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Evaluation of anterior tooth size discrepancy in different dental malocclusion groups

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Abstract

Introduction: The main goal of Orthodontic treatment is to achieve optimal occlusion. To achieve this goal maxillary and mandibular tooth should be proportional in size. Hence the purpose of the present study was to evaluate the anterior tooth size discrepancy in three dental malocclusion groups.

Material and Methods: It was a cross sectional study, which included 119 pretreatment casts (86 Male and 33 Female) of patients. Patients with fully erupted permanent anterior teeth in both arches were distributed into three dental malocclusion groups: Angle Class I(45), Class II(59) and Class III(15). The mesio-distal width of each tooth from right canine to left canine was calculated with a manual caliper on the study casts. Anterior tooth size (3-3) ratios were calculated by applying Bolton's formula. To compare the mean anterior tooth size ratios among the three malocclusion groups, Analysis of variance (ANOVA) was applied. The results of the test were considered significant at $p \leq 0.05$.

Results: The mean anterior tooth size ratios, in Class I patients were 1.34 mm, Class II patients were 1.39 mm and Class III patients were 1.91 mm. Comparison of anterior tooth size ratios among the three dental malocclusion groups showed insignificant difference (p=0.08). Comparison of anterior tooth size ratios between male and female patients in three malocclusion group were also found to be insignificant (p=0.06).

Conclusions: Comparison of mean anterior tooth size ratios among the three dental malocclusion classes revealed insignificant results.

Keywords: Anterior bolton ratio; dental malocclusion; bolton analysis; finishing; crowding

Introduction

The main goal of Orthodontic treatment is to achieve optimal occlusion. To achieve this goal maxillary and mandibular teeth should be proportional in size. Any disproportion among the size of teeth is known as tooth size discrepancy.[1] Andrew in 1972 presented 7 keys of optimal occlusion in which one of the key was "absence of the tooth size discrepancy".[2] The discrepancy depends on whether there is excessive tooth material in the upper or lower arch. Excessive tooth material in upper arch may expressed as increased over-jet, over-bite , crowding, linguoversion of upper anterior teeth or spacing in lower arch. In the lower arch, excessive tooth material is expressed as reduced over-bite and over-jet, crowding, labioversion of upper anterior teeth or spacing in upper arch.[1] These problems can influence the orthodontic treatment end results and stability.[3]

In the anterior segment, tooth size plays an important role to obtain normal over-jet and over-bite in the arch.[4] It is observed clinically that alignment and levelling is related to the mesio-distal size of teeth and crowding is correlated with the teeth having larger mesio-distal widths.[5,6]

Although the natural teeth match well mostly, about 5% of the population has some amount of variability among the mesio-distal widths of teeth.[7] Tooth size discrepancy must be quantified before orthodontic treatment planning. This problem is treated by either addition of tooth mass in case of peg/small

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upper laterals (e.g. buildups or veneers) or removal of tooth mass in case of large lower laterals (e.g. inter-proximal reduction).[8] Tooth size discrepancy is calculated by Bolton's formula. Bolton calculated the well defined ratios for the mesio-distal size of the teeth that should be found between upper and lower anterior teeth (3-3) as well as for the posterior teeth/overall arch (6-6).[9] Anterior segment ratio was 77.2±0.22 and ratio for the whole arch was calculated to be 91.3±0.26. When the discrepancy is greater than 2mm standard deviation (SD) of the normal ratio, the ratio is considered significant clinically.[10,11]

The association between malocclusion and tooth size discrepancy has been observed in literature. Lavelle[12] evaluated anterior tooth size discrepancies in 160 patients of different malocclusion groups from Caucasoid, Mongoloid, and Negroid population. He stated that patients with Angle Class III malocclusion had small sized upper teeth in comparison with Class II and I patients. The study results established that Class III patients had greater Bolton discrepancy than other malocclusion classes. Nie and Lin[13] observed the tooth size discrepancies in 360 Chinese patients of skeletal Class I , Class II and Class III malocclusion patients. They concluded that Class III patients had greater anterior Bolton ratios than Class II and Class I . Mujahid et al[14] compared the anterior Bolton ratio between Angle Class I and Class II dental malocclusion patients in a Pakistani sample. They found that anterior Bolton ratios were not different significantly between Class Iand Class IImalocclusion patients. Jan et al[15] compared the overall Bolton ratios between two ethnic groups (Punjabi and Pathan) in a Pakistani sample. They found overall Bolton ratios were insignificantly different between Punjabis and Pathans.

Several studies[16-19] reported the association of tooth size discrepancy with different malocclusion classes but none of them discussed the relationship between tooth size discrepancy and three dental malocclusion types according to Angle, especially in Pakistan. So the rationale of the current study was to evaluate the differences in anterior inter-maxillary tooth size discrepancy in three dental malocclusion groups, in a Pakistani sample. This would be helpful in resolving the problems related to orthodontic cases finishing and improving our knowledge regarding one of the complicated problems influencing orthodontic treatment.

Material and Methods

Ethical Review Committee of Margalla Institute of Health Sciences Rawalpindi (MIHS) approved the current study. Informed written consent was obtained from the patients whose pre-treatment records were used. Pre-treatment study casts of patients were collected from the archive of orthodontics department of MIHS and patients with completely erupted permanent anterior teeth from right canine to left canine, in both arches were included in study. Patient's study casts with deciduous dentition, presence of any abnormality of dental morphology, history of orthodontic treatment, caries or extensive restorations, inter-proximal stripping of any of the anterior teeth were excluded from the study. Total 119 patients (86 Males and 33 Females) satisfying the study inclusion criteria were distributed into three dental malocclusion groups according to Angle's classification: Class I(45 subjects), Class II(59 subjects) and Class III(15 subjects). The mesio-distal width of each anterior tooth at its maximum inter-proximal distance, from right canine to left canine in both arches were calculated with a manual calliper to the nearest 0.1 mm. The readings were noted on designed pro forma and anterior Bolton ratios were calculate by the given formula:[20]

$$\text{Anterior Bolton Ratio (\%)} = \frac{\text{Sum of mesio-distal width of 3-3 in mandible}}{\text{Sum of mesio-distal width of 3-3 in maxilla}} \times 100$$

SPSS-21 was used for statistical analysis. Descriptive statistics were calculated for anterior tooth size ratios in three malocclusion groups and for both genders. Analysis of variance (ANOVA) was applied to compare the anterior tooth size ratios among the three malocclusion groups. To compare the anterior tooth size ratio between two of the three malocclusion groups in varying combinations and to compare the ratios between male and female patients, Independent sample t-test was applied.

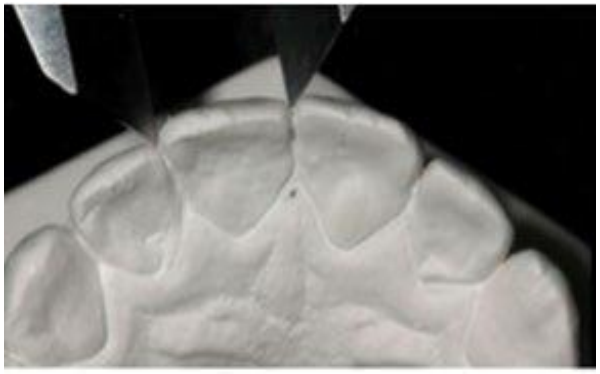

Figure 1: Measuring mesio-distal width of the teeth using a manual caliper

Results

Sample comprised of 119 patients, 27% (n=33) males and 72% (n=86) females. Descriptive statistics (mean and standard deviations) for three malocclusion groups (Class I , Class II and Class III) and gender were calculated. The mean anterior tooth size ratios, for Class I patients were 1.34±1.14mm, Class II patients were 1.39±0.87mm and Class III patients were 1.91±1.23mm. Comparison of anterior tooth size ratios among the three dental malocclusion groups showed insignificant difference p=0.08. Mean highest anterior tooth size ratios were observed in Class III malocclusion group (Table I).

The mean anterior tooth size ratios in 12 Class I males were 1.52±1.2mm, 13 Class II males were 1.32±0.5mm and 8 Class III males were 1.79±0.61mm. Mean anterior tooth size ratios in 33 Class I female were 1.27±1.1, 46 Class II females were 1.41±0.94 and 7 Class III females were 2.04± 1.7. Comparison of anterior tooth size ratio between male and female patients in three malocclusion group was found to be insignificant p=0.06 (Table II). Comparison of

Table I: Comparison of mean anterior tooth size ratios among three

Malocclusion Classes	N (119)	Mean± SD	*P* value
Class I	45	1.34±1.14	0.08
Class II	59	1.39±0.87	
Class III	15	1.91±1.23	

Malocclusion classes

$p \leq 0.05$ value is significant

Table II: Comparison of mean anterior tooth size ratios between male and female patients in three malocclusion classes

Gender		**Class I**	**Class II**	**Class III**	***P* Value**
Male	**Mean ± SD**	1.52± 1.28	1.32± 0.58	1.79± 0.61	0.06
(33)	**N**	12	13	8	
Fem-ale (86)	**Mean ±SD**	1.27 ±1.1 0	1.41 ±0.9 4	2.04 ±1.7	
	N	33	46	7	

Table III: Comparison of anterior tooth size ratio between two malocclusion classes in different combinations

Malocclusion classes	*p* Value
Class II and Class I	0.9
Class II and Class III	0.07
Class I and Class III	0.07

two malocclusion groups with respect to anterior tooth size ratios, in different combinations were insignificant (Table III).

Discussion

Several studies[16-19] were conducted, to describe the significance of optimal tooth size relationship between upper and lower arches for the proper finishing of orthodontic cases.[21] To get optimal occlusion with normal over-jet and over-bite, teeth of both arches should be proportionate in size to each other. In the current study anterior tooth size ratios were compared among three dental malocclusion groups. The results showed insignificant differences in the anterior tooth size ratios among the three malocclusion groups although mean highest anterior tooth size ratio was observed in Class III group which is in agreement with some previous studies in different populations. Crosby and Alexander[10] included 109 orthodontic patients in their study and compared the anterior Bolton ratios among Class I and Class II division 1 and 2 patients. They stated statistically insignificant differences in the tooth size discrepancy among the three malocclusion classes like current study results but this study neither included Class III patients nor specified the inclusion criteria of study. While the current study selected the patient according to Angle dental malocclusion type and included Class III patients. Similar results were observed by Basaran et al,[22] Al-Khateeb and Abu-Alhaija[23] and Akyalcin et al[24] in their studies. Basaran et al included larger sample size (360 patients) in their study in comparison to the current study. While Al Khateeb and Abu Alhaija, in their study selected 140 children from Jordanian population with age 13 to15 year.

Araujo and Souki[25] included 300 patients in their study and divided patients into three malocclusion groups based on ANB angle and Sassouni analysis. They found statistically significant higher mean anterior ratio in Class III group and significantly greater occurrence in Class III and Class I patients. The study results were in contrast with current study's results, by recording significant differences in anterior Bolton ratios in Class III patients from other malocclusion classes. This difference in the results might be due to the use of ANB angle and Sassouni analysis in contrast to selection on the basis of Angle's classification.

Mujahid et al[14] compared the mean anterior tooth size ratios between 55 Angle Class I patients with 53 Class II patients, in a Pakistani sample. The mean anterior Bolton ratios were found to be 2.33 mm for Class I and 2.51mm for Class II group. They found statistically insignificant differences between Class I and Class II malocclusion patients with respect to anterior Bolton ratios. These results showed partial agreement with current study results but this study did not involved Class III malocclusion patients.

Batool et al[19] observed tooth size variability in different malocclusion group and selected patients according to skeletal malocclusion (ANB angle) type. They observed higher tooth size discrepancy in mandibular anterior segment in skeletal Class II group. The study results showed dissimilarities from the current study and some previous study's results. This difference might be due to cephalometric variable used for the study inclusion criteria.

Ahmed and Fida[26] explained the percentages of cases that were outside 2mm standard deviations from the Bolton's mean. They selected 110 patients based on Class I , Class II and Class III malocclusion type. They observed highest percentages of the patients were of Class III malocclusion group. They found insignificant differences (outside 2mm SD) in anterior, posterior and overall Bolton's ratios among the three malocclusion groups. They also explored that there were insignificant differences between male and female patients with respect to anterior and posterior tooth size discrepancy just like in

the present study. While in the current study, only anterior tooth size ratios were compared between male and female patients. In previous studies Nie and Lin[13] and Ta et al[3] observed similar results about gender dimorphism. Nourallah et al[27] and Bernabe et al[28] found insignificant differences in over all tooth size discrepancy between male and female patients. While Fattahi et al[29] stated that male patients had higher overall and anterior tooth size ratios than female patients. Similar results were observed by Uysal et al[30] in their study, who selected two groups: 150 normal occlusion and 560 malocclusion patients and compared tooth size discrepancy between the two groups. A gender dimorphism was recorded in normal occlusion group. These dissimilarities in the results of our study from this and some previous studies might be due to differences in study inclusion criteria, sample sizes, ethnic differences and different dental or skeletal malocclusion types used.

Conclusions

Insignificant differences were found for anterior tooth size ratios among three malocclusion groups as well as between two genders. However, anterior Bolton ratios were highest in Class III malocclusion patients.

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