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Original Articles

Sexual Dimorphism in Odontometric Dimensions of Maxillary Teeth in Bulgarians

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The aim of the present study was to determine the sex differences in odontometric dimensions of maxillary teeth in Bulgarians. The study included 169 subjects of Bulgarian origin in the age group of 20-40 years. Buccolingual, mesiodistal and cervicoincisal dimensions of maxillary teeth were measured by Dentistry Sliding Vernier Caliper and analyzed with SPSS 23.0. Cervicoincisal dimensions in maxillary incisors, canines, premolars and molars were significantly higher in males compared to females. Similar significant differences were found in mesiodistal dimensions in maxillary canines and molars. Buccolingual dimensions in upper molars were significantly higher in males compared to females. The results of the present measurements exhibited significant sex differences in maxillary teeth in Bulgarians. Our results showed that maxillary canines and molars exhibited the greatest sexual dimorphism. In accordance with similar odontometric studies, teeth may differentiate both genders and thus determine the need for further investigations in this field.

Key words: sex differences, odontometric dimensions, maxillary teeth.

Introduction

Sex determination in forensic anthropology is an essential step for medicolegal purposes and crucial for identification as the number of possible matches is reduced to 50% [2]. The identification of sex is of significance not only in cases of mass fatality incidents where bodies are damaged beyond recognition but also in situations where only fragments

of jaw bones with teeth (or teeth alone) are found. Teeth, being the central component of the masticatory apparatus of skull, are excellent material in living and nonliving populations for anthropological, genetic, odontologic and forensic investigations, because they are the hardest and chemically the most stable tissue in the body [3]. Odontometrics help us determining sex in young individuals in whom secondary sexual characters have not developed. It is cheaper than the DNA analyses and does not require specific techniques. Sex determination using dental features is based on the comparison of tooth dimensions in males and females, or upon the comparison of frequencies of non-metric dental traits, like Carabelli's trait of upper molars, deflecting wrinkle of lower first molars, distal accessory ridge of the upper and lower canines or shoveling of the upper central incisors. Therefore, odontometrics provide information on sex. There are numerous studies in which differences in male and female odontometric features in specific populations have been identified. Since there are such differences within the same population, it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements. Standards for one population are not useful for other populations. The aim of this study is to evaluate the degree of sexual dimorphism in the maxillary teeth for the South region of Bulgarian population and thus to present odontometrics as an easy-to-use additional technique to determine sex.

Materials and methods

The present study included 86 males and 83 females of Bulgarian origin living in Pazardzhik and Plovdiv in the age group 20-40years. Before starting the study, subjects were informed about the nature of the study and written informed consents were obtained. Patients were included based on the following criteria:

- presence of complete set of fully erupted and periodontally healthy maxillary teeth
- presence of non-carious and non-worn maxillary teeth
- no dental history of any crown restorations or bridges
- normal occlusion

Exclusion criteria:

- History or clinical evidence of cleft palate
- Orthognathic surgery or trauma
- History or clinical features suggestive of endocranial disorders, metabolic disorders, developmental disorders and history of prolonged illness

Buccolingual, mesiodistal and cervicoincisal (coronal height) dimensions of maxillary teeth were measured by Dentistry Sliding Vernier Caliper, Ridge Mapping Caliper Type A and Type B. We used the technique of Martin-Saller, 1957, modified by Prof. Yordanov [18]. According to him the mesiodistal dimension is the greatest mesiodistal distance between the contact points of maxillary teeth, usually it is in the upper or middle third of coronal height. It is also termed the dental width. The buccolingual (vestibulolingual) dimension, also termed as the dental thickness is the greatest dimension between buccal and lingual surfaces of crown, taken at right angle

to the plane in which mesiodistal diameter is taken. Cervicoincisal (cervicoocclusal) dimension, also termed as the coronal height is the greatest dimension by vertical axis from the tip of the highest tubercle to the cervical line on the buccal side. For the coronal height of the maxillary molars we used the technique of Zubov, 1968, modified by Prof. Yordanov, 2012. According to it it is better to measure the height between the occlusal surface (the lowest point between the two vestibular tubercles) and the cervical line, without considering the height of the tubercles.

The measurements were analyzed with SPSS 23.0 using Student's t-test. The level of statistical significance was set at $P< 0.05$. The degree of significance was considered weak ($P<0,05$), moderate ($0,01>P>0,001$) or high ($P<0,001$).

Results

1. We found statistically significant differences between the two sexes in the coronal height of the maxillary central and lateral incisors. In the right and left central incisors and in the right lateral incisor there was moderate degree of significance ($0,01>P>0,001$), while in the left lateral incisor the degree of significance was weak ($P<0,05$). The mean values in males were higher than in females (**Table 1**).

Table 1. Comparison between coronal height of maxillary incisors in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
I11H	86	9.30	0.94	0.14	83	8.77	0.90	0.14	0.008
I12H	86	7.88	1.05	0.16	83	7.32	0.78	0.12	0.006
I21H	86	9.30	0.83	0.13	83	8.74	0.90	0.14	0.004
I22H	86	7.79	1.06	0.16	83	7.26	0.88	0.13	0.013

2. Similar differences were found in the coronal height of the maxillary canines, but they were with high degree of significance ($P<0,001$). Males show higher values than females (**Table 2**).

Table 2. Comparison between coronal height of maxillary canines in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
C13H	86	9.40	0.69	0.11	83	8.67	0.78	0.12	0.000
C23H	86	9.42	0.70	0.11	83	8.65	0.81	0.12	0.000

3. Coronal height of the maxillary premolars showed statistically significant higher values in males compared to females. The degree of significance in the first premolars and the second left premolar was weak ($P<0,05$), while in the second right premolar we found moderate degree of significance ($0,01>P>0,001$), (**Table 3**).

4. We found statistically significant differences in the coronal height of the upper molars between the two sexes in favor of males again with the exception of the left

second molar where no statistically significant differences were found. In the right molars the degree of significance was moderate (0,01>P>0,001), while the first left molar showed weak degree of significance (P<0,05), (**Table 4**).

Table 3. Comparison between coronal height of maxillary premolars in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
P14H	86	6.95	0.87	0.13	83	6.58	0.63	0.10	0.026
P15H	86	6.65	0.72	0.11	83	6.21	0.60	0.09	0.003
P24H	86	6.95	0.87	0.13	83	6.53	0.59	0.09	0.011
P25H	86	6.58	0.70	0.11	83	6.23	0.57	0.09	0.013

Table 4. Comparison between coronal height of maxillary molars in Bulgarian males and females

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
M16H	86	6.19	0.55	0.08	83	5.81	0.55	0.08	0.002
M17H	86	6.12	0.50	0.08	83	5.74	0.49	0.08	0.001
M26H	86	6.16	0.75	0.11	83	5.81	0.59	0.09	0.019
M27H	86	5.95	0.62	0.09	83	5.72	0.55	0.08	0.068

5. Mesiodistal dimensions of the maxillary canines showed statistically significant higher values in males compared to females with high degree of significance (P<0,001), (**Table 5**).

6. Similar significant differences between the two sexes were found in the mesiodistal dimensions of upper first right and left molars again in benefit of males with high degree of significance (P<0,001), (**Table 6**).

Table 5. Comparison between mesiodistal dimensions of maxillary canines in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
C13MD	86	8.72	0.63	0.10	83	7.95	0.65	0.10	0.000
C23MD	86	8.72	0.59	0.09	83	7.95	0.62	0.09	0.000

Table 6. Comparison between mesiodistal dimensions of maxillary molars in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
M16MD	86	10.70	0.67	0.10	83	9.95	0.62	0.09	0.000
M17MD	86	10.00	0.53	0.08	83	9.56	1.48	0.23	0.070
M26MD	86	10.58	0.82	0.13	83	10.00	0.65	0.10	0.000
M27MD	86	9.98	0.51	0.08	83	9.77	0.65	0.10	0.100

7. We found statistically significant differences between males and females in the vestibulolinqual dimensions of the maxillary first right and left molars with moderate degree of significance (0,01>P>0,001). Males showed higher mean values than females (**Table 7**).

Table 7. Comparison between vestibulolingual dimensions of maxillary molars in Bulgarian males and females.

	Males				Females				Sexual differences
Tooth	N	Mean	SD	SE	N	Mean	SD	SE	P
M16VL	86	10.84	0.53	0,08	83	10.53	0.59	0.09	0.015
M17VL	86	10.47	0.55	0.08	83	10.23	0.57	0.09	0.058
M26VL	86	10.84	0.53	0.08	83	10.56	0.59	0.09	0.024
M27VL	86	10.35	0.53	0.08	83	10.26	0.58	0.09	0.440

Discussion

Our results showed sexual dimorphism in some of the dimensions of the maxillary teeth. The mean values were statistically higher in males than females. They are in accordance with similar results found by Ditch and Rose [3] who were the first proved that teeth can be used successfully for defining the sex. Other authors confirmed these results - Iscan and Kedici [5], Pettenati- Soubayroux [14]. We found statistically significant differences in the coronal height of all maxillary teeth in favor of males which is probably related with the fact that males have larger cranial sizes and more specifically lower third of the face [6]. Avinash Tejasvi measured the circumference of the cranium in Indians and also proved larger cranial sizes in males compared to women [18]. Differences in the coronal height of maxillary teeth proving sexual dimorphism in favor of males were described by Bhuvan Nagpal [9], Lakhanpal [7], Garn[4].

According to the present study there were statistically significant differences in the mesiodistal dimensions of the maxillary canines and molars and in the vestibulolingual dimensions of the maxillary molars. The mean values in males were again higher compared to females. The reasons for the bigger odontometric dimensions in the male maxillary teeth are probably the differences in the differentiation of the dentition in males and females. According to Schwartz and Dean [17] the concentration of the sexual hormones during the development of the tooth germ is related with that. The differences in the odontometric dimensions between the sexes is due to the thickness of the tooth dentin which is more in males because the mitotic cellular activity in the dental epithelium and papilla are influenced by the Y- chromosome. This chromosome induces genesis of dentin which defines the size of the enamel-dentinal junction. These findings are in accordance with the results of Smith [16] and Saunnders [15] who claimed that there was larger dentinal zone in males which leads to greater odontometric dimensions in the male maxillary teeth.

Garn proposed formula for calculating the percentage of the sexual dimorphism: ((Xm/Xf)-1) *100 where Xm is the mean value of the dental size in males and Xf – in females [4].

Our results showed that the mesiodistal dimensions of the maxillary canines have the highest degree of sexual dimorphism (9,68 %) with statistically significance of high level (P<0,001). These results are similar to the ones from Acharya [1]. Krishnamurthy studied the teeth in South Indians [6], while Lund and Mornstad measured the dental size of the Sweden population [8] and both claimed that the mesiodistal dimensions of the maxillary canines showed the highest degree of sexual dimorphism.

Our results showed high degree of sexual dimorphism in the mesiodistal dimensions of the maxillary molars (7,54%) also in favor of males. These findings are in accordance with the ones from Narang SR [10] who studied North Indians and Iscan and Kedici who described similar significant differences in the maxillary molars of Turkish population [5].

In contrast to our study where the mesiodistal dimensions of the maxillary canines and molars showed the highest degree of sexual dimorphism other authors claimed that the vestibulolingual dimensions of the maxillary canines and molars showed higher degree of sexual dimorphism. Such results were published by Nikola who studied the odontometric dimensions in Austrian population [11].

We did not find statistically significant differences between the two sexes in the mesiodistal and vestibulolingual dimensions of the maxillary central and lateral incisors. In contrast to that Peckmann TR found significant sexual dimorphism in the maxillary central incisors of Chilian population [12]. Similar results were published by Pereira C who found sexual dimorphism in the maxillary lateral incisors of Portuguese population [13].

The fact that in different populations different maxillary teeth show sexual dimorphism proves that the odontometric dimensions are population specific which defines the need of data for each population.

In some studies mesiodistal dimensions show higher degree of sexual dimorphism, in others vestibulolingual dimensions show higher degree of sexual dimorphism. Due to these reasons it is recommended measuring of all the odontometric dimensions.

Conclusion

Sexual dimorphism in tooth size and the accuracy of odontometric sex prediction is found to vary in different population and therefore it is necessary to determine specific population values in order to make identification possible.The present study revealed the existence of sex differences in the coronal height of maxillaryincisors, canines, premolars and molars, mesiodistal dimensions of maxillary canines and first molars and vestibulolingual dimensions in maxillary molars in Bulgarians. Our results showed that maxillary canines and molars exhibited the greatest sexual dimorphism. In accordance with similar odontometric studies, teeth may successfully differentiate both sexes and thus determine the need for further investigations in this field.

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