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Comparison of mesiodistal widths of teeth in crowded versus non- crowded dentitions

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Abstract

Introduction: Dental crowding, its etiology as well as its effects have intrigued Orthodontists since the beginning of the specialty. This has been owed to various factors, size of teeth being one of these. Hence the aim of this study was to compare the size of teeth in crowded and non-crowded dentitions in Peshawar population to ascertain its role in the etiology of malocclusion.

Material and Method: Twenty-six crowded and non crowded casts respectively (total 52) were measured for maximum mesiodistal width from right permanent first molar to the contra lateral with digital caliper. Data were analyzed using SPSS version 20.0. Student *t* tests were used to compare mesiodistal width between two groups. Inter-observer reliability was determined using Bland-Altman plot. Data normality was determined by drawing P-P plot.

Results: Inter-observer reliability was very high and data was normally distributed. In mandibular arch for both genders, central and lateral incisors were larger in the crowded group. In maxillary arch for females, central and lateral incisors were larger in crowded group. In case of maxillary arch for males, central incisor and canines were larger in the crowded group. The comparison of labial segment only in crowded versus non-crowded cases showed that only maxilla in males had statistically significant difference in the tooth size. While the comparison of sizes of teeth from molar to molar (12 teeth) in crowded versus non-crowded cases showed no statistical significant difference for any arch or gender.

Conclusions: There was no significant difference in mesiodistal widths of teeth between crowded and non-crowded groups with the exception of anterior maxilla in the female group. Individual teeth size variations were found in central and lateral incisors in the mandible and central incisor and canines in male patient's maxilla, being larger in the crowded group.

Keywords: Arch length discrepancy; bolton discrepancy; space analysis

Introduction

Dental crowding is a consequence of tooth size dental arch dimension discrepancy. Identifying the etiology of malocclusion has proven to be important for the diagnosis as well as treatment planning in orthodontics. Different theories have been proposed in the literature to identify the cause of dental crowding. These mainly include genetic and environmental causes.[1]

Malocclusion is a developmental condition. In most instances, malocclusion is caused not by some pathologic process, but by moderate distortion of normal development.[2] Malocclusion is one of the commonest aesthetic and functional problem in our country and worldwide. The most prevalent reason behind a malocclusion in both mixed and permanent dentition is crowding. Such patients are usually referred to an orthodontist by the family dentist or by the patient's parents because of obvious dental irregularities or lack of sufficient space for tooth eruption. Such patients usually present with a Class I molar relationship or a tendency toward either Class II or Class III malocclusion.[3] Malocclusion can have both dental as well as skeletal basis. One way to

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peep into the cause of dental crowding is to compare tooth sizes between crowded and non-crowded dentitions since tooth size also contributes towards dental crowding.[4]

Crowding of teeth being the most common type of malocclusion at present undoubtedly is related in part to the continuing reduction in jaw size in human evolutionary development. Jaw dimension does seem to have a strong genetic control and the transverse dimensions directly affect the amount of space for the teeth.[5] A relative harmony in the mesiodistal dimension of the maxillary and mandibular teeth is a major factor in coordinating posterior interdigitation, overbite and overjet in centric occlusion.[6]

Mesiodistal tooth width has an anthropological significance because it provides valuable information on human evolution with its technological and dietary changes. On a clinical level, mesiodistal tooth width is correlated to the arch alignment and large teeth are associated with crowded dental arches. Moreover, a relationship has been noted between tooth size and third molar eruption and impaction.[7] Differences in tooth sizes have been associated with different ethnic backgrounds and malocclusions.[8,9] A comparative study between Jordanians, Iraqi, Yemenites, and Caucasians reported that Jordanians and Iraqis had larger teeth than the other populations.[10]

Tooth size greatly varies among different ethnic races.[11] In an investigation of tooth size of 139 Swedish boys, Lundstrom[12] found that crowding was more in individuals with larger teeth. The results of Fastlicht's[13] studies were consistent with those of Lundstrom's and reported a significant relationship between tooth size and crowding. Doris et al[14] found larger tooth sizes in crowded cases rather than in the non-crowded cases, with the greatest difference found between the maxillary lateral incisor and second premolars. In an investigation performed by Howe et al,[15] comparisons were made between crowded and non-crowded groups using study models. They indicated that arch dimensions made a greater contribution towards dental crowding than did tooth sizes. Hence the objective of this study was to compare the size of teeth in crowded and non-crowded cases in Peshawar population so as to get an insight in this etiology in a local setting.

Material and Methods

In this study, 52 pairs of study cast were selected from records of the Orthodontics Department of Khyber College of Dentistry, Peshawar. These were divided into two groups. The first group consisted of 26 pairs of study models of Class I occlusions based on a Class I skeletal relationship without any abnormal spacing or crowding. The samples were divided evenly between the sexes (13 females and 13 males). They all exhibited a straight profile, normal overbite and overjet. The second group consisted of 26 pairs of study models of Class I malocclusion with a Class I skeletal base which had more than 5mm of dental crowding. Again, the samples were equally divided between the sexes (13 females and 13 males). A digital vernier caliper (Japan) with an accuracy of 0.01 mm was used to obtain all measurements (Figure 2). To facilitate access to the inter-dental spaces, the caliper with narrowed tips was used. The caliper was positioned parallel to the occlusal surface and perpendicular to the long axes of the teeth to achieve the greatest mesiodistal diameter (contact points of the tooth). Maximum mesiodistal widths were measured from right first molar to left first molar in both arches.

Sample size was calculated using statistics calculator for *t*-test. The calculated sample was 26 per group and total 52, by entering power of study 80% (0.8), anticipated effect size (cohen's) of 0.8 and probability level of 0.05.

Casts having permanent dentition (excluding third molars), no proximal restorations, no

previous orthodontic treatment were included in the study where as casts with missing or supernumerary teeth or those of treated cases or with restorations were excluded from the sample. The data was statistically analyzed utilizing Social Package of Statistical Science software (SPSS version 20). P-P plot was used to investigate the distribution of the data. The data was found to be normally distributed (Figure 1) as depicted by a straight line. Parametric test (independent Student *t*-test) was used to compares mesiodistal widths of teeth between crowded and non-crowded dentitions. Mean and standard deviation (SD) were computed for each variable. Pearson coefficient of correlation was used to measure the correlation between right and left sides of teeth. Statistical significance was set at the level $P < 0.05$. Bland- Altaman plot were drawn for inter-observer reliability which showed that maximum measurements which were carried out by two examiners were close to zero mean (no difference) and almost all were within two standard deviation limit of 95% confident interval (Figure 3). These results showed perfect inter-observer reliability between the examiners.

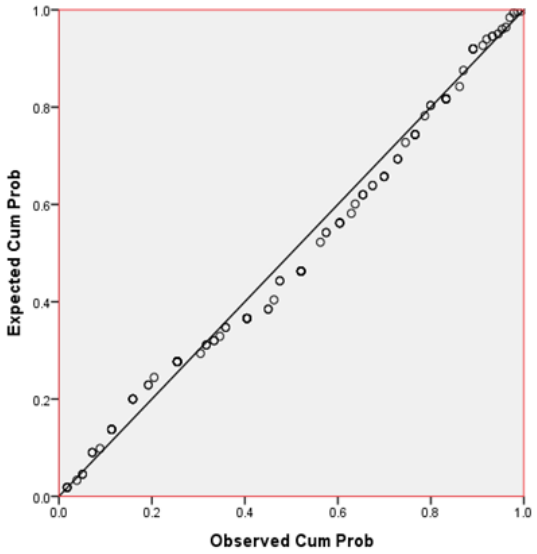

Fig 1:P-P plot for total sum of teeth sizes in whole sample

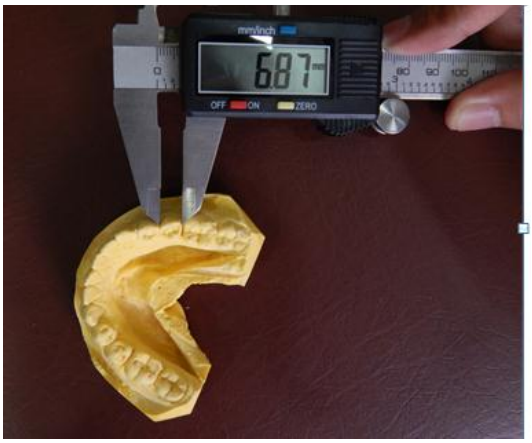

Figure 2: Measurement of maximum mesiodistal width of a tooth on a cast

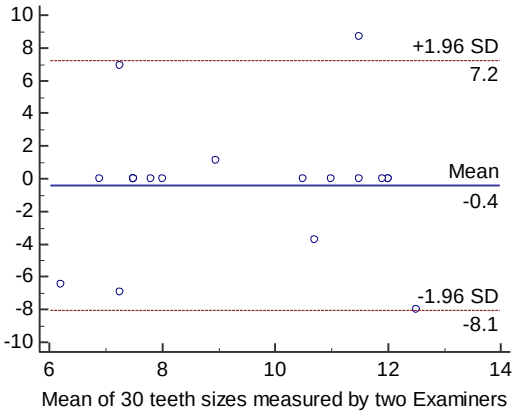

Figure 3: Bland-Altman plot for inter-observer reliability

Results

A total of 52 casts constituted the sample out of which 26 had crowding whereas 26 were non-crowded. Male to female ratio was 1:1. Mean age in this study was 21 ± 1.26 years. In mandibular arch of females, there was a statistical significant difference in sizes of teeth in crowded versus non-crowded cases, only for central and lateral incisor with a p-value less 0.05 (Table I). Similar results were found for males in mandibular arch (Table II). In maxillary arch for females, there was statistical significant difference in sizes of teeth in crowded versus non-crowded cases, only for central and lateral incisors with p-value less 0.05. (Table III) but in cases of maxillary arch for males there was a statistical

significant difference in sizes of teeth between crowded versus non-crowded cases and that too only for central incisors and canines with a p-value less 0.05 (Table IV). The comparison of anterior teeth (labial segment) sizes in crowded versus non-crowded cases showed that, only maxilla in males had statistical significant difference between tooth sizes. The comparison of 12 teeth (molar to molar), with respect to their sizes in crowded versus non-crowded cases showed no statistical significant difference for any arch or gender (Table V).

Table I : Comparison of teeth size in mandibular arch for females (n=26)

Crowded - normal tooth size	Mean diff	Std. Dev diff	Std. Error Mean	95% CI* Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
CMW6** - MW6***	.00	.54	.14	-.32	.326	.000	12	1.000
CMW5 - MW5	.23	.75	.20	-.22	.68	1.105	12	.291
CMW4 - MW4	-.11	.74	.20	-.56	.33	-.562	12	.584
CMW3 - MW3	-.038	1.03	.28	-.66	.58	-.135	12	.895
CMW2 - MW2	.38	.46	.12	.104	.66	2.993	12	.011
CMW1 - MW1	.428	.495	.13	.12	.72	3.091	12	.009

*Confidence Interval

**Mesiodistal width of crowded tooth

*** Mesiodistal width of non-crowded tooth

Table II : Comparison of teeth size in mandibular arch for males (n=26)

Crowded - normal tooth size	Mean diff	Std. Dev diff	Std. Error Mean	95% CI Difference		T	df	Sig. (2-tailed)
				Lower	Upper			
CMW6- MW6	.00	.54	.14	-.32	.32	.000	12	1.000
CMW5 - MW5	.24	.75	.20	-.20	.69	1.18	12	.260
CMW4 - MW4	-.13	.75	.20	-.58	.324	-.62	12	.542
CMW3 - MW3	-.03	1.03	.28	-.66	.58	-.135	12	.895
CMW2 - MW2	.40	.42	.116	.153	.66	3.49	12	.004
CMW1 - MW1	.41	.49	.136	.117	.71	3.03	12	.010

Table III : Comparison of teeth size in maxillary arch for females (n=26)

Crowded - normal tooth size	Mean diff	Std. Dev diff	Std. Error Mean	95% CI Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
CMW6- MW6	.10	.99	.27	-.491	.70	.391	12	1.000
CMW5 - MW5	-.084	.98	.27	-.682	.51	-.308	12	.260
CMW4 - MW4	-.16	.42	.112	-.417	.09	-1.37	12	.542
CMW3 - MW3	-.68	.61	.16	-1.052	-.311	-4.04	12	.895
CMW2 - MW2	-.23	1.30	.36	-1.02	.55	-.640	12	.004
CMW1 - MW1	-.59	.97	.27	-1.18	-.002	-2.18	12	.010

Table IV: Comparison of teeth sizes in maxillary arch for males (n=26)								
Crowded - normal tooth size	Mean diff	Std. Dev diff	Std. Error Mean	95% CI Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
CMW6- MW6	.136	.99	.275	-.46	.73	.502	12	.625
CMW5 - MW5	-.04	.98	.28	-.64	.54	-.169	12	.869
CMW4 - MW4	-.13	.44	.12	-.40	.14	-1.048	12	.315
CMW3 - MW3	-.68	.50	.14	-.98	-.37	-4.891	12	.000
CMW2 - MW2	-.29	1.17	.32	-1.00	.418	-.896	12	.388
CMW1 - MW1	-.59	.76	.21	-1.05	-.12	-2.775	12	.017

Table V : Comparison of anterior 6 and total 12 teeth size in both arches and genders (n=52)								
Arch and gender	Crowded - normal tooth size	Mean diff	SD diff	95% CI* Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
maxilla-male	CTW6** – NCTW6***	-3.13	4.43	-5.82	-.455	-2.549	12	.026
	CTW12† – NCTW12††	-3.21	8.274	-8.2	1.784	-1.401	12	.187
Maxilla –female	CTW6 – NCTW6	-3.01	5.183	-.41737	-6.146	.11548	12	.058
	CTW12 – NCTW12	-3.29	9.127	-1.05372	-8.803	2.21895	12	.217
Mandible-male	CTW6 – NCTW6	1.563	3.0	-.27021	3.40867	1.859	12	.088
	CTW12 – NCTW12	1.76	6.0	-1.88291	5.42137	1.055	12	.312
Mandible-female	CTW6 – NCTW6	1.5	3.15	-.36635	3.44327	1.760	12	.104
	CTW12 – NCTW12	1.7	6.04	-1.88291	5.42137	1.055	12	.312

*Confidence Interval

**Total width of six teeth in crowded cases

***Total width of anterior six teeth in non-crowded cases

† Total width of 12 teeth in crowded cases

†† Total width of 12 teeth in non-crowded cases

Discussion

This comparative study was performed to determine difference in teeth sizes between crowded versus non-crowded permanent teeth. To measure this accurately is of paramount importance in orthodontic research. In this study, we used standard armamentarium to measure teeth sizes with accuracy by the help of digital calipers. Dahlberg's formula [16-18] (the root mean squares style) and the intra-class correlation coefficient were used for correlation. Improper methods applied in reporting reliability e.g. reporting of a high correlation coefficient and/or showing no significance from a paired t test. When reporting a reliability measure or a result of methods comparison, it is common to find the following improper statement in the orthodontic literature.[19] Graphic representation is the best method to determine reliability.[20] In the current study, there was no significant difference in mesiodistal widths of teeth between crowded

and non-crowded groups with the exception of anterior maxillary dentition in females. Jahan H et al[2] reported a significant difference in both tooth widths as well as transverse arch dimensions between crowded and non crowded dentitions. The crowded group was found to have a significantly smaller maxillary arch width and larger tooth size as compared to the uncrowded group. The present study in accordance with the study of Jahan H et al only had difference in the anterior maxillary teeth of the female sample. Further insight is required to ascertain variation in transverse arch dimensions in Pakistani population and its basis for crowding in patients. Howe et al[15] made comparisons between crowded and non-crowded groups using study models and also showed that arch dimension made a greater contribution towards dental crowding as compared to tooth size. In contrast to the current results, studies by Lundstrom,[12] Fastlicht's[13] and Doris et al[14] reported that teeth are larger in size in crowded cases as compared to non-crowded dentitions. Genetic and ethnic variations may play a role in this context since tooth sizes are controlled by genes.[21]

Conclusions

There is a significant size difference in the sizes of dentition in anterior maxilla of females according to this study which might relate to the etiology of malocclusion in Pakistani population. This needs to further looked into with a larger sample

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