

## Relationship between tooth dimensions and malocclusion

Javaria Farooq,<sup>1</sup> Imtiaz Ahmed,<sup>2</sup> Gul-e-Erum,<sup>3</sup> Syed Naveed Iqbal<sup>4</sup>

### Abstract

**Objective:** To observe the difference in dimension of teeth among adult females with and without malocclusion.

**Methods:** The cross-sectional study was conducted at Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, from April 2011 to April 2013, and used non-probability consecutive sampling. Mesiodistal and buccolingual crown dimensions were measured on study casts by using digital sliding caliper in 2 groups of females. Group 1 had 150 subjects with normal occlusion, while Group 2 had 234 with malocclusion. Independent t test was conducted to evaluate the difference between the dimensions of teeth of the two groups. Statistical analysis was done on SPSS version 16, and p value was considered significant at 0.05.

**Results:** Overall, the difference between the groups showed a greater tooth dimension in the malocclusion group of population compared to the normal group, and the most significant difference was observed in the mesiodistal dimension of maxillary 2nd premolar, which was  $0.9 \pm 0.6801$  mm greater in dimension in the malocclusion group compared to the normal group. The least difference was observed in the buccolingual dimension of the mandibular central incisor where the malocclusion group had only  $0.08 \pm 0.5247$  mm larger mandibular central incisors in the buccolingual dimension compared to the normal group.

**Conclusion:** Mesiodistal and buccolingual crown dimensions were characteristically larger in the malocclusion group.

**Keywords:** Tooth dimension, Malocclusion. (JPMA 64: 670; 2014)

### Introduction

Malocclusion has been a major concern for most countries<sup>1</sup> since the rising problem seems to be affecting more and more individuals, leading them to seek orthodontic correction. According to the national data of USA, almost half of the adolescents face the problem of malocclusion and its orthodontic correction.<sup>2</sup> Locally, the issue of prevalence and distribution of malocclusion has also been explored on various occasions.<sup>3-5</sup> Its high prevalence and rising ratio place further importance on the study of its aetiology.

Various factors have been related to malocclusion, but one thing long standing regarding its aetiology is its relationship with growth and development.<sup>6,7</sup> Various researches have tried to prove that it is originally the environmental trigger before birth that induces developmental issues like malocclusion.<sup>8-10</sup> For the malocclusions that are not developmental, an association between the change in position of teeth and arch dimensions has been considered to be the causative factor.<sup>11-13</sup>

The size of the teeth is a characteristic developed during

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<sup>1-3</sup>Department of Orthodontics, Dr Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Karachi, <sup>4</sup>Sindh Government Hospital, New Karachi, Pakistan.

**Correspondence:** Javaria Farooq. Email: javariafarooq@hotmail.com

the developmental process. Its role as a causative agent in malocclusion is critical and has been researched upon by scientists.<sup>14</sup> Orthodontic problems like Tooth-Size-Arch-Size discrepancies (TSASDs) are most commonly related to tooth sizes. Studies focussed on finding out the association between tooth sizes and TSASDs have generally included all genders pooled together and have ignored the significance of the difference that exists between the tooth sizes of males and females. A more focussed study to evaluate each gender separately and identify the significance of tooth sizes with the malocclusions can provide important etiological knowledge regarding malocclusions.

Hence, the current study aimed at finding out the association between tooth sizes and the condition of occlusion of females only with normal occlusion compared with females of abnormal occlusion.

### Patients and Methods

The cross-sectional study was conducted at Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, from April 2011 to April 2013, and used non-probability consecutive sampling, picking up a total of 384 female patients. They were evaluated and their tooth sizes were noted down. Of the total, 150(39%) had normal occlusions whereas 234(61%) subjects had certain degree of malocclusion.

The subjects were selected and grouped in the 2 categories. Those in group 1 had a normal occlusion who had a class I molar relationship, class I canine relationship, average overjet and overbite values and no deviation of the midline. Group 2 with malocclusions was selected on the basis of treatment with the orthodontist, only excluding the cases which exhibited any signs of developmental defects like hypodontia or hyperdontia etc. or those that had their premolars extracted as part of their treatment.

The measurements of tooth sizes were done on cast models of the subjects with the help of calibrated sliding calipers. The measurements were done systematically starting from the central incisor followed to the 1st molar. Mesiodistal and buccolingual measurements of each tooth were recorded in a proforma along with the general details of the subject and her allotted group. Mesiodistal measurements were recorded from the point of maximum convexity at the mesial surface of the clinical crown to the point of maximum convexity at the distal surface of the clinical crown. Similarly, the buccolingual was also measured from the points of highest convexity on each surface.

The intra-observer variability was calculated by taking the measurements of tooth sizes of 50 patients at 2 different occasions which were a week apart. Then t test was used to check the difference in the measurements of these 2 observations which was found to be statistically insignificant.

Statistical analysis was done using SPSS version 16 and p value was considered significant at 0.05. Student's t test

was applied for each tooth to see if there was a difference between the measurements of each tooth within each group. This was followed by a dummy variable regression analysis to assess the difference between the normal and the malocclusion groups with relation to each variable.

There was no ethical issue involved in the study as the impression-taking to make a plaster study model on which teeth size has been measured is routine practice for making orthodontic records for treatment planning of orthodontic cases which indicate that the procedure followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 1983.

## Results

The tooth sizes of the malocclusion group and treated group were calculated for their descriptive statistics and the mean values for the two groups were noted (Table-1).

Independent t test was conducted to evaluate if there was a difference between the dimensions of teeth of the normal group and the malocclusion group (Table-2). The dimensions that were significantly different between the two groups were the buccolingual dimension of maxillary lateral incisor, first molar, mandibular canine and mandibular 2nd premolar, mesiodistal and buccolingual dimension of maxillary canine, 2nd premolar and mandibular central incisor and the mesiodistal dimension of maxillary first premolar and mandibular lateral incisor. Overall, 12(50%) of the total 24 variables of tooth dimensions measured between the two groups showed a significant difference.

**Table-1:** Tooth dimensions of maxillary and mandibular teeth.

	Central incisor Mean±SD	Lateral incisor Mean±SD	Canine Mean±SD	1st Premolar Mean±SD	2nd Premolar Mean±SD	1st Molar Mean±SD
<b>Tooth dimensions of maxillary teeth in malocclusion group.</b>						
Mesiodistal	9.236±0.6553	7.3714±0.6523	8.321±0.7116	7.6746±0.605	7.2922±0.6801	10.6182±0.6909
Buccolingual	7.4414±0.5894	6.5016±0.6909	8.0796±0.6803	9.8156±0.4854	9.8344±0.5767	11.3836±0.6214
<b>Tooth dimensions of mandibular teeth in malocclusion group.</b>						
Mesiodistal	5.4264±0.4282	6.0414±0.4517	7.1526±0.5251	7.3272±0.4085	7.3026±0.4773	11.0148±0.5818
Buccolingual	5.8768±0.5247	6.3216±0.5078	7.3334±0.5851	8.2496±0.4951	11.1538±0.658	8.8242±0.5163
<b>Tooth dimensions of maxillary teeth in normal group.</b>						
Mesiodistal	8.756±0.3688	6.846±0.4318	6.2105±0.2866	7.6755±0.1666	9.3325±0.2741	9.1885±0.3187
Buccolingual	6.846±0.4318	6.9335±0.6083	7.493±0.2636	6.9685±0.2617	6.3585±0.2789	9.9985±0.4043
<b>Tooth dimensions of mandibular teeth in normal group.</b>						
Mesiodistal	5.208±0.1772	5.7255±0.1743	6.494±0.2964	7.096±0.2939	7.199±0.4775	10.793±0.4241
Buccolingual	5.793±0.2529	6.0465±0.4743	7.003±0.3152	7.8535±0.4035	8.5035±0.3302	10.6289±0.3059

**Table-2:** Tooth dimensions in normal and malocclusion groups.

Tooth	Dimension	Malocclusion group Mean±SD	Normal group Mean±SD	P-value	Difference
11	Mesiodistal	9.236±0.6553	8.756±0.3688	0.13	0.48
	Buccolingual	7.4414±0.5894	6.846±0.4318	0.201	0.5954
12	Mesiodistal	7.3714±0.6523	6.9335±0.6083	0.799	0.4379
	Buccolingual	6.5016±0.6909	6.2105±0.2866	0.011	0.2911
13	Mesiodistal	8.321±0.7116	7.493±0.2636	0	0.828
	Buccolingual	8.0796±0.6803	7.6755±0.1666	0.005	0.4041
14	Mesiodistal	7.6746±0.605	6.9685±0.2617	0.001	0.7061
	Buccolingual	9.8156±0.4854	9.3325±0.2741	0.057	0.4831
15	Mesiodistal	7.2922±0.6801	6.3585±0.2789	0	0.9337
	Buccolingual	9.8344±0.5767	9.1885±0.3187	0.039	0.6459
16	Mesiodistal	10.6182±0.6909	9.9985±0.4043	0.133	0.6197
	Buccolingual	11.3836±0.6214	11.0655±0.184	0	0.3181
41	Mesiodistal	5.4262±0.4282	5.208±0.1772	0.003	0.2184
	Buccolingual	5.8768±0.5247	5.793±0.2529	0.045	0.0838
42	Mesiodistal	6.0414±0.4517	5.7255±0.1743	0.003	0.3159
	Buccolingual	6.3216±0.5078	6.0465±0.4743	0.438	0.2751
43	Mesiodistal	7.1526±0.5251	6.494±0.2964	0.13	0.6586
	Buccolingual	7.3334±0.5851	7.003±0.3152	0.065	0.3304
44	Mesiodistal	7.3272±0.4085	7.096±0.2939	0.17	0.2312
	Buccolingual	8.2496±0.4951	7.8535±0.4035	0.119	0.3961
45	Mesiodistal	7.3026±0.4773	7.199±0.4775	0.553	0.1036
	Buccolingual	11.1538±0.658	8.5035±0.3302	0.034	2.6503
46	Mesiodistal	11.0148±0.5818	10.793±0.4241	0.064	0.2218
	Buccolingual	8.8242±0.5163	10.6289±0.3059	0.101	-1.8047

Overall the difference between the groups showed a greater tooth dimension in the malocclusion group of population compared to the normal group. The greatest significant difference was observed in the mesiodistal dimension of maxillary 2nd premolar, which was 0.9mm±0.6801mm greater in dimension in the malocclusion group compared to the normal group, and the least difference was observed in the buccolingual dimension of the mandibular central incisor where the malocclusion group had only 0.08mm±0.5247mm larger mandibular central incisors in the buccolingual dimension compared to the normal group.

Out of the dimensions that showed significant difference between the malocclusion group and the normal group, the maxillary lateral incisor and 1st molar and the mandibular canine and 2nd premolar were 0.29±0.6909mm, 0.31±0.6214mm, 0.33±0.5851mm and 2.65±0.658mm larger buccolingually respectively in the malocclusion group compared to the normal group. The maxillary first premolar and the mandibular lateral incisor were 0.7±0.605mm and 0.3mm±0.4517mm larger mesiodistally compared to the normal group. The maxillary canine was 0.8±0.7116mm larger mesiodistally and 0.4±0.6803 larger buccolingually in the malocclusion group compared to the

normal group. The maxillary second premolar, showing the greatest difference, was 0.9mm±0.6801mm larger mesiodistally and 0.6mm±0.5767 larger buccolingually in the malocclusion group. The mandibular central incisor, showing the smallest difference, was 0.2mm±0.4282 larger mesiodistally and 0.08mm±0.5247mm larger buccolingually in the malocclusion group compared to the normal group.

## Discussion

Malocclusion is a phenomenon that arises due to various aetiological factors and has a spectrum of manifestations.<sup>6,15</sup> For the orthodontists, the real challenge of its correction is in understanding its causative factors. Trends have shown that the prevalence of malocclusion has always been on the rise due to the industrialisation of the human race and change in eating lifestyles.<sup>15</sup> This was first investigated by a study,<sup>16</sup> which claimed that the consistency of the diet makes a difference in the pressure placed on the perioral muscles and causes the jaws to grow in size.<sup>17-19</sup> and alter the arch dimensions.<sup>20-24</sup> One aspect of these malocclusions are TSASDs. Researchers have often argued that there has been a trend in reducing arch sizes or increased tooth dimensions that are leading to this rise in malocclusions.

Various researchers have found that the mesiodistal dimension of mandibular incisors has been comparatively more in people showing anterior crowding when compared to those who have ideal anterior teeth alignment.<sup>25-27</sup>

However, there have been researches where it has been proven otherwise and no change has been seen between crowded or non-crowded arches.<sup>28,29</sup>

It has been previously proven that tooth dimensions are dimorphic along gender lines and tooth crowns are, on an average, 3% to 6% larger in men than in women,<sup>30</sup> therefore, generalising tooth dimensions in a mixed population of males and females would result in bias within the study. Hence, the current study targeted only females as the discrepancy of tooth dimensions within male malocclusion groups has already been studied.<sup>14</sup>

The current study shows that there exists a significant difference between the tooth dimensions in the malocclusion and the normal group. This is in accordance with previous studies.<sup>27,31-34</sup>

It was further proven in the study that the malocclusion group exhibited teeth of statistically significant larger tooth dimensions compared to the normal group and this was also in accordance with earlier studies.<sup>26,35,36</sup>

A study<sup>31</sup> compared mesiodistal tooth crown dimensions of orthodontically treated patients with marked dental crowding with a sample displaying little or no crowding. The mesiodistal crown diameters of five tooth types, from central incisor through second premolar, were each significantly larger in the crowded arches, whereas in this research the maxillary lateral incisors, mandibular canine and the mandibular premolars did not show a significant difference in their mesiodistal widths. This difference could be because the earlier study chose a sample that consisted of males and females both, hence causing a bias due to gender dimorphism.

Another study<sup>35</sup> compared the mesiodistal tooth dimensions in normal and malocclusion groups, but it pooled both the genders in one sample. The result represented only central incisor, lateral incisor and molar to have a significant difference in crown dimensions. In this research, only the mandibular incisors and molar showed a significant difference in the mesiodistal widths, but the maxillary incisors and molars were not significantly different in their mesiodistal dimensions between the malocclusion and the normal groups.

## Conclusions

Tooth size is an important contributor of the causes of

dental malocclusion. A better understanding of the teeth that are significantly different in crown dimensions between the normal and the malocclusion groups can provide the clinician with a better understanding to shape the treatment plan in the best interest of the patient. The study found that average tooth size was significantly larger in the sample with malocclusions than those who had a normal occlusion; both mesiodistal and buccolingual crown dimensions were characteristically larger in the sample with crowding; and the teeth that were significantly larger in the malocclusion group were the buccolingual dimension of maxillary lateral incisor, first molar, mandibular canine and mandibular 2nd premolar, Mesiodistal and buccolingual dimension of maxillary canine, 2nd premolar and mandibular central incisor and the mesiodistal dimension of maxillary first premolar and mandibular lateral incisor.

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