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Tooth Size in Crowded and Spaced Dentition among Western Uttar Pradesh Population: A Biometric Study

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Abstract

Introduction: No cause effect relation is established for any malocclusion with 100 percent certainty for any patient but mesiodistal tooth dimension or tooth morphology has been suggested as an important contributing factor. Orthodontic examination is invariably incorrect without tooth size assessment.

Aims and objectives: The present study was performed to co-relate the relationship of mesiodistal tooth size and the total tooth material among crowded and spaced dentition in western Uttar Pradesh population.

Material and methods: One hundred and twenty subjects, consisting of 62 females and 58 males were selected having Angle's Class I dental occlusion. The dental study models were divided into crowded and spaced dentition. Mesiodistal width of individual teeth from left first molar to right 1st molar and combined Mesiodistal width were measured and compared.

Results: The values for mesiodistal tooth size and total tooth material were more for males as compared to females. Individual mesiodistal tooth size and total tooth material was more in crowded dentition group than spaced dentition group.

Conclusion: Tooth size plays an important role in the malocclusion that is crowding and spacing. The crown diameter is more in crowded dentitions and less in spaced dentitions. The tooth size should be an important criterion while diagnosing and formulating a treatment plan for the patient.

Key Words: Mesiodistal tooth size, Arch length

Introduction:

Some authors[1, 2] have suggested directly or indirectly that crowding is usually associated with presence of large teeth size and spacing with presence of smaller teeth size. Such discrepancies in tooth size could have important effects in the application of diagnostic criteria.

The orthodontic examination is incomplete without a careful analysis of the mesiodistal crown size, which is a decisive variables among the factors associated with the development of occlusal and facial irregularities. These discrepancies effects the inter-digitation during and after orthodontic treatment. Considering the above fact, there seems to be relationship between the tooth size, dental crowding, and spacing. Human variability is so large that it is not justified to apply the same norms for the entire population. Hence this study was done on western Uttar Pradesh population to evaluate the relationship, if any, between tooth size, dental crowding and spacing and to correlate them with each other.

Material and Methods:

A total of one hundred and twenty pretreatment dental casts (62 females and 58 males) with Angle's Class I occlusion were selected from the OPD (outpatient department) of Department Of Orthodontics And Dentofacial Orthopaedics, Subharti Dental College, Meerut (Table No. 1). Dental casts having spacing more than 3mm were placed in spaced dentition group and those having crowding more than 3 mm were placed in crowded dentition.

Table No. 1: Overview of Sample Distribution

Group	Arch	Casts (n)	Sex (n)		Mean age (years)	S.D.
			Male	Female		
Crowded	Maxillary	30	14	16	17.8823	4.0137
n = 60	Mandibular	30	15	15	17.8823	4.0137
Spaced	Maxillary	30	13	17	17.5294	3.4299
n = 60	Mandibular	30	16	14	17.5294	3.4299
Total	Maxillary	60	27	33	17. 3725	3.4148
n = 120	Mandibular	60	31	29	17.3725	3.4148

The dental casts met the following:

Inclusion criteria:

1. Western Uttar Pradesh origin – patient residing in the region for three generations and more were selected,
2. All permanent teeth erupted till 1st molars,
3. Age 12-25 years,
4. Angle's class I dental occlusion

Exclusion criteria:

1. Undergone any prior orthodontic treatment,
2. Proximal restorations,
3. Casts with anomalies or mutilated dentitions,
4. Casts with attrited teeth below the contact point,
5. Angle's class II and III

Alginate impressions were taken on standard stock trays and the cast were immediately poured after the impressin making. The maximum mesiodistal width was measured on non soaped models using digital read out sliding caliper (Aerospace Digital vernier caliper - China) with the caliper tips kept parallel to occlusal and vestibular surface[3]. For establishing the occlusal plane three points were selected,the posterior end of the plane is set by the centres of the retromolar pads, and the anterior end of the plane is at the upper lip line. These three points establish the plane of occlusion (According to Mamootil JA in Autralian dental journal 1994). The MD width was taken as the distance between anatomic contact points. The mesiodistal width of central incisor, lateral incisor, canine, first premolar, second premolar and first molar were measured on each side and in both the dental arches. All the measurements were repeated after 15 days by the same operator.

To determine measurement error, Dahlberg's formula was used -:

Standard error = $\sqrt{\sum sd^2/2n}$

The total tooth material (TTM) for both the arches was calculated by adding the M-D width of all the teeth including incisors, canine, premolars and 1st molar. Unpaired t- test was used to evaluate the difference of mean values of MD width and TTM between males and females in both the groups. The results were then statistically evaluated. A level of significance ($P \leq 0.05$) was used for the statistical tests.

Results:

The mean values of MD width of each measured tooth and TTM values in both maxillary and mandibular arches were more for males than females. In both the sexes the crowded dentition group demonstrated the maximum values for MD width of each measured tooth, than spaced dentition group. The result was statistically significant except for maxillary incisors in males and maxillary lateral incisor in females.

Table No. 2: Comparison of Total Tooth Material (TTM) between Crowded and Spaced Dentition in Males and Females

Variables	Sex	Arch	Crowded		Spaced		T-test P - value	Significance
			Mean	S.D.	Mean	S.D.		
Total tooth material (TTM)	M	Maxillary	98.84929	4.63281	94.3179	5.584662	0.031669	S
		Mandibular	90.196	2.533281	84.438125	6.14396638	0.0025069	S
	F	Maxillary	96.21933	2.409484	92.10267	2.846104	0.001289	S
		Mandibular	88.74867	2.652707	81.676	3.9206373	5.26088E.06	S

TTM between crowded and spaced dentition groups was compared in males as well as females for both the maxillary and the mandibular arch (Table No. 2). In males, as well as females, the mean values of TTM in the crowded dentition group were significantly greater than that of the spaced dentition group in both the maxillary and mandibular arch.

The mean values of MD width of each measured tooth between crowded and spaced dentition groups were compared in males as well as females (Table No. 3, 4). In the males the mean values of each measured tooth in the crowded dentition group were more than that of the spaced dentition group in both the arches. On statistical evaluation, in the maxillary arch, there was a statistically significant difference in the M-D width of each measured teeth except central incisor between crowded and spaced dentition groups. In mandibular arch there was a statistically significant difference in the MD width of each measured teeth except second premolar between crowded and spaced dentition groups (Table No. 3).

In females also the mean values of MD tooth width of each measured teeth in the crowded dentition group were more than that of spaced group in both the arches. In the maxillary arch, except lateral incisor all other measured teeth showed significant difference in the MD width while in the mandibular arch, all the measured teeth showed statistically significant difference in the MD width between crowded and spaced dentition groups (Table No. 4).

The statistical assessment of error by Dahlberg's method showed that the maxillary first premolar in the average dentition group had the highest error (0.0045 mm), and the maxillary canine in the spaced dentition group had the lowest error (0.000). This was statistically not significant.

Table No. 3: Comparison of Mean Values of MD Crown Dimensions of Teeth between Crowded and Spaced Dentitions in Males

Arch	Tooth type	Crowded		Spaced		T-test P-value	significance
		Mean	S.D.	Mean	S.D.		
Maxillary	I1	9.011071	0.470385	8.660769	0.774638	0.053328	NS
	I2	7.338571	0.547044	6.946538	0.725484	0.030692	S
	C	8.140357	0.523397	7.802308	0.382542	0.008918	S*
	P1	7.456071	0.560101	7.064615	0.392981	0.004376	S*
	P2	6.984286	0.403195	6.655385	0.576508	0.020049	S
Mandibular	I1	6.054	0.920826	5.274063	0.535735	0.0002	S*
	I2	6.424333	0.315121	5.7040625	0.401825	0.001	S*
	C	7.250333	0.36392	6.766563	0.625035	0.000454	S*
	P1	7.370667	0.556943	6.836875	0.607844	0.00063	S*
	P2	7.107667	0.472219	6.93	0.654892	0.223492	NS

Table No. 4: Comparison of Mean Values of MD Crown Dimensions of Teeth between Crowded and Spaced Dentitions in Females

Arch	Tooth type	Crowded		Spaced		T-test P-value	Significance
		Mean	S.D.	Mean	S.D.		
Maxillary	I1	8.829	0.390997	8.351666667	0.244612055	7.68846E-07	S*
	I2	6.924667	0.572091	6.741666667	0.322266578	0.133770698	NS
	C	7.806667	0.473245	7.451333333	0.370570235	0.002045379	S*
	P1	7.190333	0.358305	6.85	0.463561922	0.002417811	S*
	P2	6.860667	0.318292	6.600666667	0.362785 52	0.004593244	S*
Mandibular	I1	5.696333	0.319716	5.132333333	0.319716289	4.18069E-09	S*
	I2	6.301333	0.38405	5.672	0.373689895	2.61778E-08	S*
	C	6.932333	0.410598	6.420666667	0.266483 27	5.91599E-07	S*
	P1	7.340333	0.407655	6.678	0.408448705	4.57275E-08	S*
	P2	7.238667	0.397065	6.722666667	0.503607218	4.90061E-05	S*

Discussion:

Tooth size arch length discrepancy or Bolton's ratio which is also considered as seventh key[4] to normal occlusion is an important factor while planning for ideal arch alignment. It would appear from the literature[1, 5-8] that conflicting evidence exists regarding the role of tooth size in crowding. Thus the present study was conducted to evaluate the correlation between tooth size in crowded and spaced dentition groups having Angle's Class I dental occlusion.

In most of the previous studies[1,5-8] on tooth size the sample selection has been done irrespective of dental malocclusion type. But the type of malocclusion and associated soft tissue aberrations can also affect the amount of crowding and spacing present in the arch, this can lead to inappropriate conclusions.

The study conducted by Fattahi et al[9] concludes that subjects with Angle class III malocclusion had significantly greater prevalence of tooth size discrepancy than those with Angle's class I and class II malocclusion. Thus, to eliminate all these problems which may confound the result, in the current study all the samples having Angle's class I dental occlusion were selected so the effect of tooth size on crowding and spacing can be studied separately.

In the current study all the measurements were taken on non-soaped dental casts as soaped models may affect the tooth size measurements. This was in accordance with a study conducted by Hunter and Priest et al[10], which concluded that soaped models were slightly larger in overall dimension.

Many investigators related sex with the mesio distal crown dimensions of teeth and hence the relationship with crowding. According to Garn[11], Bishara[12], Lavelle[13], Claudia et al[14], and Schwartz[15] tooth sizes differ according to sex i.e. male teeth are somewhat larger than female teeth. Findings of our study are in accordance with the above mentioned studies as mesio distal width of each measured tooth in both the groups considered (crowded and spaced) in the current study had showed that males have significantly larger tooth size as compared to females. The age group of the subjects in the study was between 12 to 25 years. As early adulthood dentition has less mutilation and less attrition in most of the subjects. Thus effect of these factors on mesio distal tooth width would be negligible. This was in accordance to the studies of Doris et al[7] and N. Puri et al[8] who indicated that early permanent dentitions provide the best sample for tooth size measurements. Earlier studies on tooth morphology have been conducted by using either direct intraoral measurements or measurements on the cast. Direct intraoral measurements cannot be taken easily and accurately particularly for the posterior teeth. The accuracy of plaster cast made from alginate impression was investigated by Hunter and Priest[10] who in his study concluded that alginate impression produce the most accurate dental cast when poured immediately. Thus in our study we have obtained measurements of tooth dimensions from the plaster casts poured from alginate impressions immediatetely after taking the impressions and stock traus were used. Mean values of mesio distal width of all the measured teeth and TTM were significantly greater in the crowded dentition group as compared to spaced dentition group in both males and females. These findings were in accordance with the earlier studies[2,3,16] which found that the groups with crowded arches had consistently larger teeth than those with less or no crowding. In contrast, other studies[17, 18] have been unable to distinguish between crowded and non-crowded dentition on the basis of mesio-distal tooth dimensions. The study by Tsai et al[19] showed that there is no difference in the tooth size between crowded and spaced groups in primary anterior teeth.

This study validates that there is a statistically significant correlation between tooth size and dental crowding. Large teeth were found to be associated (not always) with crowding and smaller teeth were found to be associated with spacing (not always). Because the results are consistent and widespread across all the tooth types, it can be inferred that tooth size is an important risk factor for malocclusion.

Conclusions:

The purpose of the current study was to determine the influence of tooth size in crowded and spaced dentition and whether people with bigger tooth crown dimensions were at a greater risk of having malocclusions assessed as tooth-size arch-size discrepancies (TSASD).

Major findings are:

MD crown dimensions of all the measured teeth and TTM were greater in crowding dentition groups than in spaced dentition, and the difference was statistically significant.

In males, mandibular central incisor displayed the maximum component of variability, while mandibular second premolar exhibited the least variability among the two groups.

Both mesiodistal width and Total tooth material, of all the measured teeth in both the sample group, were significantly greater for males than females, thereby confirming the sexual dimorphism in tooth size.

In females, mandibular first premolar showed the maximum component of variability while maxillary lateral incisor exhibited the least variability among the two groups.

Clinical relevance:

1. While evaluating malocclusion tooth size should be measured and considered an important etiological factor.
2. As tooth crown size is a risk factor for tooth size arch size discrepancy, the clinical solution is to reduce tooth mass by extraction or reproximation and also we can increase the arch dimensions where options are limited.

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