

Sexual Dimorphism of the First Permanent Maxillary Molars – Research on the Population of Central Bosnia

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ABSTRACT

Aim of this study was to examine the existence of sexual dimorphism of the first permanent maxillary molars in the population of central Bosnia. The sample for the study comprised 94 subjects with intact crowns of the first permanent maxillary molars, without orthodontic anomalies. Mesiodistal and buccopalatal diameters were measured on the plaster models, based on calculated variables: robustness index or crown area (IRC) and sexual dimorphism (SD). Linear dimensions of the first permanent maxillary molars, as well as the IRC exhibited sexual dimorphism with larger values in males, except MD diameter on the left side. The greatest sexual dimorphism demonstrates IRC from the right. Linear dimensions of the first permanent maxillary molars and IRC can be used for sex determination in population of Central Bosnia.

Key words: sexual dimorphism, forensic dentistry, molars, tooth size, crown area

Introduction

Determination of the sexual dimorphism of skeletal remains with no identity is a basic step in medico legal and anthropological researches^{1,2}. Methods of the determination of sex depend on the type and condition of bones. The only method that gives completely accurate results is the DNA technique, although in many cases it can not be used³. DNA analysis is expensive and time-consuming method, which is looking for qualified professionals and sometimes it is impossible because of the decomposition of the body or its contamination⁴.

The teeth are an excellent material for anthropological, genetical, odontological and forensic research, because they are resistant to various ante-mortem and post-mortem changes, more than other skeletal parts, and the fact that the development of most of the teeth ends before skeletal maturation makes them valuable indicator of sex⁵⁻⁷. According to many studies, teeth show sexual dimorphism, which can be used for sex determination⁸. Determination of sex using dental characteristics is primarily based on the comparison of the dimension of teeth or dental nonmetric characteristics between men and women².

Differences in odontometric characteristics of teeth exist between different populations and races, as well as within the same. Knowing these characteristics of pri-

mary and permanent teeth, certain populations may be useful in the development of anthropological profile, especially when there are no other sources of information⁹.

Therefore, it is essential to establish specific population standards, in order to be able to compare the data to the different time periods and different geographical areas⁹. This is supported by research results Lagocka et al., who say that the basic dimensions of teeth in Caucasian who live in the territory of present Poland have not changed over the past 700-900 years¹⁰. For all these reasons, the use of dental morphology to determine the sex is the procedure that can be applied in a variety of researches, especially in forensic odontology, where sex is determined even from fragments of jaws and dentition¹¹.

Canines and first permanent maxillary molars show the greatest sexual dimorphism. The canines are at least extracted teeth due to the relatively reduced incidence of dental caries and periodontal diseases. On the other hand, the advantage of the first molars is early sprouting and a very small percentage of impacts. Gender in adults can be accurately determined if the skeleton is preserved. But odontometric measurements continue to be very important in sex estimation^{6,12}. Aim of this study was to examine the existence of sexual dimorphism of the first permanent maxillary molars based on linear dimensions (mesiodistal and buccopalatal) in the population of central Bosnia.

Materials and Methods

The sample of the study comprised 94 patients aged 15-25 years, with intact crowns first permanent maxillary molars. The selection criteria were: all study casts were of good quality, all teeth were fully erupted, no proximal caries, restorations or abrasion of first molars, no orthodontic treatment, no abnormal tooth morphology. Following measurements were carried out on the models: mesiodistal and buccopalatal diameter of the first permanent maxillary molars.

Mesiodistal diameter (MD) of the crown is the largest mesiodistal dimension between the contact points in parallel with the occlusal surface.

Buccopalatal diameter (BP) of the crown is the greatest distance between the buccal and palatal surfaces of the crown, taken at right angles to the occlusal surface. All measurements are done by one researcher using a digital caliper (0.01mm accuracy).

Based on the obtained measurements, following variables were calculated:

1. Crown area or tooth robustness index (IRC) is the product of BP and MD dimensions, derived by multiplying the linear measurements (i.e. BPxMD).
2. Index of sexual dimorphism

$$ISD=(X_m/X_f - 1) * 100,$$

X_m – the average value for men

X_f – the average value for women.

All statistical analyses were performed using SPSS 15.0 (SPSS, Inc, Chicago, IL) and MedCalc® Statistical Software, version 9. Comparisons between sexes and between left and right side were done using Student's t-test.

Results

Mean values of mesiodistal and buccopalatal dimensions of left and right first permanent maxillary molars are shown in Table 1 and 2.

TABLE 1

MEAN VALUES OF MD DIAMETER FOR MALES AND FEMALES ON BOTH SIDES OF THE MAXILLA

	Sex	N	MV	Std. deviation	Std. error
MDL	Males	36	10.49	.58	.09
	Females	58	10.41	.64	.08
T test: t=0.619, p=0.537					
MDR	Males	36	10.65	.59	.09
	Females	58	10.32	.68	.09

T test: t=2.439, p=0.017

MDL – mesiodistal diameter (left side), MDR – mesiodistal diameter (right side), N – the total sample, MV – mean value

Mesiodistal diameter of the first permanent maxillary molars on the right side was higher in men than in women ($p<0.05$), while there was no significant difference between the sexes on the left side (Table 1). Buccopalatal diameter on both sides of maxilla was significantly higher in male compared to female ($p<0.001$, Table 2).

Percentage of sexual dimorphism was greater for BP dimension (4.4% for the left side and 3.8% for the right side) relative to the MD dimension. Of all the dimensions of the crown, the crown area index (IRC) showed the highest percentage of sexual dimorphism (5.4% for the left side and 7.0% for the right side) (Table 3).

TABLE 2

MEAN VALUES OF BP DIAMETER FOR MALES AND FEMALES ON BOTH SIDES OF THE MAXILLA

	Sex	N	MV	Std. deviation	Std. error
BPL	Males	36	11.48	.64	.10
	Females	58	10.98	.59	.07
T test: t=3.781, p=0.000					
BPR	Males	36	11.51	.65	.10
	Females	58	11.09	.61	.08

T test: t=3.151, p=0.002

BPL – buccopalatal diameter (left side), BPR – buccopalatal diameter (right side), N - the total sample, MV – mean value

TABLE 3

MEAN VALUES AND SEXUAL DIMORPHISM FOR THE STUDIED PARAMETERS

	MDL	MDR	BPL	BPR	IRCL	IRCR
X_m	10.5	10.7	11.4	11.5	120.8	122.9
X_f	10.4	10.3	11.0	11.1	114.6	114.8
ISD	0.8	3.2	4.4	3.8	5.4	7.0

MDL – mesiodistal diameter (left side), MDR - mesiodistal diameter (right side), BPL - buccopalatal diameter (left side), BPR – buccopalatal diameter (right side), IRCL – tooth robustness index at left side (crown area), IRCR – tooth robustness index at right side (crown area), X_m – the average value for men, X_f - the average value for women, ISD – index of sexual dimorphism (percentage)

Discussion

The fact that the development of the majority of teeth is complete before skeletal maturity, dentition makes a valuable indicator of sex, particularly young people⁸. There are no odontometric standards for sex estimation in Bosnian population. This study determined the existence of sexual dimorphism of the first permanent maxillary molars based on linear dimensions measured on plaster casts. Mesiodistal and buccopalatal dimension of the teeth controls the combination of hereditary and external factors, and it's necessary to conduct studies on different populations, so data can be compared and used in practice^{13,14}.

Comparison of the mean values of measured parameters between males and females in this study shows that there is no significant difference in MD diameter on the left side, while the right side of the MD diameter was significantly higher in males, which is in accordance with the results of Deo¹⁵.

BP diameter was statistically higher in males than females on both sides of maxilla. These results are in accordance with research of Harris, Suazo and Prathiba^{16–18}.

Many authors considered that males have larger teeth dimensions than females, which is attributed to the impact of the Y chromosome, which is believed to control the thickness of dentin, while the X chromosome is responsible for the thickness of the enamel^{11–14,19–21}.

Studies carried out on different populations show different percentage of dimorphism of maxillary molars. The greatest sexual dimorphism in this study has BP diameter on the left side (4.4%), which is similar to the results of Sonika⁸, while Narang²² found greater dimensions to the left.

In this research, the BP diameter shows greater sexual dimorphism in relation to the MD diameter on both sides, which is in concordance to researches of Sonika⁸, Garn²³ and Ahmed²⁴. These differences in dimorphism are explained by various factors. Some authors attribute this to the influence of external factors, such as diet, cultural and biological factors²².

A higher percentage sexual dimorphism of BP diameter compared to the MD diameter in this study agrees with the results of research Agnihotri on the population Jat Sikhs¹³, Garn on American whites²³ and Filipovic on the population of Serbia¹². MD dimensions are also sometimes difficult to measure due to the proximal contact between the teeth, excessive attrition and interproximal wear¹².

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Crown area in this study was higher in males than in females on the left and right side of maxilla. Index of sexual dimorphism of the crown area was greater on the right side (7.0%), compared to the right side (5.4%).

This is in concordance with the results of Kondo and Townsend²⁵ and Agnihotri¹³, which say that overall size of the crown, as well as individual cusps, show sexual dimorphism with the values larger in males.

The results of this study contribute to the knowledge of dental profile of the Bosnian population and the establishment of specific population standards for sex determination, and have their application in dental forensics and orthodontics.

Conclusion

Sexual dimorphism is the specific population characteristic. According to this research, the linear dimensions of the first permanent maxillary molar, particularly the BP diameter, and the variables calculated from linear dimensions (crown area and index of sexual dimorphism), can be used for sex determination.

Every country should have its odontometric population standards for sex estimation in forensic and anthropological cases. It is necessary to do research on a larger sample to establish specific data for the whole Bosnian population.

This research on the maxillary molars on the population of Central Bosnia provides useful information for anthropological, genetic, odontology and forensic research, especially due to the fact that the morphology of the teeth is under the influence of cultural, racial and external factors.

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SPOLNI DIMORFIZAM PRVOG STALNOG MAKSILARNOG MOLARA – ISTRAŽIVANJE NA POPULACIJI SREDNJE BOSNE

SAŽETAK

Cilj ovog rada je ispitivanje postojanja spolnog dimorfizma prvog stalnog maksilarnog molara na populaciji srednje Bosne. Uzorak studije su činila 94 ispitanika sa intaktnim krunicama prvih stalnih maksilarnih molara, bez ortodontskih nepravilnosti. Na studijskim modelima su vršena sljedeća mjerenja: meziodistalni (MD) i bukopalatinalni (BP) dijametar prvog stalnog maksilarnog molara, na osnovu kojih su izračunate varijable: indeks robusnosti krunice (IRC) i indeks spolnog dimorfizma (ISD). Linearne dimenzije prvog stalnog maksilarnog molara, kao i IRC pokazuju spolni dimorfizam sa vrijednostima većim kod muškog spola, osim MD promjera sa lijeve strane. Najveći spolni dimorfizam pokazuje IRC sa desne strane. Linearne dimenzije prvog stalnog maksilarnog molara, kao i IRC mogu biti upotrijebljene za određivanje spola u populaciji centralne Bosne.