. In one study¹⁴ the data were derived from casts of 180 patients, including 30 males and 30 females from each of 3 populations (black, hispanic, and whites). The results confirmed significant ($p < .05$) ethnic group differences in all 6 arch segment lengths and in all 3 interarch ratios. A study was done on Americans of Dominican

Table-1: Descriptive statistics.

AFID bolton ratio	Mean	Minimum	Maximum	SD
Overall bolton ratio	90.69	81.41	99.44	3.65
Anterior bolton ratio	78.93	63.54	95.53	6.33

Table-2: Showing comparison of bolton ratio between punjabi and pathan population.

Bolton Ratio	Cast				p-value $\leq .05$
	Punjabi (n=64)		Pathan (n=43)		
	Mean	SD	Mean	SD	
Overall bolton ratio	90.24	3.66	91.36	3.56	.119
Anterior bolton ratio	78.08	6.52	80.19	5.89	.091

Table-3: Showing comparison of bolton ratio between male and female groups.

Bolton ratio	Gender				p-value $\leq .05$
	Male (n=51)		Female (n=56)		
	Mean	SD	Mean	SD	
Overall bolton ratio	91.09	3.71	90.40	3.60	.396
Anterior bolton ratio	79.55	6.54	78.36	6.13	.335

population the ratio was 91.36. According to our sample the Pathan population had a tendency towards a higher Bolton Ratio, while in Punjabis the overall bolton ratio mean is less. Similar results were reflected in mean Anterior Bolton Ratio, Pathan population had a larger mean overall bolton ratio than the Punjabi population (80.19 vs. 78.08) however, the result was not statistically significant, table-2.

The mean age of taking of orthodontic records was 16.6 years with a range of 11 to 41 years. Our mean Overall Bolton Ratio in males and females was 91.01 and 90.40 respectively. The males had a larger Bolton ratio while the females had a smaller Bolton ratio but the difference was statistically insignificant (p value .396). The anterior bolton ratio for males was calculated at 79.55 and for females 78.36, which was also statistically insignificant ($p = .335$). Here too although the males had a larger mean Anterior Bolton Ratio the difference was statistically insignificant ($p = .335$), table-3.

background²². They concluded that the overall Bolton Ratio was similar to the standard value, however the anterior ratio was different and they emphasized on a separate standard for Dominican Population.

A study was done on Bangkokian population¹⁹. Thai sample was compared with the Caucasian sample. (CPRs) Cumulative Percentage Ratios were determined and 37 pairs of dental casts were recorded for Thai population with normal occlusions. Significant differences were noted. Majority of CPRs were different than the Caucasian population.

Tooth size ratios for Turkish²⁰ population were noted and compared with Bolton Ratios from 150 Turkish patients. The mesiodistal dimensions of the maxillary teeth showed greater variability than the mandibular teeth, with the first molar dimensions having the greatest variability. The overall and anterior ratios were found to be 89.88 ± 2.29 and 78.26 ± 2.61 , respectively. A statistically significant sex

difference was found only in overall ratio ($p < .001$).

One study with 306 subjects of varying ethnicity, sex and malocclusion was undertaken. 3 groups namely African Americans, Hispanics and Caucasians were compared²¹. Tooth size Ratios compared with Analysis of Variance (ANOVA) showed no differences in different sexes and different ethnicities and malocclusion groups.

Our research partially agrees with these international studies. We calculate that racial differences in Bolton Ratio are not statistically significant. A hypothesis is born that no racial differences exist between Punjabi and Pathan population regarding bolton ratios. When compared with the Classical Bolton Ratio values, our population had less overall Bolton Ratio and more Anterior Bolton Ratio, but the values were statistically not significant. Our population had tooth size discrepancies specially in the anterior region. Further research among different ethnicities like Balochi, Sindhi and Kashmiri population may further clarify this situation. We should calculate our own Bolton Ratios independent of the values for other nations.

CONCLUSION

Customized Bolton ratios for Pakistani population should be calculated. Calculating Bolton Ratios should be mandatory in treatment planning charts. Tooth size discrepancies specially in the anterior segment were found in Punjabi and Pathan population and were equally distributed.

CONFLICT OF INTEREST

The authors of this study reported no

conflict of interest.

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