**ORIGINAL ARTICLE**

# Anterior Tooth Size Discrepancies among different classes of Malocclusion

REHAN HAMID[1], MUHAMMAD AZEEM[2], MARYAM HANIF[3], *ARFAN UL HAQ[4], USMAN SHAKOOR[5]*

## ABSRACT

**Aim:** To find the correlation between anterior Bolton ratios and different classes of malocclusions.
**Methods:** The study was conducted at Department of Orthodontics, Faisalabad Medical University & de'Montmorency college of Dentistry, where total of 45 plaster models of three malocclusion groups were randomly selected, with 15 plaster models of each malocclusion group. Anterior Bolton ratios were measured on model and class of malocclusion was diagnosed on plaster model by Angle's system of molar classification.
**Results:** Statistically significant correlation exists between anterior Bolton ratio and class III malocclusion group.
**Conclusion:** Anterior Bolton ratio discrepancies are more frequent in class III malocclusion group.
**Keywords:** Bolton ratio; Class III.

## INTRODUCTION

Occlusion can be defined as relationship between upper and lower teeth while functions and parafunctions[1]. Ideal occlusion can be labeled as hypothetical concept with perfect alignment and inter-arch relationships[2]. Normal occlusion can be labeled as any deviation from ideal occlusion which is satisfactory aesthetically and functionally[3].

Normal occlusion can be judged by different parameters. As per Andrews there are six keys of occlusion. These six keys are: Correct inter-arch relationship with normal molar relationship, mesial crown angulation of all the teeth, correct labiolingual inclination of teeth, absence of torsiversion, absence of spaces between the teeth and flat occlusal plane[4]. Later on, Bennet proposed the 7th key of normal occlusion which is known as correct teeth size or normal Bolton ratios[5].

According to Angle there are three classes of malocclusion named as, Class I, II and III malocclusion.[6] Correct molar relationship as per Angle is one in which mesiobuccal cusp of upper first molar occludes with the buccal groove of lower first molar along with correct line of occlusion[6]. Correct Bolton ratios are important for proper occlusal interdigitation, and normal overjet and overbite[7,8]. Any discrepancy in Bolton ratios can result in spaces, crowding, and abnormal overjet and overbite issues[9].

*[1,3] Ex-House officer, de'Montmorency College of dentistry, Lahore.*
*[2]Assistant Professor Orthodontics, Faisalabad Medical University, Pakistan.*
*[4]Dean & Professor Orthodontics, Faisalabad Medical University, Pakistan.*
*[5]Resident, de'Montmorency College of dentistry, Lahore, Pakistan.*
*Correspondence to Dr. Muhammad Azeem Email:dental.concepts@hotmail.com, Cell: +92-345-8409007*

Following this rationale, it can be expected that Bolton ratios are different in different malocclusion groups. This present study was aimed at finding the correlation between anterior Bolton ratios and different classes of malocclusions.

## METHODOLOGY

The cross sectional study was conducted at the Department of Orthodontics, Faisalabad Medical University & de'Montmorency college of Dentistry, in which models of untreated 45 subjects were included. 15 models were of class I malocclusion, 15 of class II and 15 of class III malocclusion group. Duration of study was from March 2016 to January 2018.

Following patients were included: Fully erupted teeth till second molars, no transverse issue, no severe vertical dysplasia and good quality pre-treatment models. Any patient having prior history of orthodontic treatment, having tooth wear or any dental tooth pathology was excluded. Plaster casts were used to evaluate the anterior Bolton ratios using formulae[10]

Anterior Bolton Ratio (B') =
Sum of mesiodistal width of mandibular 6 Anteriors X100
Sum of mesiodistal width of mandibular 6 Anteriors= 77.2%

Ten models were randomly reassessed 1 week later to determine the reliability and method of error by Dahlberg formula, the method error was found to be 2.9 % and data was found out to be reliable.

**Statistical analysis:** The means, standard deviations, and range of anterior Bolton ratios were calculated for both the genders in three malocclusion groups, if no gender difference was found, the anterior Bolton ratios of both the genders were

combined for each malocclusion group. The mean ratios were compared in three malocclusion groups using ANOVA test. The data was analyzed using SPSS 19.0.

## RESULTS

Age distribution is shown in Table I and II. No statistically significant sex difference was found between the anterior Bolton ratios in the 3 malocclusion groups. Thus the mean anterior ratios were combined for both the genders. In the anterior Bolton ratio, a statistically significant difference was found between the Bolton standard[11] and the Class III malocclusion group (Table III).

Table I: Age distribution (N=45)

| Age (years) | |
|---|---|
| n | 45 |
| Mean | 18.11 |
| SD | 3.45 |
| Minimum | 14 |
| Maximum | 24 |

Table II: Descriptive stats for age (N=45)

| **Class I (n=15)** | | **Class I (n=15)** | | **Class III (n=15)** | |
|---|---|---|---|---|---|
| Mean | SD | Mean | SD | Mean | SD |
| 18.23 | 3.89 | 18.12 | 3.59 | 3.59 | 3.54 |

Table III: Comparison of anterior Bolton ratios in 3 malocclusion groups and Bolton standards (P values)

| | **Bolton standards** | **Class II** | **Class III** |
|---|---|---|---|
| Class I | 0.371 | 0.578 | 0.078 |
| Class II | 0.171 | | 0.198 |
| Class III | 0.004 | | |

## DISCUSSION

This present study was aimed at finding the correlation between anterior Bolton ratios and different classes of malocclusions. Results showed that in the anterior Bolton ratio, a statistically significant difference was found between the Bolton standard and the Class III malocclusion group.

No statistically significant sex difference was found between the anterior Bolton ratios in the 3 malocclusion groups. This is in agreement with the findings of studies by Araujo, Nie, Alkofide, Richardson and Al-Tamimi[12-16]. Findings of our study are in contrast with the findings of studies by Smith et al[17] and Lavelle et al[18] where gender differences were found.

A statistically significant difference was found between the Bolton standard and the Class III malocclusion group. This is in agreement with the studies by Araujo, Nie, and Alkofide.[12-14] Findings of our study are in contrast with the findings of studies by Crosby and Usyal[19,20] where no malocclusion differences were found.

In inclusion criteria of present study, we selected patients in age range of 12-14 years which is in accordance with the study by TA et al.[21] We selected patients in age range of 12-14 years in order to minimize the influence of tooth wear, caries or restorations on Bolton ratios.

There are many techniques to calculate the anterior Bolton ratios such as, eye balling method in which size of upper lateral incisors and upper second premolars are checked visually, three dimensional methods and Vernier calipers[22-24]. We utilized vernier caliper method in present study which is in accordance with evidence[25].

Clinical implication of present study is that Bolton issues are more frequent in class III malocclusion thus require special measures to counter that while treatment planning of any class III case. Limitations of current study are its small sample size and cross sectional approach. Further large scale studies are suggested.

## CONCLUSION

- It was concluded that Bolton ratios and vertical facial types are not correlated.
- Further large scale studies are suggested to establish strong correlation between Bolton ratios and vertical facial types.

## REFERENCES


1. Mina M, Borzabadi-Farahani A, Tehranchi A, Nouri M, Younessian F. Mathematical beta function formulation for maxillary arch form prediction in normal occlusion population. Odontology. 2017 Apr 1;105(2):229-36.
2. Klaus K, Stark P, Serbesis TS, Pancherz H, Ruf S. Excellent versus unacceptable orthodontic results: influencing factors. European Journal of Orthodontics. 2017 Mar 24:cjx006.
3. Muhamad AH, Nezar W, Azzaldeen A. The curve of dental arch in normal occlusion. Open Science Journal of Clinical Medicine. 2015 Jan 29;3(2):47-54.
4. Andrews LF. The six keys to normal occlusion. American journal of orthodontics. 1972 Sep 1;62(3):296-309.
5. Begum M, Goje SK, Karra A, Mohan S. Tooth size and arch parameter discrepancies among different malocclusions in young permanent dentition of 13-15-year-old school children of Nalgonda District-South Indian population. Journal of Orthodontic Research. 2014 Jan 1;2(1):4.
6. Arvind TV, Baskaranarayanan B, Chidambaram S, Premkumar S. Association between the British Standards Institute's incisor classification of malocclusion and Angle's Classification of malocclusion-an analytical study. RGUHS Journal of Medical Sciences. 2015 Apr 1;5(2):62-6.

7. Correia GD, Habib FA, Vogel CJ. Tooth-size discrepancy: A comparison between manual and digital methods. Dental press journal of orthodontics. 2014 Aug;19(4):107-13.
8. Alam MK, Shahid F, Purmal K, Ahmad B, Khamis MF. Bolton tooth size ratio and its relation with arch widths, arch length and arch perimeter: A cone beam computed tomography (CBCT) study. Acta Odontologica Scandinavica. 2014 Nov 1;72(8):1047-53.
9. Shahid F, Alam MK, Khamis MF, Honda Y, Sugita Y, Maeda H. Geomorphometrics of tooth size and arch dimension analysis by conventional digital caliper and digital stereomicroscope to establish standard norms for the Pakistani population. Journal of Hard Tissue Biology. 2015;24(2):155-68.
10. Kale PV, Chhajed DR, Khapli SS, Tripathi NR, Randhawa GK. Extraction: A Parameter in Bolton Ratio. Journal of Dental and Allied Sciences. 2015 Jan 1;4(1):3.
11. Bolton WA. The clinical application of a tooth-size analysis. Am J Orthod 1962;48:504-29.
12. Araujo E, Souki M. Bolton anterior tooth size discrepancies among different malocclusion groups. The Angle orthodontist. 2003 Jun;73(3):307-13.
13. Nie Q, Lin J. Comparison of intermaxillary tooth size discrepancies among different malocclusion groups. American Journal of Orthodontics and Dentofacial Orthopedics. 1999 Nov 30;116(5):539-44.
14. Alkofide E, Hashim H. Intermaxillary tooth size discrepancies among different malocclusion classes: a comparative study. Journal of Clinical Pediatric Dentistry. 2002 Jul 1;26(4):383-7.
15. Richardson ER, Malhotra SK. Mesiodistal crown dimension of the permanent dentition of American Negroes. American journal of orthodontics. 1975 Aug 1;68(2):157-64.
16. Al-Tamimi T, Hashim HA. Bolton tooth-size ratio revisited. World journal of orthodontics. 2005 Sep 1;6(3).
17. Smith SS, Buschang PH, Watanabe E. Interarch tooth size relationships of 3 populations:“Does Bolton’s analysis apply?”. American Journal of Orthodontics and Dentofacial Orthopedics. 2000 Feb 29;117(2):169-74.
18. Lavelle CL. Maxillary and mandibular tooth size in different racial groups and in different occlusal categories. American journal of orthodontics. 1972 Jan 31;61(1):29-37.
19. Crosby DR, Alexander CG. The occurrence of tooth size discrepancies among different malocclusion groups. American Journal of Orthodontics and Dentofacial Orthopedics. 1989 Jun 1;95(6):457-61.
20. Uysal T, Sari Z, Basciftci FA, Memili B. Intermaxillary tooth size discrepancy and malocclusion: is there a relation?. The Angle orthodontist. 2005 Mar;75(2):208-13.
21. Ta TA, Ling JY, Hägg U. Tooth-size discrepancies among different occlusion groups of southern Chinese children. American Journal of Orthodontics and Dentofacial Orthopedics. 2001 Nov 30;120(5):556-8.
22. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics-E-Book. Elsevier Health Sciences; 2014 Mar 12.
23. Naidu D, Freer TJ. Validity, reliability, and reproducibility of the iOC intraoral scanner: a comparison of tooth widths and Bolton ratios. American Journal of Orthodontics and Dentofacial Orthopedics. 2013 Aug 31;144(2):304-10.
24. Celikoglu M, Nur M, Kilkis D, Sezgin OS, Bayram M. Mesiodistal tooth dimensions and anterior and overall Bolton ratios evaluated by cone beam computed tomography. Australian orthodontic journal. 2013 Nov;29(2):153.
25. Shellhart WC, Lange DW, Kluemper GT, Hicks EP, Kaplan AL. Reliability of the Bolton tooth-size analysis when applied to crowded dentitions. The Angle Orthodontist. 1995 Oct;65(5):327-34.
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