



ESTIMATION OF CANINE DIMENSIONS AS PREDICTORS OF SEX IN THE SOUTHERN BULGARIAN POPULATION

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ABSTRACT

Purpose. Sex determination in forensic anthropology is an essential step for medicolegal purposes and very important for identification, as the number of possible matches will be halved. A dental profile includes all the individual dental traits and dimensions which can provide significant information on such human biological problems as the genetic relationships between populations and human environmental adaptation. The purpose of this research was to determine the sex differences in dental measurements of canines, inter-canine width, and canine indices in Bulgarians.

Material and Methods. The study included 169 subjects of Bulgarian origin in the age group of 20 – 40 years. Buccolingual, mesio-distal and cervicoincisal diameters of canines and inter-canine width were measured by Dentistry Sliding Vernier Caliper and analyzed with SPSS 28.0. Maxillary and mandibular canine indices were calculated.

Results. Mesio-distal and cervicoincisal dimensions of upper canines, inter-canine width and mandibular canine index exhibited statistically significant differences with a high degree of significance between males and females in contrast with the maxillary canine index of Bulgarian males and females, which revealed no statistically significant differences.

Conclusion. In accordance with similar odontometric studies, canines, inter-canine width, and mandibular canine index may differentiate both sexes successfully, and thus they can be reliable predictors in forensic identification.

Keywords: sex differences, canines, inter-canine width, canine index, Bulgarians, forensic anthropology.

INTRODUCTION

Forensic dentistry is a vital branch of forensic sciences which deals with the investigation and evaluation of dental evidence for identification of victims of crime, accidents, or calamities. In case when visual identification of victims is difficult due to the destruction of the soft tissue, the skull and teeth often provide the identification material. [1] Teeth are the hardest and most robust tissues of the human body. They are resistant to decomposition even in major accidents, crime, burial, or other severe exposure to the elements. Dental patterns are unique for every individual thus, they form an excellent material for forensic investigations. [2] Many authors reported the application of tooth features for defining approximate age. [3] Identification of sex is also important in decreasing the number of victims, allowing the exclusion of half of the population. This research proves the importance of dental dimensions in sexual dimorphism for the following reason: the pelvis is by far the most precise structural indicator, especially the femur [4], but may be fragmented; sexual peculiarities in bone of non-adults are not fully developed; DNA analysis can give precise results, but it is expensive and time requiring. Many studies have identified differences in male and female optometric features, but the degree of sexual dimorphism in dental size differs from one population to another [5, 6] Many researchers report that canines are among the most dimorphic teeth. [7] They are a good candidate for sex determination because they are often present in old age because they are the least extracted teeth due to their resistance to periodontal disease, dental attrition, and abrasion. [8]

Facial attractiveness has a key role in modern society, and it affects self-esteem, social opportunities, professional performance, and employment prospects. Smile is the summary of features, which includes the lips, soft tissue (gingiva) and hard tissue (teeth). Numerous factors, such as the color, the shape, the size, the proportions of the teeth and the shape of the dental arch, contribute to dental aesthetics. They are influenced by individual preferences, cul-

tural factors, and sociodemographic factors. The selection of teeth for an edentulous patient can be challenging, especially when no pre-extraction records exist. The size, form and color of the teeth must be in harmony with surrounding oral and facial structures. [9]

In anthropology, certain ratios between some dental and cephalometric dimensions are of great interest because they can assist in studying evolutionary trends in anthropological processes. The main features of the human masticatory system are the maxilla and mandible, teeth, temporomandibular joint, and masticatory muscles. It is functionally connected to nutrition and also to articulated speech. Therefore, it has undergone enormous development in human history. The factors that led to this are various: change of food type, usage of fire and different tools, different climate upright position, enlargement of cerebral dimensions, change in climate and lifestyle, the formation of language and speech. [10]

Therefore, standards for one population are not applicable to other populations. The purpose of this study is to assess the extent of sexual dimorphism in the canines, the inter-canine width, and the canine indices in the southern Bulgarian population and thus to reveal its application in forensic anthropology and dental prosthetics and orthodontics.

MATERIALS AND METHODS

The present research included 86 males and 83 females of Bulgarian origin from South Bulgaria in the age group 20-40 years. Before starting the study, subjects were informed about its nature, and written informed consent was obtained. Patients were included based on the following criteria: the presence of a complete set of fully erupted and periodontally healthy teeth, presence of non-carious and non-worn teeth, no dental history of any crown restorations or bridges, normal occlusion.

Exclusion criteria were 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, mesio-distal and cervicoincisal (coronal height) diameters of canines were obtained. We used the technique of direct anthropometry, modified by Prof. Yordanov [11]. According to him, the mesio-distal dimension is the largest mesio-distal distance between the contact points of the canines, usually, it is in the upper or middle third of the coronal height. It is also termed the dental width. The buccolingual (vestibulo-lingual) dimension, also termed as the dental thickness is the greatest dimension between the buccal and lingual surfaces of the crown, taken at the right angle to the plane in which the mesiodistal diameter is taken. The cervicoincisal (cervico-occlusal) dimension, also termed as the coronal height, is the greatest dimension by the vertical axis from the tip of the incisive margin to the cervical line on the buccal side.

We also measured maxillary and mandibular inter-canine distance as the linear distance between, respectively, upper and lower canines from right to left.

We used Dentistry Sliding Vernier Caliper, Ridge Mapping Caliper Type A and Type B.

Canine indices were calculated using the following formulas:

Maxillary canine index (MaxCI)= Mesiodistal crown width/Maxillary inter-canine distance

Mandibular canine index (ManCI)= Mesiodistal crown width/Mandibular inter-canine distance

The measurements were analyzed with SPSS 28.0 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 mesiodistal dimensions and coronal height of the **maxillary canines** on both right and left sides with a high degree of significance ($P < 0.001$), while in the vestibulolingual dimensions, there was no statistically significant difference. The mean values in males were significantly higher than in females.

Table 1. Comparison between dimensions of maxillary canines in Bulgarian males and females.

Tooth	Males				Females				Sexual differences
	N	Mean	SD	SE	N	Mean	SD	SE	P
C13MD	86	8.72	0.63	0.96	83	7.95	0.65	0.1	0
C13VL	86	8.02	0.89	0.14	83	7.98	0.8	0.12	0.799
C13H	86	9.4	0.7	0.1	83	8.67	0.79	0.12	0
C23MD	86	8.72	0.59	0.09	83	7.95	0.62	0.09	0
C23VL	86	8.02	0.91	0.14	83	8	0.79	0.12	0.9
C23H	86	9.42	0.7	0.11	83	8.65	0.81	0.12	0

2. Our results revealed statistically significant differences between mesiodistal dimensions of mandibular left and right canines, but the degree of significance was weak ($P < 0.05$). No

statistically significant differences in vestibulolingual dimensions and coronal height were exhibited. Mean values in males were again higher than those in females.

Table 2. Comparison between dimensions of mandibular canines in Bulgarian males and females.

Tooth	Males				Females				Sexual differences
	N	Mean	SD	SE	N	Mean	SD	SE	P
C43MD	86	6.88	0.85	0.13	83	6.51	0.59	0.09	0.021
C43VL	86	7.44	1.01	0.15	83	7.44	0.85	0.13	1.000
C43H	86	8.79	0.8	0.12	83	8.65	0.9	0.14	0.449
C33MD	86	6.88	0.73	0.11	83	6.51	0.59	0.09	0.011
C33VL	86	7.33	1.02	0.16	83	7.47	0.85	0.13	0.493
C33H	86	8.77	0.90	0.14	83	8.60	0.95	0.15	0.417

3. Significant differences between inter-canine distance in Bulgarian males and females for both jaws were revealed. They had a high degree of significance, and the mean values were higher in males ($P < 0,001$). The maxillary canine index did not show a significant

difference between the two sexes. In contrast, the mandibular canine index exhibited a statistically significant difference with a high degree of significance, and the mean values in females were higher than in males.

Table 3. Comparison between inter-canine width and canine indices in Bulgarian males and females.

	Males				Females				Sexual differences
	N	Mean	SD	SE	N	Mean	SD	SE	P
ICanMax	86	38.42	0.88	0.13	83	34.26	0,79	0.12	0
ICanMan	86	32.63	1.22	0.19	83	26.16	0.75	0.11	0
MaxCI		0.227	0.02	0		0.232	0.02	0	0.182
ManCI		0.211	0.03	0		0.249	0.02	0	0

DISCUSSION

Our results showed sexual dimorphism in some of the dimensions of canines. Mesio-distal dimensions and coronal height of the maxillary canines revealed statistically significant differences between Bulgarian males and females, with a high degree of significance for both the right and left sides of the jaw. The mean values were statistically higher in males than females. These findings are in accordance with the research of Khangura et al., who measured the dimensions of permanent maxillary canines in northern Indians. [12] Differences in these dimensions of the canines in favor of males were also reported by Omar and Azab, who conducted a study among Egyptians. [13] The reasons for the larger odontometric dimensions in the male canines are probably the differences in the differentiation of the dentition in males and females. According to Schwartz and Dean, the concentration of the sexual hormones during the development of the tooth germ is related to that. [14] The differences in the odontometric dimensions between the sexes are 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- Y-chromosome. This chromosome induces the genesis of dentin, which defines the size of the enamel-dentinal junction. These

findings are in accordance with the results of Saunders [15], who claimed that there was a larger dentinal zone in males, which leads to greater odontometric dimensions in the male canines.

Our study showed the difference between the mesiodistal dimensions of the mandibular canines but with the weak degree of significance, which is in accordance with the research of Ali Ahmed, who measured the mandibular canines in Iraqis. [16] Our findings are in contrast with other research, which reported that mandibular canines are the most dimorphic teeth. [17] We think that the fact that maxillary canines exhibited differences with a larger degree of significance than mandibular is probably due to the difference in the time of the upper and lower jaw's embryonic development and the different mechanism of growth between the two jaws. The maxilla stops its development earlier than the mandible, while the mandible's development continues until adolescence.

According to our results, maxillary and mandibular inter-canine distance showed statistically significant differences with a high degree of significance between males and females. Also, Gupta et al. [8] reported a similar significant difference between the inter-canine width of males and females. Otuaga et al. measured inter-canine distance in Nigerians and claimed that it is significantly

higher in males than in females. [18] This is probably due to the fact that males have larger cranial sizes. Avinash Tejasvi measured the circumference of the cranium in Indians and also proved the males had larger cranial sizes than females [19].

Our research revealed no statistically significant differences between the maxillary canine index of Bulgarian males and females, while the difference between the mandibular canine index was a high degree of significance. Similar findings were reported by other authors. [8] The mean values this time were higher in females than in males. Similar observations have been reported by Archaya and Mainali [20], who stated reversed sexual dimorphism in canines in Nepalese population. These findings could be attributable to evolution resulting in a reduction in sexual dimorphism. Maxillary and mandibular indices show the relation between canine width and inter-canine distance, which is very useful in dentistry for defining certain values applicable to dental treatment. We believe that our findings can be useful for prosthodontists, who must determine tooth size and shape to achieve an optimal aesthetic result when treating patients with missing canines. If the size and shape of a replaced tooth are not in harmony with the patients' face and other teeth, psychological and social problems might arise. [21] Orthodontist can use canine index values to determine how much space is needed to be opened.

CONCLUSION

Sexual dimorphism in dental dimensions and the accuracy of odontometric sex prediction are found to vary in different populations, and therefore, it is necessary to determine specific population values in order to assist forensic identification. The present study revealed the existence of sex differences in the mesio-distal diameters and coronal height of maxillary canines, inter-canine width, and mandibular canine index with a high degree of significance. The mean values were higher in males

than females except for the mandibular canine index, where females showed higher mean values. In accordance with similar research, we think that canines may successfully differentiate both sexes and thus determine the need for further investigations in this field.

Abbreviations

C13MD - mediolateral dimension of maxillary right canine
C13VL - vestibulolingual dimension of maxillary right canine
C13H - height of maxillary right canine
C23MD - mediolateral dimension of maxillary left canine
C23VL - vestibulolingual dimension of maxillary left canine
C23H - height of maxillary left canine
C33MD - mediolateral dimension of mandibular left canine
C33VL - vestibulolingual dimension of mandibular left canine
C33H - height of mandibular left canine
C43MD - mediolateral dimension of mandibular right canine
C43VL - vestibulolingual dimension of mandibular right canine
C43H - height of mandibular right canine
IcanMax - Inter-canine maxillary distance
IcanMan - Inter-canine mandibular distance
MaxCI - Maxillary canine index
ManCI - Mandibular canine index

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