

Comparison of Tooth Size Discrepancy in CI II Malocclusion Patients with Normal Occlusions

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KEY WORDS

CI II Malocclusion;
Bolton Analysis;
Normal Occlusion;
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ABSTRACT

Statement of Problem: There must be a proper mesiodistal tooth size ratio (Bolton analysis) between maxillary and mandibular teeth for good occlusal interdigitation. Therefore the Bolton analysis should be considered during diagnosis, treatment planning and predication of ultimate results.

Purpose: The purpose of this study was to appraise tooth size ratios in CI II malocclusion group and compare them with normal individuals.

Materials and Method: This study was carried out on 60 pre-treatment orthodontic casts of class II malocclusion patients and 60 diagnostic casts of normal occlusion individuals which were selected through cluster sampling in accordance with the selective criteria. Each group consisted of 30 men and 30 women. The greatest mesiodistal diameters of all the teeth on each cast were measured by a digital calliper with 0.01mm accuracy except the second and third molars. Then tooth size ratios were analyzed as Bolton described. The statistical analysis were performed by chi-square and t-tests using SPSS.

Results: The prevalence of anterior and overall tooth size discrepancy was relatively high (28.3%, 20%), showing no significant difference between men and women ($p > 0.05$). The mean of anterior and overall tooth-size ratios in CI II malocclusion group were 79.18 and 92.39 respectively, which were statistically different from the Bolton study (ideal occlusion) ratios ($p < 0.05$). There were no statistical difference between the means of anterior and overall ratios of men and women, neither in CI II malocclusion group nor in the normal individual group ($p > 0.05$).

Conclusion: Considering the high frequency of tooth size discrepancy among CLII patients and the significant difference in Bolton ratios between this malocclusion and ideal occlusions; it seems that tooth size discrepancy can be considered as a possible etiologic factor and Bolton analysis should be performed as a pre-treatment diagnostic tool for this type of malocclusion.

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Introduction

Accurate diagnosis and proper orthodontic treatment planning requires taking a detailed history, intra and extra-oral examinations and full analysis of diagnostic records, including orthodontic photographs, essential radiographs and well-trimmed diagnostic casts [1-2]. One of the factors that play an important role in primary

diagnosis and proper treatment planning is the assessment of mesiodistal width of maxillary and mandibular teeth. It seems that a correct relation between maxillary and mandibular teeth dimensions is essential to achieve and maintain a normal occlusion and also normal horizontal and vertical overlap (overjet and overbite) at the ultimate stage of orthodontic treatment. Indeed, an ap-

appropriate relation in teeth dimensions is needed to achieve the most possible outcomes in aesthetic and function at the end of orthodontic procedures [1-5]. There are different ideas among orthodontists about the frequency of significant tooth-size discrepancy and whether it has to be measured in the routine clinical evaluations [2]. If tooth size discrepancy is present, compensatory methods such as interproximal enamel stripping, tooth extraction and adhesive or prosthetic restorations should be considered in treatment plan, otherwise, the stability of treatment outcomes would be compromised [5]. Tooth size discrepancy is usually limited to a single tooth, which most commonly are maxillary lateral incisors and mandibular second premolars. Occasionally, it may involve the whole dentition [2]. There is evidence of variation in tooth size between different nations, races and also between male and female individuals [6-8]. The studies indicate that like other characteristics of human being, there is a difference between tooth size of men and women. Men's teeth are generally larger than women's. These differences in gender also appear in maxillary primary and permanent lateral incisors and canines [3, 5]. Furthermore, in a study by Lavelle et al., dark skins had larger anterior and total tooth size in comparison with the white skins [6]. There are several methods for evaluating tooth size relationships, among which the most common and important method is Bolton analysis. The basis of Bolton analysis which was introduced by Bolton in 1958, is measuring the mesiodistal width of maxillary and mandibular teeth [1].

Bolton determined $77.2 \pm 0.22\%$ as ideal anterior tooth ratio and $91.3 \pm 0.26\%$ as an ideal total tooth ratio in his study [1]. Several studies have been performed to evaluate Bolton study ratios and among them, some have reported the anterior and total ratios less or more than the values suggested by Bolton study in different types of malocclusion [7-13]. Others reported values which were nearly close to the Bolton study ratios [12-13]. Smith et al. suggested that Bolton ratios are only reliable in white women [7]. Mirzakouchaki et al. [14], and Salehi et al. [15], claimed that in Iranians and Turkish-Iranians with normal occlusion, anterior and total ratios were not different from Bolton study ratios. Fattahi et al. [3], and Roueinpeykar et al. [16], also reported a significant difference between anterior ratio of

patients with different types of malocclusion and Bolton ratio, but total ratio didn't show a difference. Considering these differences and disparities which were observed between different nations and races and also regarding the fact that most of these studies have been performed in the southern regions of Iran, it seems essential to render similar study in other parts of our country and compare the acquired results with Bolton study ratios. Qazvin has a suitable geographical location to reach this goal and high frequency of class II malocclusion is observed in this city which necessitates a special attention. Therefore, we decided to evaluate tooth size discrepancy in patients with class II malocclusion and compare it with normal occlusion in the city of Qazvin.

Materials and Method

This study was a descriptive and analytical study. The sampling method was a two-phase cluster sampling and the participants were selected randomly from high schools of Qazvin. Among all, 60 students (thirty girls and thirty boys) had normal occlusion, which was defined as having a normal profile, class I molar and canine relationships, spacing less than three millimetres and absence of crowding. Other 60 students had class II malocclusion. The second group comprised of 30 patients with class II div I malocclusion and 30 patients with class II div II malocclusion, each subgroup consisting of 15 boys and 15 girls. Students who had class II molar and canine relationship and increased overjet and overbite were included in class II malocclusion group. Axial inclination of upper incisors determined whether the patient belonged to the div I or to the div II subgroups. All participants were in permanent dentition with all twelve teeth fully erupted on each arch. No apparent tooth size anomaly, caries, attritions, fractures or mesiodistal filling were observed. They all had signed an informed consent to attend the study.

After preparing well-trimmed casts, a digital calliper with 0.01mm precision (Mitutoyo-Digimatic calliper, Japan) was used to operate the measurements. The largest mesiodistal width perpendicular to long axis of each tooth was measured by the investigator. The measurements were then analyzed by Bolton analysis as follows:

$$\text{Anterior tooth ratio} = \frac{\text{Mesiodistal width of 6 anterior mandibular teeth}}{\text{Mesiodistal width of 6 anterior maxillary teeth}} \times 100$$

$$\text{Total tooth ratio} = \frac{\text{Mesiodistal width of 12 mandibular teeth}}{\text{Mesiodistal width of 12 maxillary teeth}} \times 100$$

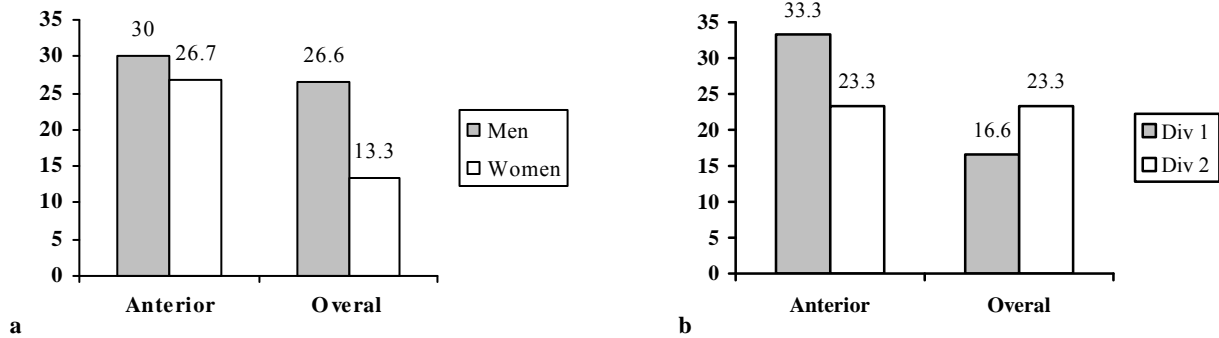


Figure 1a Prevalence of tooth size discrepancies in different sexes of Class II patients **b** Prevalence of tooth size discrepancies in two divisions of Class II patients

40 casts were selected randomly and measured again after 2 weeks to evaluate the reliability of measurements. After measuring anterior and total tooth ratios of both normal occlusion and class II malocclusion groups, the mean of each group was calculated separately for boys and girls. The frequency of tooth size discrepancy among patients with class II malocclusion was determined separately for each gender (male and female) and for each subtypes of malocclusion (div I and div II) and it was defined as measures exceeding two standard deviations from Bolton study mean ($2SD \pm$ Bolton mean). Statistical significance was determined with a 95% assurance. Data were entered to SPSS software 15 and analyzed using t-test and X^2 test.

Result

The average age of participants was 16 ± 2 years. The secondary measurements which were operated after two weeks to determine the reliability of measurements up to 0.01 mm using Pearson correlation test, showed a high correlation of 0.95. The frequency of anterior and total tooth size discrepancy in boys and girls with class II malocclusion is shown in Figure 1. The frequency of anterior and total tooth size discrepancies were 28.3% and 20% respectively. Using X^2 test, no significant difference was found in the frequency of anterior and total tooth size discrepancies in terms of gender ($p= 0.725$

and 0.38 respectively) (Figure 1). Moreover, comparing the frequency of anterior and total tooth size discrepancies, there was not a significant difference between div I and div II subtypes ($p= 0.201$ and 0.785 respectively) (Figure 2).

In class II malocclusion group, the mean anterior tooth ratio was 78.85% for girls and 79.5% for boys and the mean total tooth ratio was 92.21% for girls and 92.59% for boys, which indicated no significant difference in terms of gender ($p= 0.381, 0.573$). In normal occlusion group, the mean anterior ratio was 79.02% for girls and 79.62% for boys and the mean total ratio was 92.43% for girls and 93.51% in boys, which again didn't show a significant difference. Considering different occlusions, these amounts in the Bolton study (ideal occlusion) were compared with class II malocclusion and normal occlusion groups. Although there was no significant difference between class II and normal occlusion groups ($p= 0.250$ and 0.452 respectively), both anterior and total ratios differed significantly in class II patients and ideal occlusion group of the Bolton study (Table 1 and Table 2).

Discussion

The importance of tooth size discrepancy has been broadly noted in the literature. Many orthodontists suggest that mesiodistal tooth size discrepancy is a major

Table 1 Mean and standard deviations in different occlusions

	O.R		A.R		Number
	Standard Deviation	Mean	Standard Deviation	Mean	
CI II	2.595	92.39	0.368	79.017	60
Normal Occlusion	2.302	92.97	2.568	79.32	60
CI II div 1	0.502	62.14	0.626	78.74	30
CI II div 2	0.446	92.65	0.386	79.60	30
Ideal Occlusion (the Bolton study)	1.91	91.3	1.65	77.2	55

Table 2 P value in different occlusions

	O.R		A.R	
	CI II div2	CI II div1	CI II div2	CI II div1
Normal Occlusion	0.112	0.485	0.370	0.466
CI II div 1	-	0.452	-	0.250
Ideal Occlusion (The Bolton study)	0.014	0.005	0.019	0.000

AR=Anterior Ratio, OR = Overall Ratio

diagnostic finding and has to be measured before starting any orthodontic treatment [5]. In comparison with the 5% frequency of tooth size discrepancy in general population, the frequency of anterior and total tooth size discrepancies were relatively high in this study. The mean total tooth ratio of all patients was 92.39%, which was close to the Bolton's recommended ratio. Though, the mean anterior tooth ratio was 79.8% and was higher than Bolton's anterior ratio, which indicates a tendency to larger mesiodistal widths at anterior mandibular segment of our patients. The frequency of anterior tooth size discrepancy was 28.3% in our study, which was close to Crashy, and Alexander study in Texas [17] and Freeman study in Brazil [18], but the frequency of total tooth size discrepancy was higher in our study compared to the mentioned studies. Racial variations and different patient selection criteria (type of malocclusion) which were applied in the studies may have caused this difference. Our results show that the mean Bolton ratios of patients with class II malocclusion were a little lower than the mean Bolton ratios of normal occlusion group, but it was not statistically significant. The mean anterior and total tooth size ratios of patients with class II malocclusion were 79.8% and 92.39% respectively, which had a statistically significant difference with Bolton study ratios. Though, Batoool et al. noticed no significant difference between total tooth size ratios of different skeletal groups [2]. In consistence with our results, Ta TA et al. [19] reported a significant difference between total tooth size ratios of patients with class II malocclusion and Bolton study ratios. Moreover, Endo et al. [8], Fattahi et al. [3], and Roueinpeykar et al. [16], found a significant difference between anterior tooth size ratios of Class II patients and Bolton study ratios. These differences between studies could be explained by different sample sizes of the studies, racial variations and the level of the operator's accuracy. We concluded that the frequency of anterior and total tooth size discrepancies

were not significantly different in terms of gender, that was in concordance with results of Mirzakouchaki et al. [14], Salehi et al. [15], Roueinpeykar et al. [16], Endo et al. [8] and Cigar et al. [5]. In contrary, Uysal et al. [20] found significant difference between men and women when compared the total tooth size ratios of the participants. This could also be due to the national and racial variations and different study groups.

Conclusion

Considering the high frequency of tooth size discrepancy among patients with class II malocclusion and the significant difference between Bolton ratios of these patients and those of ideal occlusion, it seems that tooth size discrepancy can be regarded as a possible etiologic factor for this type of malocclusion. Hence, Bolton analysis is an important diagnostic tool that should be performed as a pre-treatment evaluation for all orthodontic patients. In company with other diagnostic tools, it could possibly contribute to achieve correct final relationships and increase the stability of orthodontic treatments.

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