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ODONTOMETRIC ANALYSIS OF PERMANENT CANINES IN GENDER DETERMINATION

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Abstract - Establishing the gender of a dead person is an important procedure in forensic medicine, especially during mass disasters. Teeth are very important material as they are available even after considerable postmortal changes because they are resistant to chemical and mechanical agents. The results of this study indicate that there are significant differences between the sexes in canine dimorphism. The conducted research suggests using the linear dimensions of permanent maxillary and mandibular canines as an additional method for gender determination in forensic practice because of speed and simplicity.

Key words: Canine width, mandibular/maxillary canine, sexual dimorphism

INTRODUCTION

The characteristics of teeth are subject to numerous investigations by anthropologists, biologists, orthodontists and forensic experts (Ling, 2007). Teeth are the hardest mineralized tissue in the human body, which makes them resistant to mechanical, chemical and thermal effects. The resistance of teeth to postmortem destruction compared to other parts of the human body renders them useful for identifying the sex of victims in mass disasters (Van der Kuijl et al., 1995; Blau et al., 2006; Ermenc et al., 1999; Brannon et al., 2003; Bux et al., 2006; Ndiokwelu et al., 2003; Dawidson, 2007).

The concept of sexual dimorphism refers to differences in size, appearance, shape, etc. between males and females that can be applied to dental identification because no two people are identical (Kiesu, 1990). Sexual dimorphism of the permanent teeth has been the subject of previous studies (Jensen et al., 1957; Gomez, 2005; Kondo et al., 2004; Suazo et al., 2008; Astete et al., 2009), where it was shown that males have larger teeth than females (Garn et al., 1966; Lavelle, 1972; Bernabe et al., 2004; Schwartz et al., 2005, Adeymi et al., 2003). Tooth size varies between populations (Schwartz et al., 2005; Bernabe et al., 2006; Smith et al., 2000; Santoro et al., 2000; Ta Ta et al., 2001). Sex determination using dental characteristics is based on the comparison of tooth size between men and women (Vodanović et al., 2007) or the frequency of immeasurable tooth marks, such as the presence of the Carabelli tuberculum on the upper molars. The two most commonly used parameters in determining a person's sex based on dental measurements are the mesiodistal and buccolingual crown diameter of the permanent teeth (Iscan et al., 2003). The mesiodistal diameter of the maxillary and mandibular canines provides evidence of sex determination based on the existence of sexual dimorphism (Mohammed et al., 1997).

Since there are no odontometric standards for determining sex in the Serbian population, the purpose

of this study was to analyze the presence of sexual dimorphism in the mesiodistal and buccolingual diameter of the maxillary and mandibular permanent canines in a sample of Serbs.

MATERIALS AND METHODS

The material of the present study consists of plaster casts of the permanent dentition of 200 Serbian subjects (100 males and 100 females). The population from which the sample was taken included patients for orthodontic treatment in the Department of Orthodontics at the Medical Faculty in Niš, aged 18-25 years. The selection criteria were: (i) the presence of completely erupted permanent canines; (ii) good quality of study models; (iii) the absence of mesiodistal and occlusive abrasion, caries lesions, Class II fillings; (iv) the absence of prosthetic or composite restoration (v) the absence of anomalies related to shape, structure and tooth development. Measurements were taken by a digital caliper (Model No. CD6 GS, Mitoyoto,Tokyo) with a precision of 0.01 mm. We determined the mesiodistal and vestibulolingual diameters of each permanent tooth following procedures described by Moorrees and Reed (1964). The mesiodistal (MD) dimension was defined as the greatest distance between contact points on the approximate surfaces of the tooth crown, and was measured with the caliper beaks placed occlusionally along the long axis of the tooth. The buccolingual measurement was defined as the greatest distance between the labial/buccal surface and the lingual surface of the tooth crown measured with the caliper held at right angles to the MD dimension. All the measurements were taken by one examiner.

Statistics

Measurement mistakes were determined by repeated measurement of ten models selected at random; this was done ten days after the first measurement by means of the Wilcoxon statistical test. There were no statistically significant differences in the obtained results. Mean, standard deviation (SD), coefficient of variation (CV) and percentage of sexual dimorphism were calculated. The percentage of sexual dimorphism was calculated for mesiodistal and buccolingual dimensions using the formula of Garn et al. 1967. In addition, descriptive statistics were obtained from the sample using the Student t-test and Mann-Whitney U test. According the formula, Sex dimorphism = (Xm / Xf) -1 x 100; where Xm = the average value of mesiodistal (buccolingual) dimension for men, and Xf = the average value of mesiodistal (buccolingual) dimension for females.

RESULTS

Males have significantly larger maxillary and mandibular permanent canines in both measured parameters, with significance level of $p < 0.001$. These results show that the values of sexual dimorphism are more pronounced in the maxillary than mandibular canines.

Table 1 gives the descriptive statistics and significance of differences in the mesiodistal diameters of the maxillary and mandibular canines for males and females. Table 2 shows the descriptive statistics and significance of differences in the buccolingual diameters of the maxillary and mandibular canines for males and females. The values of sexual dimorphism are more pronounced in the maxillary than in the mandibular canine.

DISCUSSION

Sex determination is very important in forensic practice. The most commonly used and most precise DNA analysis, has several disadvantages in terms of its high cost, lack of materials and inconvenience cases of mass disasters. The study of teeth is useful in human identification. In addition to determination of age, sex can also be determined from the teeth (Gustafson, 1950). Teeth may be used for differentiating sex by measuring their mesiodistal and buccolingual dimensions (Shafer et al. 2006). Men have larger tooth crowns, although the degree of sexual dimorphism varies among different populations (Schwartz et al., 2004; Vodanović et al., 2007; Filipović, 2007; Zorba et al., 2011; Hattab et al., 1996;

Table 1. Percentage of sexual dimorphism and t-test values for mesiodistal diameter; (N=100 m, 100 f).

	male			female				
	X	SD	CV	X	SD	CV	Xa	%b
Upper canines	7.90***	0.39	4.97	7.60	0.51	6.74	0.30	3.96
Lower canines	6.93***	0.35	5.02	6.70	0.39	5.75	0.23	3.46

Table 2. Percentage of sexual dimorphism and t-test values for buccolingual diameter; (N=100 m, 100 f).

	male			female				
	X	SD	CV	X	SD	CV	Xa	%b
Upper canines	7.99***	0.78	9.75	7.61	0.66	8.63	0.38	5.04
Lower canines	7.44***	0.78	10.45	7.09	0.57	7.99	0.35	4.87

*** - $p<0.001$

Suazo et al., 2008). Considering that there are differences in odontometric features in specific populations (Iscan et al., 2003), it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements (Prabhu et al., 2009).

Previous studies have indicated that there is greater significant sexual dimorphism in the upper and lower front teeth than in the other permanent teeth (Kaushal et al., 2003; Ling et al., 2006; Dayal et al., 1998; Muller et al., 2001, Lew et al., 1991, Bishara et al., 1989; Zilberman et al., 2001).

Lew and Keng (1991) and Iscan and Kedici (2003) showed a statistically significant difference in the upper and lower permanent canine teeth between males and females. Garn et al. (1967) and Muller et al. (2001), in measuring mesiodistal crown width, concluded that the mandibular canine had a higher degree of sexual dimorphism than the maxillary canine. Tinocco et al. (2012) in Brazil and Rai et al. (2006) in India concluded that the lower canine shows the greatest sexual dimorphism. On the contrary, Minzuno (1990) in Japan and Parekh et al. (2012) in the Gujarat population of India indicated that the upper canine shows the greatest sexual dimorphism.

The results of our study showed statistically significant differences between the sexes in the size of the permanent maxillary and mandibular canines, with a greater degree in the maxillary canine.

Variations in the intensity of sexual dimorphism in different studies and different populations may be explained by genetics, the influence of environmental factors, different eating habits and the complex coordinated action of environmental factors and biological influences.

CONCLUSION

Teeth may be used for sex determination with the aid of odontometric analysis. Sex dimorphism in tooth size is found to vary in different populations and there is a need for specific population data. Our study established the existence of sexual dimorphism between the permanent canines of males and females in the Serbian population, which might be useful in gender identification in forensic practice.

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