



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 4(F), pp. 26107-26110, April, 2018

**International Journal of
Recent Scientific
Research**

DOI: 10.24327/IJRSR

Research Article

BOLTON'S NORMS FOR PATNA POPULATION – A CROSS-SECTIONAL STUDY

Kumari Pushpa^{1*} and Soni Kumari²

¹Department of Orthodontics, Dr B R Ambedker College of Dental Sciences, Hariom Nagar, Patna

²Department of Orthodontics, Hazaribagh College of Dental Sciences & Hospital, Hazaribagh, Jharkhand

DOI: <http://dx.doi.org/10.24327/ijrsr.2018.0904.1992>

ARTICLE INFO

Article History:

Received 12th January, 2018

Received in revised form 8th

February, 2018

Accepted 8th March, 2018

Published online 28th April, 2018

Key Words:

Bolton's analysis, anterior ratio, overall ratio

ABSTRACT

Introduction: Prerequisite of orthodontic treatment depends on the diagnosis. There are many diagnostic aids. One of them important is correct assessment of inter-arch and intra-arch tooth relationship. Inter-arch tooth ratio (Bolton's) is one which is important to build normal overjet and normal occlusion. For this analysis most researchers used GV BLACK'S table for sake of mesiodistal dimensions of teeth. The present study aimed at establishing individual tooth size for Patna population and reliability of Bolton's ratio to this particular population and to determine sexual dimorphism.

Methods-Measurements were taken from 51 male & 52 female with Class I molar and canine relationship with ideal overjet and overbite having not treated by orthodontist. Vernier Caliper used to measure the greatest mesiodistal diameter of the teeth. From the obtained data descriptive statistical analysis was done.

Result- Increased anterior (77.79±3.08) and overall ratio (99.3±2.1) were found in relation to Bolton's ideal ratio.

Conclusion-But differences of ratios was not statistically significant. Bolton's standard can be applied to Patna population irrespective of ethnic or sex background.

Copyright © Kumari Pushpa and Soni Kumari, 2018, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Different methods and aids have been taken into consideration for proper diagnosis and treatment planning in orthodontics in which model analysis is one of the primary or essential diagnostic aids. Study model provide 3-dimensional view of dento-alveolar structure and their occlusal relationship. This model can be used for measurement of tooth size and arch length discrepancies as well as other measurement that have been used for research purposes.¹

A tooth size discrepancy refers to the disproportion maxillary to mandible teeth. Different tooth size associated with different ethnic groups and even in gender. Hence it is expected that difference in tooth widths can affect tooth-width ratios.² For proper alignment and to achieve proper occlusal relationship the tooth size must be in harmony with arch size (The sum of the width of mandible teeth must be smaller than the sum of the width of the maxillary teeth)

Undetected discrepancies may be able to lead difficult to achieve ideal or normal occlusion at the end of treatment. Finding at finishing stage can lead delays in completion of

treatment or worse or a compromised result as option.³ Although natural teeth match very well in most dentition approximately 5% of population has same degree of discrepancies among the size of individual teeth.⁴ (Proffit 2000) For proper occlusion there must be proportionality between maxillary teeth and mandibular teeth.

The First investigation of mesio-distal width was studied by G.V Black in 1902.⁵ He measured large number of human teeth and from these measurements he set-up the tables of means, figures which are still used as important reference today.

So, many investigators had followed Blacks investigation with modifications and different methods have been described to evaluate inter-arch tooth size relationship such as Kesling's diagnostic setup, Neff's "anterior coefficient" (1949).⁶ Anterior coefficient value 1.2-1.22 is ideal anterior ratio for upper and lower teeth and attain 20% overbite. So, many analysis have been used but classical most acceptable and most widely used is Bolton's analysis 1958.

*Corresponding author: Kumari Pushpa

Department of Orthodontics, Dr B R Ambedker College of Dental Sciences, Hariom Nagar, Patna

According to Bolton, a certain maxillary and mandibular tooth size relationship is important for proper occlusal interdigitations overjet and overbite. He established a mathematical ratio which according to him must follow class I occlusal pattern. He developed a method of analyzing mesio-distal tooth size ratio between maxillary and mandibular teeth by evaluation of 55 cases with excellent occlusion. The greatest mesiodistal diameter of all the teeth on each case was measured except the second and third molar. Two ratios were developed. Anterior ratio (77.2±1.65%) which were obtained by measuring the mesiodistal width of 6 anterior teeth and overall ratio (91.3±1.91%) which were obtained by measuring the mesiodistal width from 1st molar to 1st molar. The formula derived by Bolton was as follows

$$\text{Overall ratio (\%)} = \frac{\text{Sum of mesiodistal width of mandibular 12 teeth (Rt 1st molar to 1st Molar)}}{\text{Sum of mesiodistal width of maxillary 12 teeth (Rt 1st molar to 1st Molar)}} \times 100$$

$$\text{Anterior ratio (\%)} = \frac{\text{Sum of mesiodistal width of mandibular 6 teeth (Rt canine to Lt canine)}}{\text{Sum of mesiodistal width of maxillary 6 teeth (Rt canine to Lt canine)}} \times 100$$

The data from this sample was then used to indicate the distance from ideal of any measured ratio and thus the size of the discrepancy. He concluded that it would be difficult for proper occlusal interdigitation or coordination of arches in the finishing stage of orthodontic treatment without proper mesio-distal tooth size ratio between maxillary and mandibular teeth. Studies on various ethnic and racial groups has been done to check the application of Bolton's ratio i.e. Crosby and Alexander reported a large no of patient have tooth size discrepancy. Smith *et al* reported Bolton's ratio is only applicable to White female not White males and other race. Lavelle compared Negroid, Caucasian and Mongoloid and found greater overall and anterior ratio in Negroid males than females overall ratio was greater in all three races. There is a lacunae of literature among Indian population. The aim of our study is to determine individual tooth size and reliability of Bolton's ratio to this particular population and to determine sexual dimorphism.

MATERIALS AND METHODS

This cross-sectional study was conducted in Departments of Orthodontics at Dr. Br Ambedkar College of dental science and hospital. Ethical approval was taken from Institutional Ethical Committee and the study was approved from the Institutional Scientific Advisory Committee. The sample collected from Aadersh Vikash High school and from Dr. Br Ambedkar College of Dental Science and Hospital. The sample consists of 51 male and 52 females subjects with age ranging from 14 -26 years.

Criteria for sample selection

1. All subject belonged from Patna Population.
2. All subjects had angles class I molar relationship with proper intercuspation.
3. All subjects had full complement of teeth (permanent central incisor –first permanent molar compliment in each quadrant).
4. No retained primary tooth.
5. Normal morphology.

6. There was absence of interproximal, caries, restorations or other condition that would result in the reduction of mesiodistal tooth width.
7. All subject had no previous history of orthodontist treatment.
8. Good quality of study cast of this subject were fabricated and analyzed.
9. Subjects are younger age groups were chosen to minimize the changes in the mesiodistal tooth dimension because of such factor such as restoration, attrition or caries.

Appropriate upper and lower impression trays are selected followed by taking impressions. Dental impression was taken with chromatic alginate impression material.

A vernier scale is a visual aid that allows the user to measure more precisely than could be done unaided when reading a uniformly divided straight or circular measurement scale. It is scale that indicates where the measurement lies in between two of the graduations on the main scale. Its accuracy is 0.01 mm.

Cast Measuring Technique

The measurement was done directly on the cast. Teeth were measured directly at mesiodistal dimension using digital vernier caliper (modified tip) accuracy 0.01 mm (fig) sharp tips of the digital caliper facilitates accuracy of measurement. Mesiodistal dimensions of a tooth was measured from its distal contact point to its mesial contact point at its greatest interproximal distance parallel to the line of occlusion and measurements were always cross checked for technical errors.

Only 4-6 pairs of models were measured each day to prevent visual fatigue. Goose (1963) suggested that the mesiodistal diameter axis should run between the contact points of the tooth crown with its neighbors, in normal occlusion. In case of malocclusion, the positions on the crown at which the contact points would have been in normal occlusion are used. In case of a rotated tooth we have to take the mesiodistal measurement diagonally. In case of lingually inclined tooth we have to take mesiodistal measurement lingually.

The sum of mesiodistal width of twelve maxillary teeth i.e., from the right first permanent molar to the first permanent molar were measured and compared with the sum of mesiodistal width of the mandibular twelve teeth, i.e. from the right permanent molar to the left first permanent molar. The ratio between the two was the percentage relationship of mesiodistal tooth dimension of mandibular arch to mesiodistal tooth dimension of maxillary arch which was called the "Overall ratio", with a mean of 91.3%.

Formula used was-

$$\text{Overall ratio (\%)} = \frac{\text{Sum of mesiodistal width of mandibular 12 teeth (Rt 1st molar to 1st Molar)}}{\text{Sum of mesiodistal width of maxillary 12 teeth (Rt 1st molar to 1st Molar)}} \times 100$$

If the overall ratio exceeded 91.3%, it indicates mandibular tooth material excess. If ratio was, less than 91.3% it indicates maxillary tooth excess.

The same method was used in setting up a ratio between the maxillary and mandibular anterior teeth. Mesiodistal crown dimensions of maxillary and mandibular.

If the overall ratio exceeded 91.3%, it indicates maxillary tooth material excess. The amount of maxillary excess is determined using the formula:

$$\frac{\text{Maxillary 12} - \text{Mandibular 12}}{91.3} \times 100$$

If the overall ratio is more than 91.3% indicates mandibular tooth material excess. The amount of mandibular excess is determined using the formula:

$$\frac{\text{Mandibular 12} - \text{Maxillary 12}}{91.3} \times 100$$

Determination of Anterior ratio

The sum of mesio-distal width of the mandibular anterior should be 77.2% of the mesiodistal width of the maxillary anterior. The anterior ratio is determined using the following formula:

$$\text{Anterior ratio (\%)} = \frac{\text{Sum of mesiodistal width of mandibular 6 teeth (Rt canine to Lt canine)}}{\text{Sum of mesiodistal width of maxillary 6 teeth Rt canine to Lt canine}} \times 100$$

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

If the anterior ratio is less than 77.2%, it indicates maxillary tooth material excess. The amount of maxillary excess is determined using the formula:

$$\frac{\text{Maxillary 6} - \text{Mandibular 6}}{77.2} \times 100$$

If the anterior ratio is more than 77.2% indicates mandibular tooth material excess. The amount of mandibular excess is determined using the formula:

$$\frac{\text{Mandibular 6} - \text{Maxillary 6}}{77.2} \times 100$$

Statistical analysis: Data were processed and analyzed using SPSS (Statistical Package for Social Science).

Standard descriptive statistics (Mean, Standard Error of mean and standard deviation) were calculated for the each sample. Student's t-test was used to compare anterior and overall ratio in male and female Dahlberg's formula for calculating methods error. The significance level was kept at $p < .05$ (95% CI).

RESULTS

Present study was conducted on 103 subjects and results were analyzed. Values obtained were subjected to statistical analysis. No significant difference was found between the mesiodistal crown dimensions or right and left side so their values were combined and their mean values obtained which was used for further calculation and there is differences between male and female teeth dimensions i.e. male teeth dimensions are larger than female teeth dimensions.

The comparison was drawn between 1st and 2nd determination using student's t-test. No significant difference were found between two sets of measurements ($p > 0.05$)

Mean overall ratio for the males was found to be 92.7 ± 1.62 whereas for the females was 92.04 ± 2.4 . It also shows that anterior ratio for male was 78.1 ± 3.4 whereas for female was 78.6 ± 3 . (Table 1)

The mean of the overall ratio was 92.3 ± 2.15 and for the anterior ratio 78.2 ± 3 . The statistical comparison of the overall and anterior ratio between the males and female was done but no statistical significant difference was observed

The mean of the overall ratio and anterior ratios of the present study were relatively similar to that reported by Bolton mean i.e. overall ratio 87.47-95.4 and anterior ratio 73.8-80.5 with higher SD in present study.

When the comparison of the tooth dimension of Patna population with Caucasian norms was done it was found that the tooth dimension for maxillary central incisor was equal in both Caucasian and Patna population. Tooth dimensions for maxillary incisor, canine, mandibular central incisor and lateral incisor were larger than the Caucasian norms with statically significant difference ($p \leq 0.01$).

Table 1 Mean Overall Ration and Anterior Ratio among Female and Male study participants

OVERALL RATIO						ANTERIOR RATIO					
Female			Male			Female			Male		
Mean	SD	Standard error of mean	Mean	SD	Standard error of mean	Mean	SD	Standard error of mean	Mean	SD	Standard error of mean
92.04	2.4	0.24	92.7	1.62	.16	78.6	3	.30	78.1	3.4	.33

Table 2 Comparison of the tooth dimension of Patna Population with the Caucasians Standards

	Caucasian mean(mm)	Patna mean(mm)	t-value	p-value	Significance
Central incisor	8.5	8.06	1.6	.98	NS
Lateral incisor	6.5	6.5	.249	.010	$p \leq 0.01$
canine	7.5	7.4	-4.3	00	$p \leq 0.01$
1 st premolar	7	6.5	.53	00	$p \leq 0.01$
2 nd premolar	7	6.3	.46	00	$p \leq 0.01$
1 st molar	10	9.5	.56	00	$p \leq 0.01$
Central incisor	5	5.2	.64	00	$p \leq 0.01$
Lateral incisor	5.5	5.5	.50	00	$p \leq 0.01$
Canine	7	6.2	4.1	00	$p \leq 0.01$
1 st premolar	7	6.7	.38	00	$p \leq 0.01$
2 nd premolar	7	6.6	.33	00	$p \leq 0.01$
1 st molar	11	10.2	.11	00	$p \leq 0.01$

** Statistically Significant, NS=not significant

Tooth dimension for maxillary 1st premolar, 2nd premolar, 1st molar mandibular canine 1st premolar, 2nd premolar and 1st molar were smaller than the Caucasian norms. With statistically significant ($p \leq 0.01$). For maxillary central incisor values obtained was statistically non significant. (Table 2)

The result obtained in the present study indicates that sample collected was belonging to the Caucasian race. However the reality indicates that Patna Population subjects are of different race but statistical analysis shows no significant difference.

DISCUSSION

In the present study it was found that tooth dimension of Patna Population were larger than observed mean values for Caucasians. The values obtained for overall as well as anterior ratio were larger for Patna Population, not in accordance with standard set by Bolton

Statistically significant difference was obtained between the finding of the male and female. Subjects of Patna Population and Caucasian but this difference was not significant when comparison was done between male and female subjects of Patna Population. The mesiodistal width of teeth was marginally greater in males than in females although the difference was not statistically significant. Females showed higher variability than males in tooth sizes. The mean tooth width ratio both anterior and overall ratio were similar in male and female with no significant difference between them. Hence both anterior and overall ratios were derived for the whole sample and these ratios can be applied irrespective of the gender. When compared with standard Bolton's ratio it was found that the ratios derived in this study were comparable to those derived in the Bolton's study. Hence Bolton's standards can be applied to Patna population in evaluation of any intermaxillary discrepancy before final tooth alignment will be beneficial in diagnosis and treatment planning to the clinician and also meeting expectation of the patient.

Prasad K.K and Valiathan A (1994) compared norms for Indian and Chinese using Bolton's index 50 cases each of normal Angle's class I occlusion were selected and measurement were carried out on casts the overall ratio for Indian samples was 93.46 and for Chinese it was 90.84. No significant difference was apparent in the two groups.⁷

Smith SS Busehang PH Watanabe E (2000) interact tooth size relationship of three population White, Blacks and Hispanics. They collected pre-orthodontic casts of 180 patients and digitized 48 mesiodistal contact points on each model. They observed that the segments of males were significantly larger than the females; the overall and posterior ratios were also significantly larger in males than in females. They concluded that interact tooth size relationships are population and gender specific. Bolton ratio applies to White female only. The ratios should not be indiscriminately applied to White male, Blacks or Hispanics.⁸

Bernabe E, Major PW and Flores Mir C (2004) studied tooth width ratio discrepancies in a samples of Peruvian Adolescents. 200 children were selected and analyzed. No significant differences were found in anterior & total tooth size sums according to sex. Then combined male and female anterior and total ratio was calculated. There were clinically

significant tooth size discrepancies in almost one third of the sample.⁹

Al-Tamimi T and HashimHA (2005) studied tooth size ratios in a Saudi sample normal occlusion and compared tooth size ratio between the present study and Bolton's study and between genders. Dental casts and cephalometric radiographs of 65 subjects (37 males & 28 female) were used in this study. The age 18 -25 yrs. They found there were no significant differences between the mean values of the anterior ratio and overall ratio of the present study and mean values of the anterior ratio and overall ratio of present study and mean values reported by Bolton and also between genders.²

Paredes V, Gandia JL and Cibrian R (2006) did a study on Bolton ratio on Spanish population. They used a 100 pair of casts of Spanish subjects. They found out that 21 of the subject had a significant anterior discrepancy and 5 had a total discrepancy difference between Spanish values and Bolton's were significant.³

CONCLUSION

Orthodontic diagnosis has come a long way and now includes patient driven diagnostic aids and treatment planning along with its problem oriented approach. To achieve proper alignment and good occlusal contact of dentition the tooth size must be in harmony with arch size as tooth size and arch length forms are important point in evaluating good occlusion the present study was done to find factors associated with it.

References

1. McLaughlin RP, Bennett JC, Trevesi H: Systemised orthodontic treatment mechanics, Spain, 2004, Mosby.
2. Al-Tamimi T, Hashim HA. Bolton tooth-size ratio revisited. *World J Orthod* 2005; 6: 289-295.
3. Paredes V, Gandia JL, Cibrian R. Do Bolton's ratios apply to a Spanish population? *Am J Orthod Dentofacial Orthop* 2006; 129: 428-430.
4. Wedrychowska-Szulc B, Janiszewska-Olszowska J, Stepien P. Overall and anterior Bolton ratio in Class I, II, and III orthodontic patients. *European Journal of Orthodontics* 2010; 32: 313-318.
5. Dhar HCS, Bora M. The applicability of the Bolton's tooth size ratio to Assamese population. *Journal of Indian Orthodontic Society* 2010; 44: e38 URL: <http://www.jiosweb.org>.
6. Shastri D, Singh A, Tandon P. Bolton ratio in a North Indian population with different malocclusions. *J Orthodont Sci* 2015; 4: 83-5.
7. Prasad KK, Valiathan A. Model analysis – Comparison of norms for Indian and Chinese using Bolton's index. *Journal of Indian orthodontic society* 1994; 25: 77-80.
8. Smith SS, Buschang PH, Watanabe E. Interarch tooth size relationships of 3 Populations. "Does Bolton's analysis apply?" *Am J Orthod Dentofacial Orthop* 2000; 117: 169-174.
9. Bernabe E, Major P W, Flores-Mir C. Tooth-width ratio discrepancies in a sample of Peruvian adolescents. *Am J Orthod Dentofacial Orthop* 2004; 125: 361-365.