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MESIODISTAL CROWN DIMENSIONS OF THE PERMANENT DENTITION AMONG SCHOOL GOING CHILDREN IN PUNJAB POPULATION: AN AID IN SEX DETERMINATION

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ABSTRACT

Background: Variation in tooth size is influenced by genetics and environmental factors. To improve the quality of dental care available, data is required on the Mesiodistal crown dimensions of the teeth of Punjab population.

Materials and Methods: The study sample consisted of study casts of 300 subjects (150 males; 150 females) with an age range of 12-14 years of Punjab population. Alginate Impressions of both arches were taken and dental casts were made. Mesiodistal dimension of all incisors and canines was measured with the help of Digital Vernier Caliper.

Results: Males had significantly larger teeth than females. Mandibular canines showed statistically highly significant (p≤.001) sexual dimorphism as compared to maxillary canines. Statistically significant dimorphism was exhibited by only two permanent maxillary anterior teeth, i.e., right and left maxillary canines. A higher variability was found in the maxillary lateral incisor as compared to other teeth.

Conclusion: These results obtained could be of help to suggest a standard for the mesiodistal crown dimensions of the permanent dentition of Punjab population.

Key words: Mesiodistal crown dimensions, Permanent dentition, Punjab population

INTRODUCTION:

The variety of teeth, number and morphology in each individual, is a fact which increases its importance as an identifying element.[1] The relative indestructibility of the teeth make them important structures in tracing human evolution, and thereby provide valuable morphological characters for both paleontological and genetic studies.[2]

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One of the most critical factors in dental arch development and the relation of the arches to one another is mesiodistal diameter of the tooth.[3] Thus, the space necessary to allow the proper alignment of all teeth within the dental arch is the sum of all mesiodistal widths of the teeth to fit within that arch.[4] The mesio-distal widths of teeth were first formally investigated by G.V. Black in 1902.

Teeth being the central component of the masticatory apparatus of the skull are good sources of material for civil and medico legal identification.[5] Sex determination is one of the important parameters in forensic identification.[6] Sexual dimorphism refers to the systemic difference in the form (either in shape or size) between individuals of different sexes in the same species.[6] Sex determination using dental features is primarily based upon the comparison of tooth dimensions in males and females.

Richardson et al[7] found teeth of males to be larger than those of females for each type of tooth in both the arches. Sanin and Savara[8] reported differences in crown size patterns even among good occlusion cases. Howe et al[8] in their study found combined mesiodistal width for males to be more as compared to females.

In the anthropological fields, studies have been conducted directly or indirectly. Study models provide a three dimensional view of the maxillary and mandibular dental arches. According to Santoro et al[9], Plaster study models are a standard component of orthodontic records.

Since very scant research had been done on Punjab population, hence as an embankment into this field, a study was planned and conducted to establish a normative data of the permanent Incisors and Canine of children in Punjab.

MATERIAL AND METHODS:

Eleven hundred children were examined from a contemporary population of Punjab which included children studying in the different schools of Punjab and those seen in the out-patient block of Department of Pedodontics and Preventive Dentistry, National Dental College and Hospital, Derabassi, Punjab. All the subjects were diagnosed as having Class I occlusion, with no history of orthodontic treatment. The sample consisted of good quality study casts of both maxillary and mandibular of 300 subjects (150 males and 150 females) with an age range of 12-14 years of Punjabi ethnic population. Written consents were obtained from the parents of all students who underwent examination and/or impression taking.

Inclusion criteria:Fully erupted dentition up to first permanent molar with no interproximal caries, restorations, attrition, and dental anomaly.

No previous or ongoing orthodontic treatment.

Exclusion criteria: Clinically evident interproximal dental caries.

An alteration in the number or shape of the teeth that might affect the diameter of the dental arch.

Any oral habit that might influence the dental arch.

Experience of orthodontic treatment prior to the start of examination.

Impressions of both maxillary and mandibular arches were made using standard protocols and according to manufacturers' recommendations using irreversible hydrocolloid; Alginate (Tropicalgin chromatic alginate material; Zhermack). After the complete setting of the alginate, tray was removed from the mouth and poured immediately in Green Dental Stone (Kalstone Dental Stone Class III; Kalabhai, Mumbai). The green dental stone was allowed to set for at least 60 min after which it was gently separated from the impressions. After trimming the models, bases were made with Plaster of Paris (Kaldent Dental plaster class II; Kalabhai, Mumbai) with teeth in occlusion. The study models thus prepared were finished and polished.

Measurements: The maximum mesiodistal dimension of all permanent maxillary and Mandibular Incisors and Canine on the study models between the mesial and distal contact points on its approximal surfaces was measured with the help of a Digital Vernier Caliper with an accuracy of 0.01 mm (Precise, Germany), which was held parallel to the occlusal plane perpendicular to the tooth's long axis.

All measurements were carried out by a single examiner to eliminate intraobserver error. For assessment of intraexaminer error; the data collection procedure was repeated by randomly selecting the study models of 40 subjects. The measurements were made by the same examiner at an interval of 1 week. Dahlberg's method[10] for calculation of error was applied and a range of 0.051-0.183 mm was obtained and considered clinically acceptable.

Statistical Analysis: The data were subsequently processed and analyzed using SPSS statistical software program. Independent *t*-test and Paired t-test were employed to evaluate the results. All tests had 0.05 level of statistical significance. This study was approved by an institutional review board.

RESULTS:

Data were collected from 300 study casts of children ages from 12 years to 14 years. One hundred and fifty subjects were males (50%) and one hundred and fifty were females (150%). Table 1 and 2 shows mean mesiodistal crown dimensions, standard deviation and standard error for incisors and canine in males, females; on both sides in Maxillary and Mandibular permanent dentition. Statistical analysis of these results was found to be varying significantly. Comparison of Mesiodistal

Crown Dimensions of Permanent Right and Left Maxillary Incisors and Canine in males and females is elaborated in Table 3 and 4. Table 5 and 6 depicts the comparison of Mesiodistal Crown Dimensions of Permanent Right and Left Mandibular Incisors and Canines for both sexes.

DISSCUSION:

One of the basic fundamentals with which the orthodontist has to deal in constructing the denture is tooth size, specifically the mesiodistal width of the teeth.[11] It is essential for the clinician to know the size of individual tooth and groups of teeth, to make an adequate diagnosis and treatment plan.[8] The Orthodontic examination may be incomplete without a careful analysis of the patterns of mesiodistal crown size relationships.

Dunn and Dobzhansky[8] have indicated that although all human beings belong to a single species, humans inhabiting different parts of the world are exposed to different environments and are not alike. Various authors like Richardson & Malhotra, Moyers et al, Moorrees et al, Santoro et al, Bishara et al, Singh & Goyal have presented literature for tooth dimensions of different populations; some variations in tooth sizes between gender and among different racial and ethnic groups.[12]

With these considerations, a study was planned to analyze the Mesiodistal Crown Dimensions of the permanent dentition among school going children in Punjab. An age range between 12-14years was chosen as these children would have minimal dental attrition and the teeth to be measured in this study would have erupted into the oral cavity in both dental arches. Doris et al[13] indicated that early permanent dentitions provide the best sample for tooth size measurements because early adulthood dentition has less mutilation and less attrition in most individuals. Consequently the affect of these factors on actual mesiodistal tooth width will be minimum.

In the maxilla, mean mesiodistal crown dimension of central incisor was larger than lateral incisor, which was consistent with findings in an earlier Nigerian study (Adeyemi & Isiekwe, 2003)[14] and in other populations (Richardson & Malhotra 1975[7]; Santoro et al 2000[3]; Singh & Goyal 2006[8] and Uysal & Sari, 2005[15]). The permanent right and left maxillary canines were the only teeth which showed dimorphism in our study. (Table 1) The mesiodistal width of maxillary teeth showed a greater degree of variability as compared to mandibular teeth, with the maxillary lateral incisors showing the maximum variability.

In the mandibular arch, the mean mesiodistal crown dimension of the central incisor was smaller than the lateral incisor as reported elsewhere (Richardson & Malhotra 1975[7]; Uysal & Sari, 2005).[15] (Table 2) However, these results do not agree with the findings of

Moss whose approach could have been influenced by a small sample size and the fact that they used extracted teeth which were less in number than the complete set of teeth available from each individual.[8]

In the present study, mean mesiodistal crown dimensions of males were found to be larger than those of females for each type of tooth in the maxillary and mandibular arch. (Table 1, 2) Significant differences were observed between sexes for teeth. This is consistent with Garn et al[16] who indicated that the teeth of males were larger than those of females. Ling et al[17] also observed sexual dimorphism in permanent teeth. Authors, such as (Barrett et al 1963[18], Richardson & Malhotra 1975[7], Buschang et al 1988[18] and Singh & Goyal 2006[8]) also showed similar observations.

Various theories have been given in the literature for this sexual dimorphism:

According to Moss, it is because of the greater thickness of enamel in males due to the long period of amelogenesis as compared to females. However, in females the completion of calcification of the crown occurs earlier in both deciduous and permanent dentition as quoted by de Vito.[5]

Sex chromosomes are also known to cause different effects on tooth size. The 'Y' chromosome influences the timing and rate of body development, thus producing slower male maturation, and acts additively and to a greater extent than the 'X' chromosome.[5]

According to Pratibha et al[5], 'Y' chromosome has a direct effect on tooth size, which may be related to a more non-specific effect of hetrerochromatism or cellular activity.

Kalia. S[19] quoted that according to Townscend, the difference in size has been attributed to differently balanced hormonal production between the sexes consequent to the differentiation of either male or female gonads during the sixth or seventh week of embryogenesis rather than any direct effect of sex chromosome themselves.

According to Lewis et al. there is a low significant correction between sexual dimorphism of teeth and body size and it has been supported by Frayer and Wolpoff.[5]

Our results showed that sexual dimorphism was observed for every tooth included in the study between males and females. Besides this, statistically significant dimorphism was exhibited by only two permanent maxillary anterior teeth, i.e., right and left maxillary canines. Our result of maxillary canine dimorphism was in accordance with Khangura et al[6] who also reported similar findings in their study. Otuyemi and Noar[20] showed dimorphism in maxillary canines bilaterally.

According to Garn et al[16], teeth have behaved in many ways through the course of evolution, ranging from reduction of the entire dentition to reduction of one group of teeth in relation to another. It has been postulated that in the evolution of primates, canines are functionally not masticatory but are related to threat of aggression. A transfer of this aggressive function occurred from the teeth to the fingers in man. Until this transfer was complete, survival was dependent on canines especially in the males. Thus in present day humans the sexual dimorphism in canines is not mere coincidence but based on functional activity.[21]

Another reason for this dimorphism could be a biologic variation, which is a characteristic of life and is attributed to family, genetics and environmental factors.[21] Variation in food resources exploited by different populations has also been explained as one such environmental cause.[5]

Our results showed statistically highly significant sexual dimorphism for mandibular canine as compared to maxillary canine (Table 3, 4). This corroborates with the findings of Kaushal et al[22] and Garn et al[16] who also reported statistically significant sexual dimorphism for mandibular canine. However, Minzuno reported that maxillary canine showed a higher degree of sexual dimorphism compared to the mandibular canine in a Japanese population.[6] Khangura et al[6] quoted various factors for this dimorphism. They suggested variation in food resources exploited by different populations as one such environmental cause. Other authors have suggested that there could be a complex interaction between a variety of genetic and environmental factors that are responsible for dimorphism.

CONCLUSION:

Males had larger teeth as compared to females. Male - Female comparisons indicated the presence of sexual dimorphism between two sexes. Mandibular canines showed statistically highly significant sexual dimorphism as compared to maxillary canines.A higher variability was found in the maxillary lateral incisor as compared to other teeth. This tooth should be examined carefully to exclude any major size and shape discrepancy.

Our values for mesiodistal crown dimensions for the present population could be used for treatment planning regarding space management, operative dentistry and management of malocclusion for the local population. These conclusions could greatly influence clinical decision-making, and further studies should be undertaken in this field.

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TABLES:

Table 1: Mesiodistal Crown Dimensions of Permanent Maxillary Incisors and Canines for Male and Female groups of Punjab population (12-14years)

TOOTH	RIGHT					LEFT					
	GENDER		MEAN†	S.D	C.V	GENDER		MEAN†	S.D	C.V	OVERALL MEAN†
CENTRAL INCISOR	M	11	8.86	.50	6.03	M	21	8.86	.52	6.81	8.86
	F	11	8.48	.49	5.10	F	21	8.47	.50	6.33	8.48
LATERAL INCISOR	M	12	6.91	.57	8.15	M	22	6.87	.61	9.13	6.89
	F	12	6.79	.47	8.18	F	22	6.79	.47	7.29	6.79
CANINE	M	13	7.65	.41	6.14	M	23	7.63	.41	5.92	7.64
	F	13	7.54	.43	5.54	F	23	7.46	.42	5.78	7.50

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D- Standard Deviation; S.E- Standard Error of Mean; C.V – Coefficient of Variation

Table 2: Mesiodistal Crown Dimensions of Permanent Mandibular Incisors and Canines for Male and Female groups of Punjab population (12-14years)

TOOTH	RIGHT					LEFT					
	GENDER		MEAN†	S.D	C.V	GENDER		MEAN†	S.D	C.V	OVERALL MEAN
CENTRAL INCISOR	M	41	5.80	.40	7.01	M	31	5.80	.40	7.12	5.80
	F	41	5.40	.35	6.70	F	31	5.37	.30	5.53	5.39
LATERAL INCISOR	M	42	6.19	.36	6.67	M	32	6.19	.36	7.13	6.19
	F	42	5.82	.33	5.77	F	32	5.80	.32	5.33	5.81
CANINE	M	43	6.90	.42	5.99	M	33	6.93	.42	6.30	6.92
	F	43	6.73	.35	4.99	F	33	6.72	.35	5.42	6.73
	F	46	10.95	.57	5.15	F	36	10.91	.53	4.71	10.93

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D – Standard Deviation; S.E – Standard Error of Mean; C.V – Coefficient of Variation

Table 3: Comparison of Mesiodistal Crown Dimensions of Permanent Right Maxillary Incisors and Canine with Permanent Left Maxillary Incisors and Canine in Males of Punjab population (12-14years)

Gender	Tooth Pairs	Tooth	N	Mean†	S.D	S.E	p value
MALES	Set 1	11	150	8.86	.50	.04	.095
		21	150	8.86	.52	.04	
	Set 2	12	150	6.91	.57	.05	.090
		22	150	6.87	.61	.05	
	Set 3	13	150	7.65	.41	.03	.050*
		23	150	7.63	.41	.03	

*p≤0.05 Significant, **p≤0.01, ***p≤0.001 Highly Significant; p>0.05 Non Significant

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D – Standard Deviation; S.E – Standard Error of Mean

Table 4: Comparison of Mesiodistal Crown Dimensions of Permanent Right Maxillary Incisors and Canines with Permanent Left Maxillary Incisors and Canines in Females of Punjab population (12-14years)

Gender		Tooth	N	Mean†	S.D	S.E	p value
FEMALES	Set 1	11	150	8.48	.49	.04	.071
		21	150	8.47	.50	.04	
	Set 2	12	150	6.79	.47	.04	.671
		22	150	6.79	.47	.04	
	Set 3	13	150	7.54	.43	.04	<.001***
		23	150	7.46	.42	.03	

*p≤0.05 Significant, **p≤0.01, ***p≤0.001 Highly Significant, p>0.05 Non Significant

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D – Standard Deviation; S.E – Standard Error of Mean

Table 5: Comparison of Mesiodistal Crown Dimensions of Permanent Right Mandibular Incisors and Canine with Permanent Left Mandibular Incisors and Canine in Males of Punjab population (12-14years)

Gender		Tooth	N	Mean†	S.D	S.E	p value
MALES	Set 7	31	150	5.80	.40	.03	.103
		41	150	5.80	.40	.03	
	Set 8	32	150	6.19	.36	.03	.158
		42	150	6.19	.36	.03	
	Set 9	33	150	6.93	.42	.03	.115
		43	150	6.90	.42	.03	

p>0.05 Non Significant

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D – Standard Deviation; S.E – Standard Error of Mean

Table 6: Comparison of Mesiodistal Crown Dimensions of Permanent Right Mandibular Incisors and Canine with Permanent Left Mandibular Incisors and Canine in Females of Punjab population (12-14years)

Gender	Tooth Pairs	Tooth	N	Mean†	S.D	S.E	p value
FEMALES	Set 7	31	150	5.37	.30	.02	.063
		41	150	5.40	.35	.03	
	Set 8	32	150	5.80	.32	.03	.200
		42	150	5.82	.33	.03	
	Set 9	33	150	6.72	.35	.03	.164
		43	150	6.73	.35	.03	

p>0.05 Non Significant

†Mean Mesiodistal crown dimension of each tooth is represented in millimetres (mm)

S.D – Standard Deviation; S.E – Standard Error of Mean