Original Article

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Evaluation and comparison of tooth size discrepancies among different malocclusion groups

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ABSTRACT

Introduction: The compliance of proportions between the mesiodistal dimensions of the upper and the lower teeth is necessary for good intercuspidation. Given that a significant discrepancy in tooth size can prevent ideal occlusion at the end of orthodontic treatment, the absence of tooth size discrepancy is a significant factor for the realization of the ideal occlusion.

The aim: Aim of this study was to determine whether there is a difference in the incidence of tooth size discrepancies among different skeletal malocclusion groups in the orthodontic patients.

Material and methods: The sample comprised 300 pretreatment study casts (118 males and 182 females) with fully erupted and complete permanent dentition except third molars, which were selected randomly from records of orthodontic patients. All subjects were divided in three groups, according to the Angle classification of malocclusion. The measurements were made on study models with digital calipers accurately to 0.01 mm. The Class was defined by using the Steiner analysis on lateral cephalograms. The subjects were divided into three groups depending on the value of the ANB angle. For every subject, the value of the angles SNA, SNB and ANB was measured. The reliability of measurements was examined by the Pearson's correlation coefficient. To determine whether there were gender differences an independent sample t-test was performed.

Results: There is no statistically significant differences in Bolton's discrepancy by different gender, or at different classes. The average value of the anterior Bolton ratio was 78.16 and of the overall were 90.87. Values of the anterior and overall Bolton ratios are highest in patients with Class III. The highest average value of anterior discrepancy was in male subjects with III Class (-0.72), while the highest average value of overall discrepancy was in male subjects with II Class (0.65).

Conclusion: The results of the study show that there are no statistically significant differences in Bolton's discrepancy by different gender, or at different classes.

INTRODUCTION

Tooth size discrepancy is a disproportion between the size of the individual teeth. Since a significant discrepancy in the size of teeth can prevent ideal occlusion at the end of orthodontic

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treatment, the absence of the tooth size discrepancy is the seventh "key" for the realization of the ideal occlusion. [1]

Gilpatric has come to the conclusion, in his measurements, that there is a difference in the mesiodistal diameters of maxillary and mandibular teeth. [2]

Some methods that have been used throughout history in order to recognize the discrepancy between the upper and lower jaw, like Kesling's diagnostic setup or Howe's ratio, were not included in daily use. [3,4]

As the most appropriate way, used today, to determine the dento-dental discrepancy is the Bolton analysis, which is an integral

part of the diagnostic procedure for orthodontic patients. Since Bolton did not set out the criteria for persons of different sex or different Class, it has become a subject of the research in later years. Some studies have shown the existence of differences in the Bolton values in relation to gender, while others have found no significant differences between dento-dental discrepancy in male and female respondents. [5-9] There are also some deviations in the results in the different types of malocclusion. Ta and associates, as well as Nie and Lin in their researches came to the result that there are differences in the Bolton ratios in different types of malocclusion, while other studies, did not show statistically significant differences. [10-14]

The aim of this study was to analyze the relationship of dental discrepancies and different forms of malocclusions in orthodontic patients at the School of Dental Medicine, University of Sarajevo, as well as to determine the value of the anterior and the overall Bolton ratio as well as the front and the total discrepancy in the upper and lower dental arch and show whether there is a statistically significant difference between patients of different gender and Class. Until today, no research was undertaken in the orthodontic patients in Bosnia to show whether there is a connection between tooth size discrepancy and different types of malocclusions.

MATERIAL AND METHODS

Teaching and Science Research Council of the School of Dental Medicine University of Sarajevo, approved the protocol for this study. The sample comprised 300 pretreatment study casts, and lateral cephalograms (118 males and 182 females) from the archives of Department of Orthodontics, University of Sarajevo. Models that fulfilled the following criteria were taken into account:1) all permanent teeth erupted and present from right to left first molar to permit measurement of the mesio-distal crown dimension; 2) teeth emerged to the occlusal plane; 3) no previous orthodontic treatment.

Models with the following characteristics were excluded from the studies: 1) teeth with atypical shapes and sizes; 2) cavity on proximal surfaces of the teeth, 3) restorations on the proximal surfaces of the teeth, 4) teeth that made the measurements impossible due to their locations. From the obtained data 6 variables were calculated: anterior ratio, the overall ratio, front discrepancy in the upper and lower of the dental arch and the total discrepancy in the upper and lower dental arch. The largest mesial-distal diameters of the teeth are measured in millimeters by using the digital calipers Powerfix model nr. Z22855, OWIM GmbH, Neckarsulm with accuracy up to 0.01 mm. All measurements were performed by the same author (MA) under natural light. Every model was measured three times during one week and the average value was calculated. No more than 10 models were measured during a day.

The Class was determined based on the cephalometric analysis done on AudaxCeph software system. The subjects were divided into 3 groups depending on the value of ANB angle. The values of 0° to 4° of ANB angle represent I Class, values greater than 4° represent II Class, while negative values of this angle represent III Class.

Bolton's analysis was conducted on all models. Anterior and overall Bolton ratios were calculated by the following formulas:[15]

$$\text{Overall Ratio (\%)} = \frac{\text{Sum of M-D diameter (\#36-\#46)}}{\text{Sum of M-D diameter (\#16-\#26)}} \times 100$$

$$\text{Anterior Ratio (\%)} = \frac{\text{Sum of M-D diameter (\#33-\#43)}}{\text{Sum of M-D diameter (\#13-\#23)}} \times 100$$

Testing the reliability of measurement

Reliability of measurement was tested on a sample of 20% subjects, in which the measurements on models and on lateral cephalograms were repeated. In order to test the reliability, the Pearson correlation was performed. The results of correlation show that there is no statistically significant difference between the first and second measurements, which confirms the reliability of other tests and interpretations of results.

Statistical analysis was performed using the IBM SPSS Statistics v.21. tool. From descriptive statistical parameters the arithmetic means were calculated, as well as the standard deviations, range of values (min and max), and absolute and percentage frequencies. Student's t-test for independent samples and one-way analysis of variance (ANOVA) were used for testing of hypothesis. As a confidence level alpha level of 95%, that is 5% (0.05) of risk, was taken.

RESULTS

Student's t-test of independence and ANOVA found no statistically significant differences in the value of Bolton's anterior and overall ratios among the subjects of different gender and of different Class. Distribution of values obtained by calculating anterior and overall Bolton ratio show the distribution according to the model of normal distribution what is confirmed by Kolmogorov - Smirnov test. Variance in examined groups are homogenous what is indicated by Levene's test (P>0.05).

Table 1. Distributions of the subjects among the different malocclusion groups

Class	Gender					
	Male		Female		Total	
	n	%	n	%	n	%
I	60	50.8	82	45.1	142	47.3
II	37	31.4	70	38.5	107	35.7
III	21	17.8	30	16.5	51	17.0
Total	118	100	182	100	300	100

Table 2. Mean, standard deviation (SD), standard error (SE), and independent t-test for anterior and overall ratios for males (M) and females (F)

	Gender	N	Mean	SD	P
Anterior Ratio	M	118	78.39±0.45	2.47	
	F	182	78.02±0.39	2.65	0.225
	Total	300			
Overall Ratio	M	118	91.14±0.37	2.07	
	F	182	90.69±0.71	4.81	0.329
	Total	300			

Table 3. Mean, standard deviation (SD), and analysis of variance for anterior and overall ratios regarding different malocclusion groups

	Gender	N	Mean	SD	P
Anterior Ratio	I	142	78.31±0.47	2.82	
	II	107	77.88±0.45	2.34	
	III	51	78.36±0.65	2.36	0.365
	Total	300			
Overall Ratio	I	142	90.71±0.86	5.3	
	II	107	90.81±0.43	2.24	
	III	51	91.43±0.53	1.94	0.528
	Total	300			

DISCUSSION

Bolton conducted his research on a sample which involved 55 subjects. Bolton chose only subjects with ideal occlusion in Class I, whom he had chosen from a large group of subjects and that his research had the task to set up the ideal ratio for an ideal occlusion. [15]

The sample used in this study is adequate for testing the hypotheses. Our study did not show a statistically significant difference in the values of the anterior and overall Bolton ratios between different malocclussion. However values of the anterior and overall Bolton ratios are highest in subjects with Class III.

Khan and Virginia conducted a study and the results showed that there are statistically significant differences in the values of anterior Bolton ratios between Class I and Class II. However, no statistically significant difference was found between subjects with Class I and III and subjects with Class II and III. [16] Fattahi and associates in their research find that the overall Bolton ratio is greater in subjects with malocclusion Class III. [17] Oktay and Ulukaya found no significant differences among the different Classes of malocclusion when it comes to the anterior Bolton ratio, but these differences are present in the overall Bolton ratio. [18] Significant discrepancy, in subjects with different Classes, was found in the study conducted by Crosby and Alexander. For the anterior ratio, 16.7% of subjects who were in the Class I, had significant discrepancy, and this value was 23.4% in subjects with Class II division 1. [19] In a survey conducted by Strujić, results showed that there were no statistically significant differences in the values of the Bolton ratios in different types of Classes, and to similar results came Uysal and his associates in a study conducted on a sample of 710 subjects. [20,21]

Our study did not show a statistically significant difference in the values of the anterior and overall Bolton ratios between the genders. Same resluts are published by several studies. Aroujo and associates and Alkofidea and associates found no significant differences between the dento-dental discrepancy in male and female subjects. [8,9] On the contrary study published by Lavelle find gender differences. Overall and anterior ratios were higher for males, although the difference was small, less than 1%. [6] Richardson and associates also confirmed gender differences of teeth in the maxillary and mandibular arch. [7]

The clinical significance of dento-dental discrepancy

Taking into the consideration that the dento - dental discrepancy is an important factor in a detailed analysis of space, it must be seriously considered when planning orthodontic treatment. In the planning of treatment it is important to quantify the need for space in each arch in order to run the correction of malocclusion. Enlarging or reducing the width of the arch and changing the incisor inclination can have a significant spatial implications. Analysis of the space can be used to assess the need for extraction and mechanics that will be needed during orthodontic treatment.

CONCLUSIONS

• There is no statistically significant differences between respondents of different gender.

• There is no statistically significant difference between patients with different types of maloclussion. However values of the anterior and overall Bolton ratios are highest in patients with Class III.

• Further studies are needed to clarify whether a correlation exists between increased growth of the jaws and increased MD dimensions of anterior teeth.

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