

Tooth size ratios in Saudi subjects with Class II, Division 1 malocclusion

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Abstract:

Objectives: 1) To determine tooth size ratios in Saudi subjects with Class II, Division 1 malocclusion, 2) to compare tooth size ratios between Saudi males and females and 3) to compare tooth size ratios between Saudi subjects with Class II, Division 1, and Saudi subjects with Class I normal occlusion, and Bolton's results. Methods: The current study consisted of study models of sixty subjects (30 males and 30 females), aged 13 to 20 years. All subjects had Class II, Division 1 malocclusion. An electronic digital caliper was used to measure the individual mesiodistal tooth width of all maxillary and mandibular permanent teeth except second and third molars. Results: The anterior ratio and the overall ratio in Saudi subjects with Class II, Division 1 malocclusion were 77.65 ± 2.79 and 91.93 ± 2.08 respectively. The tooth size ratios were slightly greater in males than females but the differences were not significant. There were no significant differences in the anterior ratio and the overall ratio between Saudi subjects with Class II, Division 1, and Saudi subjects with Class I normal occlusion, and Bolton's results. Conclusions: The Bolton standards can be applied to Saudis with Class I normal occlusion and Class II, Division 1 malocclusion.

Key words: Tooth size ratios, Class II malocclusion, Orthodontic

Introduction:

A relative harmony in mesiodistal width of maxillary and mandibular teeth is a major factor in coordinating posterior interdigitation, overbite and overjet in centric occlusion.^[1] The treatment alternatives of tooth size discrepancies include restoration of relatively small teeth, interproximal stripping of relatively large teeth, modification of crown angulation or inclination and extraction.^[2]

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Therefore, it is important to determine the amount and location of tooth-size discrepancies before starting treatment.

Sperry et al^[1] applied the Bolton standards and found that the frequency of tooth-size discrepancy was greater in white subjects with Class III occlusion than in those with Class I or Class II occlusions. Crosby and Alexander^[3] studied 109 white orthodontic patients with varying occlusions (Class I, Class II Divisions 1 and 2, and Class II surgical) and found no significant difference in the incidence of tooth-size discrepancy among the groups.

Araujo and Souki^[4] mentioned that individuals with Angle Class III malocclusions had a significantly greater prevalence of tooth-size discrepancies than did those with Class I individuals who, in turn, had a greater prevalence than those with Class II malocclusion.

Nie and Lin^[5] did a study of this aspect of tooth-size discrepancies in a sample of 360 cases. A significant difference was found for all the ratios between the malocclusion groups, showing that the anterior, posterior and overall ratios were all greatest in Class III and lowest in Class II.

Smith, Buschnag, and Watanabe^[6] evaluated Bolton's interarch ratios in 3 populations (black, Hispanic, and white) and reported significant differences in the overall and anterior ratios between these groups. Whites displayed the lowest overall ratio (92.3%), followed by Hispanics (93.1%), and blacks (93.4%).

Review of the literature reveals that variations in tooth size ratios exist between different racial and malocclusal groups. Lavelle^[7] mentioned that although tooth size and proportion have an important role in malocclusion, the investigation of tooth width has received scant attention by orthodontists. Further, Richardson and Malhotra^[8] pointed out that the teeth in black North American males were larger than those of females for each type of tooth in the maxilla and the mandible. However, there were no statistical significant differences in anterior or posterior inter-arch tooth-size proportions.

Therefore different diagnostic standards should be established for each group separately. The aims of the present study were 1) To determine tooth size ratios in Saudi subjects with Class II, Division 1 malocclusion, 2) to compare tooth size ratios between Saudi males and females and 3) to compare tooth size ratios between Saudi subjects with Class II, Division 1,

and Saudi subjects with Class I normal occlusion, and Bolton's results..

Materials and methods:

Sixty pairs of pretreatment orthodontic study models with Class II, Division 1 malocclusion were selected from orthodontic records of subjects (30 males and 30 females) seeking orthodontic treatment at the College of Dentistry, King Saud University, Riyadh, Saudi Arabia.

Criteria for sample selection:

1. All subjects were Saudis.
2. Age ranged from 13 to 20 years.
3. Bilateral Class II molar relationship.
4. Protrusive maxillary incisors and overjet (Horizontal overlap) more than 5 mm.
5. Good quality study models
6. No restorative treatments other than Class I restorations.
7. Presence of fully erupted permanent teeth from the right first molar to the left first molar of the maxillary and mandibular arch.
8. Minimal crowding and absence of severely rotated tooth.

Measurements were made directly on the orthodontic study models. An electronic digital caliper with fine tips measuring within 0.01 mm (Mitutoyo, U.K.) was used by one operator to measure Mesiodistal tooth width. The procedure of measuring the mesiodistal tooth width was performed as described by Hunter and Priest.^[9] The caliper beaks were inserted from the buccal (labial), and held occlusally parallel to the long axis of the tooth. The beaks were then closed until gentle contact with the contact points of the tooth was made. The measurements included the mesiodistal width of all the twelve maxillary and mandibular teeth from the right first permanent molar to the left first permanent molar.

In order to calculate the tooth size ratio, the Bolton formula^[10] was computed as follows:

$$A) \text{ Over-all ratio} = \frac{\sum \text{Mesiodistal width of 12 mandibular teeth}}{\sum \text{Mesiodistal width of 12 maxillary teeth}} \times 100$$

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

Statistical analysis:

The data of the present study were subjected to statistical analysis using a computer program: Statistical Package for the Social Science (SPSS) version 9.0.

The following tests were carried out:

Descriptive statistics:

The following statistics were calculated for each variable: mean, standard deviation, and standard error of the mean.

Pearson's correlation coefficient:

Used as a method of measuring the interdependence between two variables from the same sample.

Independent t-test:

Used for comparison between the groups.

Assessment of measurement errors:

Twenty pairs of study models were randomly selected and re-measured by the same examiner with one week interval and compared with the first measurements. Three statistical tests including Dahlberg's method^[11], Pearson's correlation coefficient and Dependent paired t-test were used for analyzing the error.

Results:

The error of the method utilizing Dahlberg's equation was in the acceptable range. The independent T-test indicted that no statistical significant difference was observe between the first and the second readings. Pearson's correlation coefficient exhibited high correlation (Table I).

Descriptive statistics:

The overall ratio and anterior ratio for the Saudi subjects with Class II div 1 was 91.93 (SD2.08) and 77.65 (SD 2.79) respectively (Table II).

Sexual dimorphism:

The overall ratio and the anterior ratio were slightly greater in males than females. No statistical significant differences were found in tooth size ratios between both genders (Table III).

Comparison of tooth size ratios between the present study and Saudis with Class I normal occlusion and Bolton results:

Table IV and V revealed that the mean and standard deviation of the overall ratio and the anterior ratio in the present study were slightly greater than the results of Saudi subjects with Class I normal occlusion^[12] and Bolton's results.^[10] The statistical analysis shows that no significant differences were observed in the overall ratio and the anterior ratio between these studies.

Discussion:

The importance of tooth size ratios in orthodontic diagnosis has been widely reported in the literature and accepted by the orthodontic community because the relationship between the upper and lower

anterior dentitions is related to orthodontic finishing excellence.^[4]

Tooth size discrepancy has been described as a relative excess of tooth structure in one arch in relation to the other arch.^[2] For proper alignment of the teeth, tooth size must be in harmony with arch size.^[13] A significant variation in this harmony will lead to malocclusion and difficulties in obtaining an occlusion with optimal overjet, overbite and Class I canine and molar relation.^[1] Although the natural teeth match very well in most dentitions, approximately 5% of the population has some degree of discrepancy among the size of individual teeth.^[14]

The age range of the subjects in the present study was between 13 to 20 years of age. Doris et al^[15] indicated that early permanent dentition provides the best sample for tooth size measurements because early adulthood dentition has less mutilation and less attrition in most individuals. Consequently, the effect of these factors on the actual mesiodistal tooth width will be low.

It is of great value to use a method of measurement that is easy and quick. The manual method of measuring tooth size on dental casts can be either performed with a divider with sharp peaks or a Boley gauge. Zilberman et al^[16] carried out study comparing measurement performed by digital calipers with that done with Ortho Cad. The result indicates that measurement with digital calipers produced the most accurate and reproducible results. Thus, digital calipers seem to be a more suitable instrument for scientific work. On the other hand, Ortho Cad's accuracy was considered clinically acceptable. The measurement of the present study was done using the digital calipers.

Teeth differ in size between both males and females. Gender differences have been reported in the literature and may have clinical effect. Several studies have found that male teeth are generally larger than female teeth.^[15,17-19] According to the results of the present study, the overall ratio and the anterior ratio were slightly greater in males than in females but the differences were not significant (Table III). This is in agreement with the result obtained by Ta et al^[20] among Southern Chinese subjects and also with Alkofide and Hashim^[21] in Saudis. Some did not specify if the difference is significant or not. Lavelle^[7] reported that the overall and anterior ratios were greater in males than in females without indicating whether the difference was significant or not. However, in the present study; the overall ratio and the anterior ratio were slightly greater in males than females but no

Table I The errors of the method for individual mesiodistal tooth width by Dahlberg's method (DM), Pearson's correlation coefficient (r) and the Dependent paired t-test P = Level of significance.(n = 20 models)

Pairs	Right				Left				
	D.M	r	t-value	P	D.M	r	t-value	P	
Upper Jaw	Central incisor	0.1	0.97	-1.29	>0.05	0.14	0.96	-0.29	>0.05
	Lateral incisor	0.14	0.96	1.76	>0.05	0.14	0.94	-0.16	>0.05
	Canine	0.17	0.84	-0.42	>0.05	0.2	0.85	1.740	>0.05
	First premolar	0.1	0.97	1.96	>0.05	0.17	0.85	0.09	>0.05
	Second premolar	0.17	0.69	-1.49	>0.05	0.14	0.92	-1.49	>0.05
	First molar	0.1	0.94	0.47	>0.05	0.1	0.96	-0.92	>0.05
Lower Jaw	Central incisor	0.1	0.92	1.37	>0.05	0.1	0.88	0.69	>0.05
	Lateral incisor	0.17	0.83	0.352	>0.05	0.1	0.88	0.35	>0.05
	Canine	0.14	0.91	0.92	>0.05	0.14	0.94	-2.26	>0.05
	First premolar	0.17	0.83	-0.31	>0.05	0.1	0.93	1.41	>0.05
	Second premolar	0.14	0.90	0.45	>0.05	0.1	0.95	-0.11	>0.05
	First molar	0.14	0.91	-1.28	>0.05	0.17	0.81	-0.69	>0.05

Table II Mean, standard deviation (SD), standard error of the mean (SEM) for the anterior ratio and the overall ratio (n = 60).

Variable	Mean	SD	S.E.M
Overall ratio	91.93	2.08	0.26
Anterior ratio	77.65	2.79	0.36

Table III Degree of sexual dimorphism for the anterior ratio and the overall ratio (Male n = 30 and Female n = 30).

Variable		Males	Females	t-value	P
Overall ratio	Mean	92.08	91.79	0.549	0.585
	SD	2.05	2.13		
Anterior ratio	Mean	77.9	77.41	0.679	0.5
	SD	2.13	3.13		

Table IV Comparison of the anterior ratio and the overall ratio between the present study and Saudis with Class I normal occlusion (Tamimi and Hashim, 2005).

		Tamimi Hashim (2005)	Present study	t-value	P
Sample size		65	60		
Overall ratio	Mean	91.40	91.93	1.643	0.1029
	SD	1.50	2.08		
Anterior ratio	Mean	77.40	77.65	0.5946	0.5532
	SD	1.85	2.79		

NS = Not Significant.

Table V Comparison of the anterior ratio and the overall ratio between the present study and Bolton's results (1958).

		Bolton (1958)	Present study	t-value	P
Sample size		55	60		
Overall ratio	Mean	91.3	91.93	1.687	0.0944
	SD	1.91	2.08		NS
Anterior ratio	Mean	77.2	77.65	1.041	0.3002
	SD	1.65	2.79		NS

NS = Not Significant.

statistical significant differences were found in tooth size ratios between both genders. Thus, it was noticed that most studied have found no significant differences in the mean Bolton ratios between the sexes and in those studied which have found a difference, it has been small, with males having slightly larger ratios.

The results of the present study exhibited that there were no significant differences in the overall ratio and the anterior ratio between the Saudi subjects with Class II, Division 1, the Saudi subjects with Class I normal occlusion^[12], and Bolton's results^[10] (Table IV and V). The same finding was also observed by Xia and Xiyang^[22] Nie and Lin^[5] among Chinese, Crosby and Alexander^[3] among Americans, Alkofide and Hashim^[21] and Tamimi and Hashim^[12] among Saudis. However, the result of the present study is in disagreement with Ta et Al^[20] who reported that the overall ratio was significantly different between Class I and Class II malocclusion groups.

Till using a large and representative sample it can be stated with caution that Bolton's tables can also be used for Class II, Division 1 malocclusion patients. Further, Bolton tooth size analysis should be used initially in the diagnostic phase of orthodontic treatment in order to avoid problems that may be encountered during the finishing stage of therapy.

Conclusions:

- 1) The anterior ratio and the overall ratio in Saudi subjects with Class II, Division 1 malocclusion were 77.65 ± 2.79 and 91.93 ± 2.08 respectively.
- 2) There was no significant sexual dimorphism in tooth size ratios.
- 3) There were no significant differences in the anterior ratio and the overall ratio between Saudi subjects with Class II, Division 1, and Saudi subjects with Class I normal occlusion, and Bolton's results (1958).

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