

Evaluation of the capability to apply Bolton ratios in the Iranian population with normal occlusion

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Abstract

Aim: Determination of overall and anterior Bolton ratios in people having normal occlusion in Iran and checking the effect of sexuality upon Bolton ratios in the aforementioned population and pinpointing the ability to apply normal quantities offered by Bolton in the Iranian population.

Materials and methods: The study is a cross-sectional descriptive one by surveying study casts provided from 56 high school students (28 boys and 28 girls) having normal occlusions. Bolton ratios were considered in boys and girls separately. Statistical computations were conducted according to student t-test.

Results: The total mesiodistal width of 12 permanent teeth and 6 anterior teeth in boys exceeded that of girls however this discrepancy has not statistically significant difference. The quantity of the overall and anterior Bolton ratios did not have statistically significant differences in boys and girls. The mean and standard deviation of the overall and anterior ratios in Iranian population were $91.58 \pm 2.03\%$ and $77.73 \pm 3.17\%$ which did not have statistically significant differences from the normal quantities offered by Bolton ($P < 0.05$).

Conclusion: The normal ratios offered by Bolton can be used in the Iranian boys and girls needing orthodontic treatments.

Key words: Bolton ratios, tooth size, Iranian population

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Teeth size is a critical factor in orthodontic treatments. It has been corroborated that in order to achieve an ideal occlusion at the end of the orthodontic treatments, an appropriate ratio is needed between the mesiodistal width of the maxillary and mandibular teeth.

In 1958, Bolton presented an analysis based upon the studies he made on 55 persons bearing ideal occlusions in the Caucasian population in the United States of America bearing the aforesaid objective in mind. The aforementioned analysis has been utilized in orthodontic treatments up to now. Bolton introduced two ratios (namely overall ratio and anterior ratio) in his analysis to access an ideal occlusion. Overall ratio is resulted by dividing the total mesiodistal width of the 12 mandibular permanent teeth by the total mesiodistal width of the 12 maxillary permanent teeth. Anterior ratio is resulted by dividing the total mesiodistal width of the 6 anterior permanent teeth of the lower jaw by the total mesiodistal width of the 6 anterior permanent teeth of the upper jaw. Bolton has reported the normal overall ratio as 91.3% at

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the range of 87.5-94.8% and normal anterior ratio as 77.2% at the range of 74.5-80.4%.¹ Teeth sizes may vary in diverse races and ethnic groups. For instance Lavelle compared the maxillary and mandibular teeth sizes in three races (namely Caucasian, Negroes and Hispanics) in his researches. He found the Negroes' teeth to be larger than those of Caucasians and Hispanics. Hispanics' teeth are larger than those of Caucasians.² Also, Smith et al examined 180 pair of casts of three diverse races (Caucasians, Negroes and Hispanics) in their research in the United States of America. They found that teeth size was dependent upon the gender and population.³ Researchers have conducted Bolton analysis in people bearing normal occlusion in disparate societies. Then they collected the obtained quantities with those suggested by Bolton. Smith et al in their research in Dallas found that Bolton normal ratios can be used merely in white women, so they can't be used in white men, blacks and Hispanics.³ Nourallah et al studied 55 persons bearing normal occlusions in Syria. They reported anterior and overall ratios to be $78.99 \pm 2.18\%$ and $92.26 \pm 2.06\%$. The numbers obtained in two sexes were similar and almost the same as Bolton.⁴ Uysal et al studied 150 casts of normal occlusions in Turkey. They found that Bolton normal ratios were not suitable for the people in this country. Thus regional norm ought to be utilized. They found a significant difference between the overall ratio of men and women.⁵ Al-Tamimi et al studied 65 persons in Saudi Arabia bearing normal occlusions. They concluded that Bolton normal ratios are practical for this society. There is no difference between the two sexes with Bolton normal quantities.⁶ Parades reckoned anterior and overall ratios to be $78.32 \pm 2.45\%$ and $91.97 \pm 1.95\%$, in his research upon 100 pairs of casts in Spain. The obtained ratios were similar in two sexes but they were statistically different from Bolton.⁷ Freire et al studied 30 Caucasian Brazilians bearing normal occlusions. They calculated anterior and overall ratios as 77.83% and 91.46% which were similar to Bolton.⁸ Diop Ba et al studied 60 persons from Senegal and

concluded that Bolton normal ratios are applicable for this society.⁹

The main goal of this study is to determine total and anterior Bolton ratios in people with normal occlusion in Kerman as well as the examination of the sexuality effect upon teeth sizes and comparing the obtained results with normal quantities presented by Bolton.

Materials and methods

This study was designed on a cross-sectional descriptive manner upon casts of 56 students (28 boys and 28 girls) whose age range vary from 16 to 18 years bearing normal occlusions situated in Kerman. People under study and their parents were born and lived in the same town. These people were selected among 4300 high school students in Kerman which were involved in a social based research. The specifications of the ideal dental occlusion of these persons are as follows:

1. The molar and canine relationship in class I
2. Normal overbite and overjet
3. Lack of spacing, crowding and rotation
4. Lack of proximal restorations, onlay and crown.
5. Lack of anomaly in the number and shape of teeth.
6. The presence of all the permanent teeth except for the third molar.

The mesiodistal width of the permanent teeth was gauged and registered by a person using a sliding "Beerendonk dental vernier caliper" (Dentaurum Group, Ispringen, Germany) with a precision of 0.5 millimeter. The teeth width was measured from mesial height of contour to distal height of contour at a level parallel to the occlusal plane. The quantities obtained from each person were noted in the special table. The mean and standard deviation were considered for the total width of 6 maxillary and mandibular anterior teeth and the total width of 12 maxillary and mandibular teeth separately in two groups of boys and girls.

Overall and anterior ratios were calculated in boys and girls separately. The ratios calculated in two groups of boys and girls

were analyzed with each other and the normal ratios suggested by Bolton. Student t-test was used in SPSS software (LEAD technologies Inc, Charlotte, USA) with a 95% precision for the above-mentioned comparison.

The casts of 20 people under study were randomly selected after 45 days to check for the measurement error. The same person measured the mesiodistal width of teeth. Dahlberg formula was used for method error calculation.

Results

Table 1 contains the total mesiodistal width of 6 anterior teeth and 12 maxillary and mandibular permanent teeth in two groups of boys and girls as well as the comparison of the two groups. After comparison of the total mesiodistal width of 6 anterior teeth and 12 maxillary and mandibular permanent teeth in two groups of boys and girls, the findings indicated that the boys' teeth width were larger than those of girls, however this discrepancy has not statistically significant difference except for total width of 12 mandibular teeth ($P < 0.05$).

Table 2 contains boys' and girls' overall and anterior ratios as well as the comparison of two groups of boys and girls. The findings of this study showed that the variation in boys' and girl's overall and anterior ratios has not statistically significant difference. ($P < 0.05$) Thus the overall and anterior ratios of all the persons were considered without regarding their gender. The mean and standard deviation of the overall and anterior ratios in Iranian population were $91.58 \pm 2.03\%$ and $77.73 \pm 3.17\%$. The comparison of overall and anterior ratios in all the persons under study with normal quantities submitted by Bolton indicated that the quantities obtained in this study are not statistically different from Bolton study ($P = 0.93$ for anterior ratio and $P = 0.08$ for overall ratio).

After examination of method error by means of Dahlberg test, the conclusion denoted that the difference between the quantities reported between two times of measurement at a 45-day interval has not statistically significant difference in any of the 20 surveyed casts ($P < 0.05$).

Table 1: Mean and standard deviation (SD) of the total mesiodistal width of 6 anterior teeth and 12 maxillary and mandibular permanent teeth in two groups of boys and girls and the comparison of the two groups.

Sum of Mesiodistal Width	Boys		Girls		P-Value
	Mean	SD	Mean	SD	
6 anterior maxillary teeth	47.01	1.77	45.62	1.98	0.40 (NS)
12 maxillary permanent teeth	94.17	3.56	92.78	3.37	0.13 (NS)
6 anterior mandibular teeth	36.57	1.45	35.71	1.43	0.58 (NS)
12 mandibular permanent teeth	86.69	3.42	84.51	3.48	0.02 (S)

[NS: Non-significant ($P > 0.05$), S: Significant ($P < 0.05$)]

Table 2: Comparison of the mean and standard deviation (SD) of overall and anterior ratios in two groups of boys and girls.

Bolton Ratios	Boys		Girls		P-Value
	Mean	SD	Mean	SD	
Anterior Ratio	77.83	2.91	78.33	2.65	0.49 (NS)
Overall Ratio	92.07	2.32	91.08	1.59	0.03 (S)

[NS: Non-significant ($P > 0.05$), S: Significant ($P < 0.05$)]

Discussion

Bolton analysis is a suitable method to find out the existence of discrepancies between the size of maxillary and mandibular teeth. Such discrepancies are indispensable to obtain the ideal occlusion.

In this study, the total mesiodistal width of 12 permanent teeth and 6 anterior teeth in boys exceeded that of girls however this discrepancy has not statistically significant difference. This resembles that of most of the studies in which the width of teeth have been compared in two sexes^{2, 10-13}

The overall and anterior ratios of two groups of boys and girls were similar in this study and sexuality did not affect Bolton ratios. This is in accordance with Nourallah, Al-Tamimi, Paredes and Freire obtained in Syria, Saudi Arabia, Spain and Brazil. 4,6-8 Uysal studied Turkish population and noticed that there was a statistically significant difference between the overall ratio in men and women, nonetheless the anterior ratio was similar in the two sexes.⁵ Thus the upshots of our study resemble that of most of the studies in which Bolton ratios in two sexes have been estimated in populations bearing normal occlusions.

The anterior and overall ratios calculated in this study are similar to Bolton study in

Caucasian population in the United States of America.¹ Nourallah, Al-Tamimi, Freire and Diop Ba in Syria, Saudi Arabia, Brazil and Senegal obtained the same upshots.^{4,6,8,9} They stated that the normal ratio by Bolton can be used in their societies, whereas Uysal and Paredes did not regard the normal quantities submitted by Bolton as suitable in their societies (Turkey and Spain).^{5,7} Such variations can be a result of the effect of race and ethnicity upon the size of teeth. The effect of racial variations upon the teeth sizes has been corroborated in several studies.^{2,3,10}

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