Sexual Dimorphism in the Permanent Dentition of a Turkish Population

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Abstract

Introduction: The purpose of this study is to investigate the differences in buccolingual and mesiodistal crown diameters between males and females in a Turkish population.

Methods: Buccolingual and mesiodistal crown diameters were measured from orthodontic diagnostic models of 50 male and 70 female patients. The measurements were carried out on 28 teeth, including the lower and upper second molar teeth. To eliminate error, measurements were repeated at a different time by the same investigator on 25 randomly selected models.

Results: Strong correlations were found between the first and second measurements. The results of the study reveal that male teeth are larger in both dimensions than female teeth. Statistically significant differences exist between the sexes in the majority of teeth (except upper I2 and lower I1 mesiodistally and lower I2 buccolingually). Dimorphism was more pronounced in buccolingual measurements than in mesiodistal measurements. The most significant sexual dimorphism was found in the upper and lower canines mesiodistally and in the upper incisors and upper molars buccolingually.

Conclusion: This study reveals dental size differences between the sexes in a Turkish population. It provides important information for dentists, anthropologists, and forensic specialists.

Keywords: Tooth size, Permanent dentition, Sexual dimorphism.

Introduction

Teeth are the dentist's main area of interest, and it is important to determine their general morphological characteristics if abnormal conditions are to be detected effectively. General morphological characteristics include the dimensions of teeth, the number of roots, crown–root ratios, the number of tubercles, and anatomical variations. In addition, the mesiodistal crown dimensions are an important factor in the proper alignment of the teeth in the jaw and in the proper establishment of the occlusion, both of which are important issues for orthodontists.(1)

Tooth morphology and odontometric measurements are of interest not only to dentists but also in other branches of science, such as anthropology and forensic medicine. As Bailit points out, small differences in dental characteristics, both intra- and inter-population, may have great importance for anthropologists, because such differences reflect an ongoing evolutionary process.(2)

Many studies have shown that dental dimensions provide important evidence for gender determination in skeletal remains where gender cannot be determined by routine methods.(3) The most common technique used to determine the sex of a corpse is assessment of the physical characteristics of the pelvis and skull.(4) However, it is not possible to determine sex in this way when the body is severely damaged. Teeth, however, maintain their integrity and morphological properties even if the body is damaged to an advanced degree.(5)

Like many biological structures, dental structures are affected by both genetic and environmental factors.(6) Lundstrom investigated 97 double monozygotic and dizygotic twins and found a significant correlation in the mesiodistal tooth dimensions of the monozygotic twins.(7) Environmental factors such as prenatal and postnatal illnesses, nutrition, maternal drugs used during pregnancy, and climate differences also affect the morphology and structure of teeth. Brook and colleagues report that children with low birth weight had more enamel defects at a statistically significant level.(8)

Since tooth dimensions are influenced by both genetic and environmental factors, the data obtained from studies conducted for a specific race or region cannot be regarded as a general norm. Many studies have shown that different populations have different dental norms and that teeth show varying degrees of sexual dimorphism in different populations. Although studies conducted for different populations have provided valuable data, the literature contains only a limited number of studies on tooth dimensions in Turkish populations. The aim of the present study is to investigate tooth size and sexual dimorphism in the permanent dentation of present-day Turks.

Materials and Methods

This study was carried out on dental plaster models, obtained prior to orthodontic treatment, of 120 patients (70 female, 50 male) who applied to XXXXXX University, Faculty of Dentistry, Department of Orthodontics. Patients included in the study were in the age range of 14 to 25. The mean age of the male patients was 15.5 years, and the mean age of the female patients was 16.5 years. Individuals with all permanent teeth fully erupted (except third molars) were included.

Individuals excluded from the study were those with dental crowding that would complicate the measurement process, and those with dental caries, abrasions, attrition, restoration, or congenital dental anomalies in their teeth. Individuals over 25 years of age were also excluded because of the mesiodistal attritions that occur with age.

Dental impressions were obtained from the patients using alginate. The impressions were then filled immediately with dental plaster. Manual vibration was applied to prevent the formation of air bubbles. The distances between most distal and most mesial points and between most buccal/labial and most palatinal/lingual points of all the crowns were then measured from the plaster models.[9] Measurements of all permanent teeth in both lower and upper jaws (except the third molar teeth) were carried out by the same investigator (H.Y.) using a digital caliper sensitive to 0.01 mm.

Statistical Analyses

To detect method error, mesiodistal and buccolingual measurements on the upper and lower right teeth were repeated at a different time by the same investigator on 25 randomly selected models. The Pearson correlation coefficient was used to correlate the first and second measurements.

Statistical analyses were performed using SPSS 19 (IBM SPSS Statistics 19, SPSS Inc., an IBM Co., Somers, NY). Data were expressed as mean, standard deviation, and range. An independent sample t-test was used to compare continuous normal data between the groups. A p value of <0.05 was considered significant.

The differences between male and female tooth sizes were calculated using the formula for sexual dimorphism defined by Garn and colleagues:[10]

$$(male\ mean - female\ mean / female\ mean) \times 100$$

Results

Table 1 shows the results of intra-observer error for the first and second measurements taken at different times. High correlation rates were found for both the buccolingual and the mesiodistal measurements. Tables 2 and 3 give the means, standard deviations, ranges, and percentages of sexual dimorphism for buccolingual and mesiodistal dimensions of both maxillary and mandibular teeth.

The most variable mesiodistal tooth diameters were in the upper first premolars in females and the upper first molars in males. In buccolingual measurements, the upper second premolars in females and the lower second molars in males showed the most variation.

Sexual dimorphism was more evident in the buccolingual dimensions than in the mesiodistal dimensions. In terms of mesiodistal measurements, mandibular teeth (except central incisors) were more dimorphic than maxillary teeth. However, in terms of buccolingual measurements, a similar relationship was detected in canine and premolar teeth only.

All mesiodistal and buccolingual tooth diameters were found to be larger for males than for females. Statistically significant differences were found between the sexes in the majority of teeth (except the upper lateral and lower central incisors mesiodistally and the lower lateral incisors buccolingually).

In mesiodistal measurements, canines were found to be the most dimorphic teeth. Lower first premolars also showed significant sexual dimorphism, followed by upper first molars, lower first molars, and lower second molars.

In buccolingual measurements, upper incisors and upper molars were found to be the most dimorphic teeth, followed by lower canines and lower first premolars.

Discussion

Hunter and Priest have examined the accuracy of measurements taken from plaster casts obtained from alginate impressions. They found that measurements taken from plaster models were more reliable than those taken directly from the mouth.[11] This is probably due to the difficulties of accessing the posterior teeth and of manipulating the measuring instrument in the mouth. It has also been shown that measurements taken from plaster models differ slightly from the original dental dimensions, although the difference is not statistically significant.[11]

The results of the current study indicate that sexual dimorphism was more evident in buccolingual measurements than in mesiodistal measurements, consistent with the relevant literature.[12,13,14] For purposes of gender assessment, it may therefore be more appropriate to use maximum buccolingual crown diameters, if available, rather than mesiodistal diameters, or to use both measurements together (as suggested by Acharya and Mainali).[15] Nevertheless, Hilson and colleagues have claimed that cervical and diagonal measurements for worn teeth are as reliable as maximum crown measurements.[9] Buccolingual cervical diameters have been reported as correlating strongly with maximum buccolingual crown diameters in all teeth; mesiodistal cervical diameters correlated strongly with normal mesiodistal crown diameters in incisors and canines, but less so in premolars and molars.[9] Zorba and colleagues also pointed out that there are no serious differences between the two methods in terms of studying cervical and maximum crown diameters.[16]

In the study conducted by Iscan and colleagues in Turkey in 2003, male tooth dimensions were found to be larger than female tooth dimensions buccolingually.[12] In other studies conducted in Turkey, mesiodistal, buccolingual, and diagonal tooth dimensions were found to be larger in men than in women.[13,17] Similar results were found in studies

conducted on Greek, Chinese, and Dominican American populations.[16,18,19] The findings of the present research are consistent with the literature, in that all the mesiodistal and buccolingual measurements of male teeth were found to be larger than those of female teeth. It can therefore be said that there is almost complete consensus in the literature on this subject. Although this information is often not sufficient by itself for gender identification (due to considerable population variation), it can be used as supporting information in conjunction with other available data.

In many different populations exposed to different environmental factors, the teeth of males are larger than those of females. This indicates the dominance of the genetic influence on female and male tooth sizes rather than the influence of environmental factors. The X chromosome is known to stimulate amelogenesis, and the Y chromosome is known to stimulate dentinogenesis.[20,21] The proportion of enamel in female teeth is also known to be higher than in male teeth, and the dentin layer is known to be thicker in men than in women.[22,23] Some researchers infer from this that the differences in male and female tooth sizes are due to different thicknesses of dentin and enamel.[24,25]

The lower and upper canines have repeatedly been shown to be the most dimorphic teeth in both mesiodistal and buccolingual aspects.[1,10] Some studies have even indicated that the teeth adjacent to the canines (such as the lateral incisor and first premolar) show a greater degree of sexual dimorphism than the distant teeth, leading to the hypothesis of a "canine field".[10,14] However, a study carried out on a Nepalese population showed consistent univariate sex differences in the upper central and molar teeth as well as in the canine teeth.[15] In a study that assessed the upper teeth in a Portuguese population, the upper laterals were found to be more dimorphic than the upper canines.[5] Bishara reports sexual dimorphism in canines and first molars in populations in Mexico, Egypt, and the United States.[26]

In the present study, the canine teeth showed significant sexual dimorphism in both the mesiodistal and the buccolingual dimensions. However, no significant canine field was identified. A diffuse dimorphism between the teeth was determined, in the buccolingual measurements in particular, and the upper incisors and upper molars were found to have the greatest degree of sexual dimorphism; the upper lateral teeth were found to have the highest percentage of sexual dimorphism. These findings are in line with another study conducted in a Turkish population, in which buccolingual measurements indicated high dimorphism in the upper lateral teeth as well as in the upper and lower canines.[12] Nevertheless, Ates and colleagues found the most dimorphic variables to be the lower buccolingual dimensions of the second incisor and canine.[13]

According to the results of this study, mandibular teeth (except the central incisors) are more dimorphic than maxillary teeth for mesiodistal measurements. However, there was no such clear relationship for buccolingual measurements. Iscan and colleagues report no significant difference between the two jaws in buccolingual measurements in a Turkish population.[12] In terms of diagonal measurements, Karaman and colleagues found that the lower teeth were more dimorphic than the upper teeth, as they were in mesiodistal measurements.[17] In contrast, maxillary teeth were found to be more dimorphic than mandibular teeth in Greeks.[16]

Table 1. Bivariate correlation for mesiodistal and buccolingual tooth diameters

Tooth		Mesiodistal measurements		Buccolingual measurements	
	n	**r**	***p***	**r**	***p***
11	25	0.975	<0.001	0.957	<0.001
12	25	0.956	<0.001	0.961	<0.001
13	25	0.929	<0.001	0.951	<0.001
14	25	0.981	<0.001	0.974	<0.001
15	25	0.665	<0.001	0.983	<0.001
16	25	0.708	<0.001	0.931	<0.001
17	25	0.987	<0.001	0.829	0.041
41	25	0.954	<0.001	0.933	<0.001
42	25	0.977	<0.001	0.927	<0.001
43	25	0.950	<0.001	0.857	<0.001
44	25	0.986	<0.001	0.931	<0.001
45	25	0.991	<0.001	0.832	<0.001
46	25	0.981	<0.001	0.965	<0.001
47	25	0.982	<0.001	0.955	<0.001

Pearson correlation coefficient was used.

Table 2. Descriptive statistics for mesiodistal tooth diameters (in millimeters)

Tooth	Female *(n=70)*			Male *(n=50)*			% Sexual dimorphism	*t-value*	*p*
	Mean	SD	Range	Mean	SD	Range			
11+21	8.81	0.46	2.10	9.04	0.57	2.90	2.61	3.31**	0.001
12+22	6.88	0.48	2.49	6.94	0.52	2.51	0.87	1.02	0.309
13+23	7.91	0.42	2.05	8.23	0.46	1.99	4.05	5.60***	<0.001
14+24	7.06	0.77	8.32	7.26	0.48	2.02	2.83	2.41*	0.017
15+25	6.82	0.42	2.11	6.97	0.48	2.46	2.20	2.62*	0.009
16+26	10.29	0.57	4.68	10.65	0.64	4.55	3.50	4.62***	<0.001
17+27	9.70	0.64	2.88	9.91	0.63	3.38	2.16	2.54*	0.012
31+41	5.53	0.31	1.58	5.61	0.35	1.53	1.45	1.91	0.057
32+42	6.03	0.33	1.54	6.14	0.37	1.98	1.82	2.60*	0.010
33+43	6.80	0.38	1.96	7.16	0.46	2.20	5.29	6.37***	<0.001
34+44	7.05	0.43	2.03	7.35	0.47	2.12	4.26	5.12***	<0.001
35+45	7.19	0.52	2.98	7.37	0.51	2.64	2.50	2.76*	0.006
36+46	10.96	0.58	2.97	11.39	0.63	3.68	3.92	5.47***	<0.001
37+47	10.32	0.61	3.67	10.62	0.67	3.35	2.91	3.64***	<0.001

* $p<0.05$, ** $p<0.005$, *** $p<0.001$

Table 3. Descriptive statistics for buccolingual tooth diameters (in millimeters)

Tooth	Female *(n=70)*			Male *(n=50)*			% Sexual dimorphism	*t-value*	*p*
	Mean	SD	Range	Mean	SD	Range			
11+21	7.21	0.46	2.72	7.59	0.51	3.20	5.27	6.08***	<0.001
12+22	6.38	0.46	2.66	6.84	0.68	4.14	7.21	6.04***	<0.001
13+23	8.08	0.52	3.62	8.49	1.12	10.54	5.07	3.43**	0.001
14+24	9.16	0.59	3.09	9.39	0.72	2.99	2.51	2.65*	0.009
15+25	9.22	0.65	5.27	9.66	0.82	4.80	4.77	4.61***	<0.001
16+26	11.19	0.55	3.79	11.64	0.60	3.40	4.02	6.14***	<0.001
17+27	10.98	0.65	4.33	11.57	0.70	3.02	5.37	6.80***	<0.001
31+41	6.02	0.44	2.42	6.28	0.48	2.93	4.32	4.50***	<0.001
32+42	6.36	0.42	2.78	6.48	0.81	8.08	1.89	1.43	0.155
33+43	7.26	0.52	3.35	7.75	0.78	3.63	6.75	5.55***	<0.001
34+44	7.68	0.50	2.77	8.08	0.56	3.12	5.21	5.87***	<0.001
35+45	8.40	0.53	3.06	8.81	0.74	4.01	4.88	4.76***	<0.001
36+46	10.52	0.55	3.99	10.91	0.73	4.89	3.71	4.64***	<0.001
37+47	10.23	0.56	2.78	10.56	1.22	12.87	3.23	2.77**	0.006

* $p<0.05$, ** $p<0.005$, *** $p<0.001$

Conclusion

This study reveals the following dental size differences between the sexes in a Turkish population:

1. Male teeth are larger than female teeth.
2. Buccolingual diameters are more dimorphic than mesiodistal diameters.
3. Mandibular teeth are more dimorphic than maxillary teeth for mesiodistal measurements.
4. Canine teeth are the most dimorphic mesiodistally.
5. Upper incisors and upper molars are the most dimorphic buccolingually.

The data from this study provide important information for anthropologists and forensic specialists and may also help in determining anomalies in dental dimensions.

Conflict of Interest and Sources of Funding Statement

No external funding was available for this study. The authors declare that there are no conflicts of interest in this study.

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