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Importance of canine index in sex determination in Assiut Governorate

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Abstract Identification of living persons and the dead bodies is of great importance in the practice of forensic medicine. Establishing sex is one of the main factors employed to know the identity. Teeth form an exceptional material in living as well as dead for forensic investigations; being available even in mutilated and decomposed bodies as they are chemically very stable tissue in the body. The present study was conducted in Assiut Governorate on 500 dental casts (234males and 266 females) of Egyptian population in Assiut Governorate at random to study the value of maxillary and mandibular canines in predicting the sex. It was observed that mean canine width in both jaws is greater in males as compared to females. Mean Canine index in Lower jaws was greater in males than females but the difference is found to be statistically insignificant.

In conclusion The mandibular canines are found to be more reliable in sex determinations. The mesiodistal width of canines of both jaws is significantly greater in males than females. The mean mandibular canine width in females is 6.012 and it was equal in both sides and in males is 6.09in right side and 6.11 in left side.

Introduction

Establishment of a person's individuality is important for legal as well as civil purposes and gender determination is an essential step in identifying an individual. Dental, fingerprint and DNA comparisons are probably the most common techniques used in this context, allowing fast and secure identification processes. However, in certain circumstances related to the scene of the crime, these techniques might be unavailable, so there is still an increasing need for reliable alternative methods of establishing identity (EL-Domiaty et al., 2010).

Since the human dentition has a complement of 32 teeth, at least a few teeth are usually restored. Hence, they are routinely used in comparative identification of human remains. The form of teeth and the detail of their arrangement in the dental arches provide body information that is probably unique to the individual. The use of teeth is of special importance in young individuals where the skeletal secondary characters have not yet developed (Acharya and Mainali, 2009). In addition, the fact that teeth are one of the strongest human tissues that resist the postmortem insults renders them a valuable tool in forensic investigation (Acharya and Mainali, 2007).

The crowns of the permanent teeth develop early and once formed remain unchanged during the growth process (Cardoso, 2008). Of all the teeth in the human dentition, the canines are the least frequently extracted teeth (possibly because of the relatively decreased incidence of caries and periodontal diseases). Also, canines are reported to withstand extreme conditions and have been recovered from human remains even in air disasters and hurricanes (Kaushal et al., 2003).

Sexual dimorphism is the systematic difference in form (shape, size or color) between different sexes in same species. According to Boaz et al (2009) teeth are known to have sexual dimorphism. Tooth crowns are larger in males than in females, may be because of longer period of amelogenesis for both temporary and permanent dentitions in males.

The odontometrics, are under considerable influence of the environment, so such measurements are, population specific, and do not apply on a great scale (Hemanth et al., 2008). This raises the need to study the teeth characteristics of the Egyptian population for the forensic purposes. The present study aims to:

1- Find out the value of maxillary and mandibular canine width as a tool for sex determination.
2- Find out the canines index differences between Egyptian males and females using different statistical methods.
3- Compare the findings with other studies.

Materials and Methods

Sample

The present study comprised 500 individuals (234 males and 266 females) of Egyptian origin from different cities in Assiut Governorate (from different general health hospitals) in the age group of 15-50 years. The inclusion criteria for the study were as follows:

- Healthy state of gingiva and periodontium
- Caries free canine teeth
- Normal overjet and overbite (2-3 mm)
- Absence of spacing in the anterior teeth
- Normal molar and canine relationship

Following informed verbal consent, impressions of the dentitions were made with irreversible hydrocolloid (alginate) material for the upper and lower teeth. It was made using perforated metal trays to study the mesiodistal diameter of both right and left canines, then casts were poured in dental stone within few minutes. The measurements were measured on casts using *Sliding Vernie Calipers* for Dentists Purposes (Tresn, USA), Series: VC12 (Range 0=80 mm, reading 0.10 mm, accuracy ±0.10 mm) (Figure 4).

Measurements

The following measurements were taken from the casts for every individual:

- Mandibular canine width: was measured as the greatest mesio-distal dimension of mandibular canine on either sides of the jaw (Figure 1).
- Maxillary canine width: was measured as the greatest mesio-distal dimension of maxillary canine on either side of the jaw (Figure 2).
- The inter-canine distance: was measured as the linear distance between the cusps tips of right and left mandibular and maxillary canines (Figure 3).

Statistical analysis

The canine width and intercanine width were subjected to statistical analysis to assess sex difference using unpaired t-test. Intraobserver error was assessed using paired student t-test on 50 randomly selected casts. To minimize random and systematic errors, all measurements were performed by single examiner.

The ***canine index (CI)*** was calculated by the formula (Rao et al., 1989):

Canine index (CI) = mesiodistal diameter of canine÷ intercanine width

The data were processed using SPSS 11.0 statistical software program (SPSS Inc., Chicago, Illinois, USA) and MS Office 2003 Excel spreadsheet (Microsoft Corp., Redmond, Washington, USA).

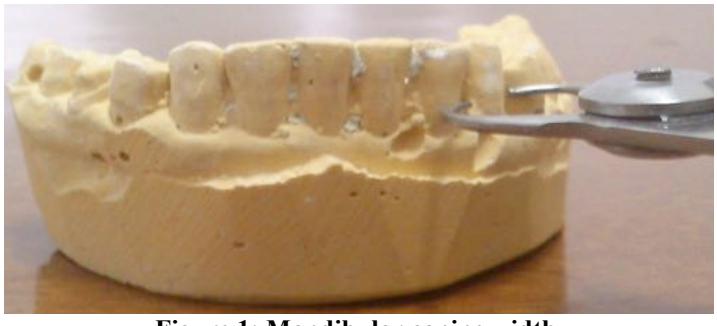

Figure 1: Mandibular canine width.

Figure 2: Maxillary canine width.

Figure 3: The inter-canine distance.

Figure 4: Sliding Vernie Calipers.

Results

For maxillary canine, the inter-canine distance between the tips of right and the left maxillary canines was measured in males and females. In males the mean inter-canine distance was 32.4±1.186mm and in females was 31.41±1.15 mm. The mean inter-canine distance was larger in males than the females and the difference was highly significant (Table1).

It is observed that in males the mesiodistal width of the right maxillary canine was 6.11±0.280 mm and the left maxillary canine was6.22±0.259 mm. In females, the mean of the mesiodistal width of the right maxillary canine was 6.18±0.237 mm and the left maxillary canine was 6.24±0.323mm. The mean mesiodistal width of the right as well as the left was significantly larger in males as compared to the females (Table1).

In males the Mean Canine Index (MCI) of the right side was 0.189±.02911 and in left side was a 0.192±.02983. In females the MCI of the right side was 0.197±03466 and of left side was 0.198 ±.03215 Canine index showed significant difference in males and females (Table 1).

For mandibular canine. The inter-canine distance was 32.11±1.186 mm in males and in females was 30.88 ±.1.150 mm. The mean inter-canine distances were highly significantly larger in males than the females.

It was found that in males the mesiodistal width of the right mandibular canine was 6.09±0.280 mm and the left maxillary canine was 6.11±.0.259 mm. In females, the mean of the mesiodistal width of the right mandibular canine was 6.01±0.237 mm and the left maxillary canine was 6.01±0.323 mm.

The mean mesiodistal width of the right as well as the left was significantly larger in males as compared to the females (Table 2).

Canine index in mandibular canines also showed highly significant difference in males and females. In males the MCI of the right side was 0.189±.0.026 and in left side was 0.190±.0.029.In female the MCI of the right side was 0.194 ±.0.041and in left side is 0.194 ±0.038 (Table 2).

Table 1: Statistical analysis of inter-canine distance, mesiodistal width& canine index of right &left maxillary canines in the studied cases

Parameters	Sex	Mean (mm)	± S.D.	Coefficient of Variation	't' stat	'P' value	Significance
Inter Canine Distance	M	32.42	1.186	4.57	3.068	<0.001	Highly Significant
	F	31.41	1.150	4.60			
Right Canine mesio-distal Width	M	6.11	0.280	3.89	7.869	<0.07	Significant
	F	6.18	0.237	3.55			
Left Canine mesio-distal Width	M	6.22	0.259	3.53	8.368	<0.05	Significant
	F	6.24	0.323	4.82			
Right Canine Index	M	0.1886	.02911	3.96	-1.688	<.092	Significant
	F	0.1969	.03466	3.74			
Left Canine Index	M	0.1921	.02983	4.59	1.149	<0.09	Significant
	F	0.1986	.03215	5.97			

M: males, F: females

Table 2: Statistical analysis of inter-canine distance, mesiodistal width& canine index of right &left mandibular canines in the studied cases

Parameters	Sex	Mean (mm)	± S.D.	Coefficient of Variation	't' stat	'P' value	Significance
Inter Canine Distance	M	32.11	1.186	4.57	3.068	<0.000	Highly Significant
	F	30.88	1.150	4.60			
Right Canine mesio-distal Width	M	6.09	0.280	3.89	7.869	<0.025	Significant
	F	6.01	0.237	3.55			
Left Canine mesio-distal Width	M	6.11	0.259	3.53	8.368	<0.02	Significant
	F	6.01	0.323	4.82			
Right Canine Index	M	0.1898	0.02628	3.96	-3.541	<0.000	Highly Significant
	F	0.1946	0.04164	3.74			
Left Canine Index	M	0.1903	0.02989	4.59	2.108	<0.000	Highly Significant
	F	0.1943	0.03866	5.97			

M: males, F: females

Discussion

Sex assessment of skeletal remains is an essential step in reconstructive identification. Sex differentiation in forensic investigation utilizes craniofacial morphology, tooth dimensions and DNA analysis (Bilge et al., 2003). Studies of sexual dimorphism provide information about evolution, behavior and eating habits of a population (Ates et al., 2006). Although human sexes differ from each other considerably, there is population specific anatomic variation (Iscan and Miller Shaivitz, 1984).

Studies on tooth morphology have been conducted using either intraoral measurements or measurements on casts. Barre et al., (1963) have observed that intraoral measurements are less reliable, but Kaushal et al., (2003) found no significant difference between the two methods. Hence, we have selected dental casts of the patients has been selected for this study. The canines are the most dimorphic teeth in many populations (Gran et al., 1967; Lund and Mörnstad, 1999; Iscan and Kedici, 2003; Acharya and Mainali, 2007). Pettenati-Soubayrouxa et al., (2002) reported that the lower canine and lower incisor are the most useful teeth in dimorphic determination..

In the present study the difference in the inter-canine distance both in males and females was highly significant (p value <0.01). It is further observed that mean mandibular inter-canine distance in males was 32.4 ±1.186mm and the value in females was 31.41379±1.150mm, for the maxilla and the mean inter-canine maxillary distance in males is 32.11429±1.186mm and the value in females is 30.87931±1.150mm, for the mandible and thus values

in males were significantly higher than those of females. Similar results have been observed by Al-Rifaiy et al., 1997 in Saudi Arabia (males: 27.0171±2.3168 and females: 26.4615±2.7761 mm), Abdullah., 1998 in Cairo (males: 26.9552±2.3129, females: 26.4575±2.7790) Kaushal et al., in India (2003) (males: 25.873±1.253, females: 25.070±1.197), and Reddy et al., on the population of Western Uttar Pradesh (2008) (males: 26.860±1.48, females: 26.287±1.45).

The present study establishes the existence of a definite statistically significant difference in mesiodistal width of canines of both jaws, consistent with Hashim and Murshid (1993), who conducted a study on Saudi males and females and found that only the canines in both jaws exhibited a significant sexual difference while the other teeth did not.

Mohammed et al (1997) in his study on Saudi Arabian population reported that the mean mesiodistal width of maxillary canines were 7.54 ± 0.68 mm (right) and 7.54 ± 0.67 mm (left) in males, while in females were 6.8 ± 0.925 mm (right) and 6.83 ± 0.934 mm (left), but the differences between males and females were not statistically significant.

Canine index in case of maxillary canines showed a significant difference between males and females.

Kaushal et al., (2004), conducted a study on mandibular canines of north Indian population in 60 cases (30males and 30 females), in the age group 17-21 yrs. Mean canine width was 7.22 ± 0.28 mm (right) and 7.29 ± 0.29 mm (left) in males, while in females it was 6.69 ± 0.25 mm (right) and 6.69 ± 0.32 mm (left). This study and the present one show more mandibular canine width in males than in females. The mean Right canine index (RCI) was 0.28 ± 0.01 and left canine index (LCI) was 0.28 ± 0.01 in males, while in females RCI was 0.26 ± 0.01 and LCI was 0.26 ± 0.19. In the present study mean RCI and LCI was 0.265 in males and in females RCI was 0.259 and LCI was 0.257. Both the studies indicate a greater mean Canine index in males than in females, but in contrast to Kaushal et al 2004, when the present study findings were subjected to statistical analysis, canine index was found to have statistically significant difference in males and females. This result also in agreement with Rao et al (1989) who studied mesiodistal width and inter-canine distance of 384 females and 382 males of South Indian population with an age-group of 15-21 years and reported that the mesiodistal width of mandibular canine was significantly greater in males than in females.

In the present study, mandibular canine width show maximum sexual dimorphism. Kaushal et al (2004) found out in their study on north Indian population values of sexual dimorphism in mandibular canine width to be 7.954% for right canines and 8.891% for left canines.

Garn et al. (1967) and Nair et al. (1999) have found the mandibular canines to exhibit the greatest sexual dimorphism among all teeth. Dahlberg (1963) considered mandibular canines as the 'key teeth' for personal identification.

A study by Anderson and Thompson (1973) consisted of measuring the mesiodistal width of mandibular canines, lateral incisors and intercanine distance of 83 males and 88 females of Toronto population, aged 14-17 years. Their study showed that mandibular canine width and intercanine distance was greater in males than in females and permitted 74.3% correct classification of sex.

Garn et al. (1973) studied sexual dimorphism by measuring the mesiodistal width of canine teeth in different ethnic groups. They concluded that the magnitude of canine teeth sexual dimorphism varies among different ethnic groups. Furthermore, the mandibular canine showed a greater degree of sexual dimorphism than the maxillary canine.

However, other investigators (Kuwana, 1983 and Minzuno, 1990) reported that, in Japanese population, the maxillary canine showed a higher degree of sexual dimorphism compared to the mandibular canine. Thus, controversy exists related to the degree of sexual dimorphism between maxillary and mandibular canines in different ethnic groups.

In conclusion, the present study had investigated the sex assessment in Egyptian population using canine dimensions and canine index. The mandibular canine index is a quick and easy method for determining sex and it is a useful tool in forensic odontology.

Recommendations

As tooth morphology is known to be influenced by cultural, environmental and racial factors, more studies on different populations will be of much use to make data base available on dental morphometric measurements with a view to determine variation among large population that may be beneficial for anthropological, genetic, legal and forensic application.

Measurements of dental casts must be compared with intra oral measurements. The study must be repeated in other regions in Egypt to be more reliable.

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الملخص العربي

أهمية مؤشر الناب في تحديد الجنس في محافظة أسيوط

صفاء ماهر جورج و هبة عطية يسى1 و وسيم فؤاد جرجس2

يعد الاستعراف علي الاحياء والأموات ذا اهمية كبيرة في ممارسة الطب الشرعي ويعد تحديد النوع هو واحد من العوامل الرئيسية التي تستخدم لمعرفة الهوية ويعتبر شكل الاسنان مادة استثنائية في الاحياء والأموات في تحقيقات الطب الشرعي لكونها متاحة حتى في حالات الجثث المشوهة والمتحللة كما انها من الانسجة المستقرة كيميائيا في الجسم

اجريت هذه الدراسة على عينة من المصريين في صعيد مصر في محافظة اسيوط والمراكز التابعة لها لدراسة قيمة الانياب في تحديد النوع وأجريت علي 500 نموذج جبسي (234 اناث و266 ذكور). ولوحظ ان عرض الناب في كلا الفكين اكبر في الذكور مقابل الاناث ومؤشر الناب في كلا الفكين اكبر في الاناث عن الذكور وكان الفرق ذو دلالة احصائية كبيرة في الفك السفلي.ونستنتج من هذه الدراسة أن مؤشر الناب السفلي اكثر فعالية في تحديد النوع وان عرض الانياب في كلا الفكين اكبر في الذكور من الاناث وعرض الناب السفلي في الاناث متساوى علي الجانبين.

1 قسم الطب الشرعي والسموم الإكلينيكية كلية الطب جامعة أسيوط
2 قسم الأسنان بإدارة أسيوط