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Tooth-Size Discrepancies Among Different Malocclusion Groups In Central India Population: A Retrospective Study

Dr. Shafna V, Dr. Ram Kishore Ratre, Dr. U R Neelima, Dr. Ketan Goel, Dr. Varsha Dogra, Dr. Alka Dubey

PG Resident, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India
HOD & Professor, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India
PG Resident, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India
PG Resident, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India
PG Resident, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India
PG Resident, Department Of Orthodontics And Dentofacial Orthopaedics, Government College Of Dentistry, Indore, India

Abstract
Objective: *To evaluate anterior and overall Bolton tooth-size ratios among different malocclusion groups in a Central Indian population and compare the findings with Bolton's original standards.*
Materials and Methods: *This retrospective study included 90 orthodontic study models (30 each of Class I, Class II, and Class III malocclusion) obtained from the Department of Orthodontics, Government College of Dentistry, Indore. Subjects aged 13–25 years with complete permanent dentition and no prior orthodontic treatment were included. Mesiodistal widths of teeth from first molar to first molar were measured to calculate anterior and overall Bolton ratios. Data were analyzed using descriptive statistics and one-sample t-tests against Bolton norms ($p < 0.05$).*
Results: *The mean anterior ratio was 77.9 ± 4.48% and the overall ratio was 91.5 ± 4.51% for the Central Indian population. No statistically significant differences were found between males and females or among Class I, II, and III malocclusion groups. Comparison with Bolton's standards showed no significant deviation.*
Conclusion: *Bolton's anterior and overall ratios are applicable to the Central Indian population regardless of gender or malocclusion class. Routine Bolton analysis remains a valuable diagnostic tool in orthodontic planning, though individual assessments are essential.*
Keyword: *Bolton analysis, tooth-size discrepancy, malocclusion, Central India, orthodontics*

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I. Introduction

Proper occlusal interdigitation, overjet, and overbite depend on a certain ratio of maxillary to mandibular tooth size. The difference in tooth size may have an impact on the stability and outcome of orthodontic treatment. Numerous investigations have demonstrated a relationship between the maxillary and mandibular teeth's mesiodistal tooth widths.

. (1–3) Bolton analyzed the relationship between the mesiodistal tooth width of maxillary and mandibular teeth by studying 55 white subjects with excellent occlusion. Using the mesiodistal width of 12 teeth, he obtained an overall ratio of 91.3% ± 1.91%; using the 6 anterior teeth, he obtained an anterior ratio of 77.2% ± 1.65%. (4)

We can better understand the impact of this crucial aspect in the development of different malocclusions by evaluating the tooth size disparity across different classes of malocclusion. Additionally, it offers fresh perspectives on how to create a suitable treatment plan and is fundamentally helpful in customizing final tooth size ratios for the best possible treatment results. In addition to this influence, the patient's gender—a

significant factor in tooth size—was evaluated. Comparing Bolton anterior and overall ratios among several occlusion groups in the population of Central India was the aim of this study.

II. Material And Methods

The orthodontic study models for the purpose of the study was obtained from Department of Orthodontics, Government college of Dentistry, Indore. Ethical approval for this study was obtained from Instituitional ethical committee, Government college of Dentistry, Indore (Approval number 255/IEC/SS).

Study Design: Retrospective study

Study location: Department of Orthodontics, Government college of Dentistry, Indore

Study Duration: November 2024 to August 2025

Inclusion criteria:
1- The age group of participants were between 13 years and 25 years to minimize loss of tooth material due to attrition.
2- No history of orthodontic treatment.

The following selection criteria was used for the orthodontic study models:
1. Good quality orthodontic study models preserved in good condition.
2. All permanent teeth erupted.
3. Absence of mesio-distal or occlusal tooth abrasion.
4. Absence of residual crown or crown–bridge restoration.
5. Absence of tooth anomalies regarding form, structure, and development.

Exclusion criteria:
1. Absence of any permanent teeth required in the study.
2. Grossly restored tooth affecting mesio-distal coronal measurement.
3. Grossly decayed tooth.
4. Inter proximal abrasion present due to any cause.

A total sample size of 90 was obtained with 30 patients for each classes (classI, class II, class III). Measurements of Mesiodistal width of all permanent teeth from first molar on one side to the first molar on the opposite side was made. These measurements for individual teeth was tabulated. The tooth size discrepancy in each of the models and in each group of malocclusion were separately tabulated and also for males and females statistically analysed and significant differences were identified.

The observations of the sample were used to measure the mean overall and anterior ratios for the given population. It was compared with Bolton's original ratio values to assess the reliability of the application of Bolton's original ratios in the population. Based on the results, need for population specific standards was formulated.

Statistical analysis

Descriptive and Inferential statistics were analysed by IBM SPSS version 30.0 (IBM Corp. Released 2024. IBM SPSS Statistics for Macintosh, Version 30.0. Armonk, NY: IBM Corp). Mean and SD were used for summarizing quantitative data. One-sample t test was used for comparison of the data with Bolton standards. A p value of <0.05 was considered as a statistical significant difference.

III. Results

Table I. Comparison of anterior and overall ratios between males and females in Central India population

		Anterior ratio				Overall ratio			
Present study	n	Mean	SD	Range		Mean	SD	Range	
Class I									
Males	30	77.95	4.39	71.50	88.00	91.25	4.59	80.00	99.00
Females	30	76.93	3.77	70.20	83.90	91.50	2.95	86.30	97.00
M+F	60	77.44	4.05	70.20	88.00	91.38	3.80	80.00	99.00
Class II									
Males	30	77.66	1.95	73.50	82.00	90.60	2.33	86.90	94.00
Females	30	80.77	7.21	72.60	93.20	92.74	8.33	80.90	118.00
M+F	60	79.21	5.42	72.60	93.20	91.67	6.11	80.90	118.00
Class III									
Males	30	78.03	2.31	75.00	82.00	92.07	3.18	88.80	102.00
Females	30	76.11	4.49	69.56	82.60	91.36	3.42	86.10	95.80
M+F	60	77.07	3.64	69.56	82.60	91.71	3.27	86.10	102.00
Bolton standards	55	77.2	1.6	74.5-50.4		91.3	1.9	87.5-94.8	

Table II : Mean value for overall and anterior ratio in Central India population

	Minimum	Maximum	Mean	Std. Deviation
Overall	80.00	118.00	91.5864	4.51098
Anterior	69.56	93.20	77.9073	4.48738

The mean anterior and overall ratios for males and females in each occlusion group are shown in Table I. No statistically significant sex difference were found between the anterior and overall ratios in the three malocclusion groups. Subsequently, the mean anterior and overall ratios were combined for males and females, no statistically significant differences were found between different groups.

IV. Discussion

Different studies investigated Bolton tooth size discrepancies across different populations and confirmed that significant inter-population variations exist in both the anterior and overall tooth size ratios. These findings align with an expanding body of literature suggesting that Bolton's original norms, derived from a Caucasian population (Bolton, 1958), may not be universally applicable to diverse ethnic groups.

In our analysis, the mean anterior Bolton ratio in the Central India group was 77.9 +/- 4..48%, while the overall ratio was 91.5 +/- 4.51 (Table II), which is not statistically significant from Bolton"s ratio.

When compared to other population-based studies:

Asian populations: Lavelle (1972) and Endo et al. (2007) reported higher anterior ratios among Japanese and Chinese populations, often exceeding 78%, suggesting larger mandibular anterior teeth relative to maxillary counterparts. (5,6)

African populations: Studies such as those by Smith et al. (2000) and Araujo & Souki (2003) showed even greater discrepancies, with anterior ratios reaching up to 79%, particularly among West African groups, likely reflecting broader tooth morphology and robust dental traits. (7,8)

Middle Eastern populations: Al-Tamimi and Hashim (2005) found anterior ratios averaging 77.7% in Saudi patients, very close to Bolton's values, but noted more individual variability, especially in females. (9)

South American populations: Paredes et al. (2006) identified both anterior and overall ratios significantly higher than Bolton's norms in a Peruvian sample, highlighting a common need for interproximal reduction or maxillary tooth augmentation during orthodontic planning. (10)

Studies by Crosby and Alexander (1989), who emphasized that reliance solely on mean values can mask clinically significant discrepancies at the individual level, suggesting that even within a single ethnic or regional group, individual assessments are essential. (11)

Table III: When compared to Indian population-based studies:

Author(s)	Year	Population Studied	Bolton Measures (Mean ± SD)	Significance vs. Bolton Norms
Sharma et al. (12)	2011	North Indian orthodontic patients (n = 150)	Anterior: 78.5%; Overall: 91.84%	24% exceeded ±2 SD for anterior ratio → **Routine Bolton analysis recommended**
Trehan & Agarwal (13)	2012	Jaipur orthodontic patients (50 M / 50 F)	Class I: 77.78 ± 4.31%; Class II: 78.3 ± 4.52%	**No significant difference** in anterior ratio ($p > 0.17$)
Hasija et al. (14)	2014	Hariyana (n=100)	Anterior: 77.8 ± 1.65%; Overall: 90.5 ± 3.13%	**No significant difference**

Saritha et al. (15)	2017	South telangana	Anterior: 79.17 ± 2.91%; Overall: 92.43 ± 1.88 %	**Significantly higher** than Bolton norms in both ratios
Kumar TVP & Chitra (16)	2018	Telangana, Class I (n = 300; age 14–25 yrs)	Anterior: 80.88 ± 3.03%; Overall: 93.99 ± 3.11%	**Significantly higher** than Bolton norms in both ratios
Bhargava et al.(17)	2021	Jaipur (180)	Not mentioned	**No significant difference in overall ratio**
Sonawane et al.(18)	2025	Navi Mumbai	Anterior: 79.67 ± 3.33%; Overall: 91.48 ± 2.18%	**No significant difference in anterior ratio**

Orthodontic treatment plans may often rely on stable anterior tooth size relationships, regardless of the kind of malocclusion, as seen by the lack of substantial changes in the anterior and total ratio among malocclusion groups.

Despite its contributions, the study had some limitations that should be acknowledged. The sample size were not be large enough to reflect the full genetic diversity within a population. Future studies should include larger, stratified samples and employ advanced imaging techniques such as 3D scans for improved accuracy.

V. Conclusion

The study concluded that there was **no statistically significant difference** in the anterior and overall Bolton ratios across different malocclusion groups in the Central India population. The results suggest that **Bolton's original ratios can be applied reliably** to this population for orthodontic diagnosis and planning. Furthermore, **no significant gender based differences** were observed, indicating a relatively consistent tooth size relationship irrespective of sex or malocclusion class.

These findings support the use of Bolton analysis as a helpful tool in clinical orthodontics in Central India, although individual assessment remains essential. The study also highlights the need for **region-specific data** and encourages future research using larger samples and advanced imaging technologies like 3D scans to improve precision.

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