Frequency of Anterior tooth size discrepancies by Bolton DiscrepancyAnalysis Among class I, II and III malocclusions

Mohammad Hossein Toode Zaeim [a], Soghra Yassaei [b], Hoori Mir Mohamad Sadeghi [a] Valiollah Rafiei [c]

Abstract

Aim: A high percentage of the problems in finishing phase are due to tooth size imbalances that can be diagnosed in initial stages of treatment. The purpose of present study is to evaluate the frequency of anterior tooth size discrepancies by Bolton Analysis among class I, II and III malocclusions.

Materials and methods: The mesio-distal widths of six anterior teeth in 90 paired casts of patients (class I, II, and III), who were selected non-randomly, were measured. Chi-square test was performed to compare the frequency of anterior tooth size discrepancies between the three malocclusion groups. Analysis of variance was used to compare the mean anterior Bolton ratios as a function of skeletal anterior-posterior malocclusions and both genders. Mean mesio-distal width of six anterior teeth were compared by Analysis of variance in 3 skeletal malocclusion groups. Statistical differences were determined at the 95% confidence level.

Results: Discrepancy was greater in class I and III than in class II. No sex difference was shown to exist in Bolton anterior ratio. mesio-distal width of upper laterals had greater variation coefficient.

Conclusion: Difference of mean anterior tooth size discrepancies among three skeletal class I, II and III malocclusions were not statistically significant.

Key words: Tooth size discrepancy, Bolton analysis, Anterior Bolton ratio, Tooth size analysis, Mesio-distal width.

(Received May 2010; Revised and accepted Sept 2010)

The orthodontic "finishing" phase needs many details to be considered to achieve an excellent result. In some patients, the finishing phase is very difficult and requires the production of complicated biomechanical forces to reach a satisfactory orthodontic solution

[a]Assistant Professor, Department of orthodontic, Faculty of Dentistry, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

[b] Associate Professor, Department of orthodontic, Faculty of Dentistry, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

[c] Dentist

Corresponding author:
Dr Hoori Mirmohammadsadeghi
E-mail: hoorimms@yahoo.com

A high percentage of these finishing-phase difficulties arise because of tooth size imbalances that could have been detected and considered early during initial diagnosis and treatment planning. An excellent orthodontic treatment result with optimal occlusion, overjet, overbite, and ideal inter-cuspation is often jeopardized by problematic tooth anatomy or tooth size discrepancies. [1]

There have been several studies suggesting methods for measuring tooth size discrepancy, but the best-known study of tooth size disharmony in relation to treatment of malocclusion was by Bolton in 1958.2 Bolton developed two ratios for estimating tooth size discrepancy by

measuring the summed mesio-distal widths of the mandibular to the maxillary anterior teeth (anterior ratio) and the total width of all lower to upper teeth from first molar to first molar (overall or total-arch ratio).3 The subjects in Bolton's original sample were chosen to have excellent occlusions, and all the cases had Bolton ratios, which by his definition tooth size discrepancy did not prevent a good occlusion. The use of Bolton's standard deviations in a random sample of orthodontic patients may overestimate the incidence of a clinically significant discrepancy in clinical practice.[2] Originally, Bolton suggested that a ratio greater than 1 SD from his reported mean values indicated a need for diagnostic consideration. Recently, a clinically significant tooth-width ratio discrepancy has generally been defined as 2 SD from Bolton's published mean ratio. [4]

Most studies have been carried out on a mixture of treated and untreated people with good or excellent occlusion. However, especially for the comparison of inter-maxillary Bolton Tooth Size Discrepancies among different malocclusions, few studies are available and the results have been controversial.[5] Although it is widely accepted that both genetic and environmental variables affect tooth development, at the present time, it is virtually impossible to identify and describe the role each of these variables plays in the determination of tooth size.[5]

Arya et al. showed differences in tooth size between sexes, as was reported by a number of authors. They tried to show differences in tooth size between Class I and Class II malocclusions but failed. In their study, the mean size of each tooth for the different groups (i.e. Class I and Class II, girls and boys) was compared. Differences for individuals between different arches were not analyzed.[6]

Lavelle showed that there was sexual dimorphism in the ratio of upper to lower arch tooth size and in tooth dimensions. In addition, there was racial dimorphism between Blacks, Mongoloids, and Caucasians.[7] The Sperry et al. study analyzed the Bolton ratios for all of Angle's groups of malocclusion. The skeletal patterns were not mentioned, although some of the Class III cases were surgically treated. Male and female subjects were not differentiated. The overall ratios showed a mandibular tooth size excess for the Class III patients.[8]

The objectives of this study were to determine (1) whether sexual dimorphism exists in tooth size ratios, (2) whether there is a difference for inter-maxillary tooth size discrepancies represented by anterior ratio of Bolton for Class I, Class II, and Class III cases and (3) compare mesio-distal dimension of anterior teeth in Class I, Class II, and Class III cases.

Material and method

Pretreatment lateral cephalograms and dental casts of 90 patients (27 male and 63 female, age between 12to 18) were chosen from the records of an orthodontic office in Yazd. Steiner's ANB and GoGn-SN angles and wits appraisal were used for distinguishing skeletally normal patients from individuals with skeletally Class II, Class III, and vertical anomalies. Each group (Class I, Class II, and Class III) consist of 30 patients. In group selection if GoGn-SN angle was more than 37° or less than 27°, wits appraisal and ANB angle were considered too.

The following inclusion selection criteria were used:

Good quality models of normal occlusion and pretreatment models of patients

All permanent teeth had erupted and were present from right first molar through left first molar

No severe mesio-distal and occlusal tooth abrasion

No residual crown or crown-bridge restoration

No tooth deformity (e.g., conic-form lateral incisor teeth);

No record of restoration or stripping of incisor and canine.

Each canine and incisors teeth was measured at the largest mesio-distal dimension using a digital caliper (accurate to 0.01 mm). The same researcher performed all measurements, and the reproducibility of the

method was tested. Measurements were repeated two times with a one-week interval. There were no significant differences between the two sets of measurements.
To statistically compare the prevalence of anterior tooth size discrepancies greater than 1 SD from Bolton ratio among the three malocclusion groups and two genders, a Chi-square test was performed. Analysis of variance (ANOVA) was used to compare the mean Bolton anterior tooth size ratios as a function of Angle classification as well as gender in two age groups (12-14 and 15-18 years old). Mean individual tooth sizes were then compared using ANOVA to determine whether tooth size was related to malocclusion classification. Statistical differences were determined at the 95% confidence level ($P < 0.05$).

presented in Tables 1 and 2. Due to the lack of a significant sexual dimorphism for tooth size ratios, the sexes were combined for each group (Table 1). One-way ANOVA test was then performed between these groups, and no statistical differences were found (Table 2). It was obvious that, for the tooth size ratios, there were no significant differences between the Class I, Class II, and Class III groups. Frequency of Anterior tooth size discrepancies in skeletal class I and class III malocclusions was greater than class II malocclusion, but was not statistically significant.

Table 1- Comparison of Anterior Bolton Ratio as a function of sex, none of the above differences were significant at P >0.05Using One-Way ANOVA Test. (P= 0.405)

Sex	n	Minimum	Maximum	Mean	SD
Male	27	74.03	85.19	78.60	2.641
Female	63	73.16	85.57	79.12	2.744

Table 2- Comparison of Anterior Tooth Size Discrepancies in different malocclusion groups, none of the differences were significant at P>0.05 (P=0.727)

Group	n	Minimum	Maximum	Mean	SD	C.V%
class I	30	73.16	85.57	79.219	2.79	3.523
class II	30	74.54	83.53	78.663	2.35	2.963
class III	30	74.03	85.19	79.011	2.02	3.827

(77.2 ± 1.65%) and "discrepancy" for ratios greater than ±1SD. 11 In the present study, comparing all of the three groups with Bolton mean showed significant difference.
Table 3 shows prevalence of tooth size discrepancy within ±1SD and ±2SD Bolton ratio between three malocclusion groups. Results of Chi-Square test demonstrating no significant difference in the prevalence of ±1SD (p=0.73) and ±2SD (p=0.68) Bolton tooth size discrepancy between three malocclusion groups.

In Table 4 we compare the mean anterior Bolton ratio in different age groups and as P value was 0.558 the difference was not significant.
Table5 shows there is no significant difference in mean individual tooth sizes between three malocclusion groups using ANOVA. But Mesio-distal width of upper laterals had greater variation coefficient.

Table 3- Prevalence of tooth size discrepancy within ±1SD and ±2SD

	±1SD		±2SD	
Group	**n**	**%**	**n**	**%**
class I	12	40	20	66.7
class II	15	50	23	76.7
class III	13	44	22	73.3

Table 4- Mean Anterior Bolton Ratio in different age group

Age	n	Minimum	Maximum	Mean	SD
12-14	50	74.54	85.19	79.11	2.506
15-18	40	73.16	85.57	78.78	2.966

Table 5 - Variation Coefficient in different teeth

C.V%	Upper		Lower	
	Right	**Left**	**Right**	**Left**
Central	6.73	6.63	6.32	6.57
Lateral	10.69	10.41	6.07	6.71
canine	6.09	6.03	7.01	6.93

The importance of tooth size discrepancies in orthodontic diagnosis has been reported in the literature and accepted by the orthodontic community because the relationship between the upper and lower anterior teeth is related to orthodontic finishing excellence.[2]

The Bolton sample was obtained from 55 models with excellent occlusion; 44 were treated. Many investigators have considered a threshold of 2 standard deviations from Bolton's mean ratio in his original study to be a clinically significant Bolton discrepancy.3,9 In a normally distributed population, 5% of people would fall more than 2 standard deviations from the mean. The present study found 27% of the sample had anterior tooth-width ratios greater than 2 of Bolton's standard deviations from Bolton's mean. (Table 3) Ethnic characteristics and greater morphologic variability in upper incisor width are believed to affect the anterior ratio, which was found to be slightly higher than the Bolton norms (77.2 ± 1.65%) in our study which is in accordance with Santoro. [10]

According to statistical data, the mean value of anterior ratio was not statistically significant between the two sexes and among the three malocclusion groups. However; our three malocclusion groups showed a high incidence of Bolton tooth size discrepancies, which might have affected the mean values of the groups. These findings are similar to Xia and Wu ,Qion and Jiuxiang ،Crossby and Alexander , and Basaran. [11, 12, 13, 5] According to Akyalcin, a skeletally similar sample of 152 subjects, no statistically significant differences were determined for the Bolton anterior and overall tooth size prevalence and means among the Angle Class I, II, and III groups. Sex also was not discriminating. [14]

Souki et al. found that individuals with Angle Class I and Class III show significantly greater prevalence of tooth size discrepancies than do individuals with Class II. Also mean anterior tooth size discrepancy for Angle class III subjects was significantly greater than for Class I and Class II subjects. 1 Similar to Othman 2, Basaran 5, and Akyalcin 14 we found no sexual dimorphism for tooth size ratio in our sample.

Conclusions

On the basis of the conditions of this study, the following summarizes the important issues of the study:

Frequency of Anterior tooth size discrepancies in skeletal class I and class III malocclusions was greater than class II malocclusion, but was not statistically significant.

The mean of Anterior Bolton ratios in skeletal Class I and class III malocclusions was greater than class II, but their difference was not statistically significant.

Mean Anterior Bolton ratio had not significant difference between two genders.

Mesio-distal width of upper laterals had greater variation coefficient.

References

1-Araujo E, Souki M. Bolton anterior tooth size discrepancies among different malocclusion groups. Angle Orthod. 2003; 73(3):307–13.

2-Othman S, Harradine N. Tooth Size Discrepancies in an Orthodontic Population. Angle Orthod. 2007; 77(4):668–74.

3-Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. Angle Orthod. 1958; 28:113–30.

4-Bernabe˘ E, Major PW, Flores-Mir C. Tooth-width ratio discrepancies in a sample of Peruvian adolescents. Am J Orthod Dentofacial Orthop. 2004; 125(3):361–5.

5-Basaran G, Selek M, Hamamci O, Akkus Z. Intermaxillary Bolton tooth size discrepancies among different malocclusion groups. Angle Orthod. 2006; 76(1):26-30.

6-Arya BS, Savara BS, Thomas D, Clarkson Q. Relation of sex and occlusion to mesiodistal tooth size. Am J Orthod. 1974; 66(5):479–86.

7-Lavelle CLB. Maxillary and mandibular tooth size in different racial groups and in different occlusion categories. Am J Orthod. 1972; 6:29–37.

8-Perry TP, Worms FW, Isaacson RJ, Speidel TM. Tooth size discrepancy in mandibular prognathism. Am J Orthod Dentofacial Orthop. 1977; 72(2):183–90.
9-Bolton WA. The clinical application of tooth-size analysis. Am J Orthod. 1962; 48:504-29.
10-Santoro M, Ayoub ME, Pardi VA, Cangialosi TJ. Mesio-distal crown dimensions and tooth size discrepancy of the permanent dentition of Dominican Americans. Angle Orthod. 2000; 70(4):303–7.
11-Xia Z, Wu XY. The application of dento-cclusal measurement in malocclusion. Stomatology.1983; 3:126–7.
12-Qiong N, Jiuxiang L. Comparison of -intermaxillary tooth size discrepancies among different malocclusion groups. Am J Orthod Dentofacial Orthop. 1999; 116:539–44.
13-Crosby DR, Alexander CG. The occurrence of tooth size discrepancies among different malocclusion groups. Am J Orthod Dentofacial Orthop. 1989; 95:457–61.
14-Akyalcın S, Dogan S, Dincer B, Erdinc AM, Oncag G. Bolton tooth Size discrepancies in skeletal Class I individuals presenting with different dental Angle classifications .Angle Orthod.2006; 76(4):637-43.