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Original Article

Gender Dimorphism of Canines in a Sample of the Egyptian population

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Abstract

Background: Canines are considered an excellent tool to distinguish gender in criminological investigations, since they are the most likely surviving parts of a victim's body in case of disasters. This study investigated sexual dimorphism by comparing the mesiodistal & labiolingual dimensions of mandibular & maxillary permanent canines and inter-canine dimension in a sample of Egyptian people.
Aim: To establish a reliable method for gender discrimination of un-identified adult victims.
Materials and Methods: Study casts of 24 males & 24 females were acquired from the Archives of Orthodontics department, of Faculty of Dentistry, Ain Shams University, Egypt. Canine's width, thickness and inter-canine dimension (ICD) were recorded, on dental casts by a digital caliper.
Results: No significant dissimilarity was found between left and right canines in males or females. Gender dimorphism was greater in upper right canine regarding the mesiodistal dimensions (MD) dimension, and greater in lower right canine regarding labiolingual (LL) dimension. The ICD measurement in both arches was found to be significantly more in males. The maxillary & mandibular canine's MD were significantly more in males. Also, the maxillary & mandibular canine's LL dimensions were significantly more in males.
Conclusions: Male gender was established to a degree of 95% if the MD dimension of the maxillary canine is more than 8.29 mm and if its LL dimension is more than 8.54mm. while in the lower arch, when the MD of the mandibular canine is more than 7.29 mm and its LL is more than 7.77mm.
Keywords: Gender Dimorphism, Canines, Egyptian Sample.

1. Introduction

Gender dimorphism is a term referring to the variations in tooth shape and size among males and females. Forensic odontology is that field of dentistry concerned with the proper interpretation of dental findings. So, odonto-metric analysis of human teeth is very important in forensic studies. It is well known that teeth are extremely stable against physical, thermal impacts or chemical degradation among all other human tissues. The availability and accessibility of teeth for investigation, made them an outstanding criminological and archaeological

modality for gender discrimination. This presented an advantage over fingerprints, as identification can be performed on severely burned remains, for instance, as in terroristic attacks [1].

Teeth dimensions can be used in gender identification, since it was established that, in majority of races, human teeth displayed gender dimorphism. Consequently, teeth are invaluable in identification of gender, in times of major disasters or terrorist attacks, when most body parts get destroyed. This is because teeth possessed the strongest structure of all body tissues, due to their resistance to mechanical, chemical, physical and thermal insults as well as microbial degradation. Hence, they are precious tools for distinguishing gender of incomplete adult cadavers [2]. The extent of dimorphism differs significantly among various races [3,4]. In modern-day humans, males still have bigger tooth sizes than females, since they show more extended phases of amelogenesis [5,6,7,8,9].

Canines are considered strategic teeth, as they are rarely extracted (probably due to their enhanced anatomical features, strong cusps and long roots resulting in low incidence of caries or periodontal diseases). Meanwhile, they might tolerate severe post-mortem conditions such as explosions and air disasters [10,11,12]. This should be of huge criminological use in personal recognition especially in Egypt which is now actively fighting terrorists in Saini [13, 5]. The MD measure of lower and upper canines and also, the lower and upper ICD are easy and affordable tools which could be used in criminological or archeological studies determining gender [7, 13–15].

Many studies were concerned with determining the degree of gender dimorphism in MD dimension of canines, particularly the lower. Hence, this study measured the MD, LL and ICD of both mandibular and maxillary canines in order to establish more accurate criteria for canine-size-differences in gender determination.

2. Materials and Methods

2.1. Research Sample

This research was done at the Faculty of Dentistry, Ain Shams University, Cairo, Egypt. The research sample consisted of 48 archived upper & lower dental casts (24 males, 24 females) of age range between 20-45 years. Casts were obtained from department of Orthodontics, Faculty of Dentistry, Ain Shams University.

The sample satisfied the following requirements:

1. Dental casts belonged to Egyptian candidates,
2. Candidates ranged from 20 to 45 years of age,
3. Existence of both upper & lower canines,
4. Lack of canines' developmental shape anomalies,
5. Lack of caries, attrition, crowding, dental/occlusal abnormalities in canines.

Ethics: no patients' consent was needed, as this study used archived material owned by Orthodontics

Department of Faculty of Dentistry of Ain Shams University.

2.2. Measurements

The MD and LL crown dimensions of maxillary and mandibular canines, and the ICD in both arches were measured by a single examiner using a digital caliper (0-150 millimeter (mm)/0-6") (INSIZE Company-made in China) [16] (fig. 1).

All measurements were carried out by the same dentist to eliminate inter-observer error.

The following dimensions were measured:

(i) ***ICD***: described as the linear distance between cusps of right and left upper canines, right and left lower canines, Fig (2).

(ii) ***LL dimension of upper and lower canines:*** described as the maximum expanse between the labial & lingual aspects of the crown, Fig (3a).

(iii) ***MD dimension of lower and upper canines:*** described as the maximum expanse between the proximal aspects of the crown. Canine measurements on both sides were recorded, Fig (3b).

2.3. Statistical Analysis

Obtained measurements were analyzed by means of the statistical package for social sciences, version 20.0 (SPSS Inc., USA). Numerical data were conveyed as mean± standard deviation (SD). Unpaired Student' t-test was used to discover the difference in the ICD, MD and LL canine dimensions among males and females.

The following tests were performed:

- Independent-samples t-test of significance was used when comparing between two means.
- The confidence interval was set to 95% and the acceptable border of error was set to 5%. Thus, the p-value was reflected as significant as follows:

Probability (P-value)

- P-value <0.05 was considered as significant.
- P-value <0.001 was considered as highly significant.
- P-value >0.05 was considered as insignificant.

- The maxillary canine was assigned as Max3, while the mandibular canine was assigned Man3.
- The maxillary inter-canine distance was assigned as Max I.C.D.
- The mandibular inter-canine distance was assigned as Man I.C.D.

3. Results

Findings of the Present Study are demonstrated in tables 1 and 2 and figures 4,5 and 6:

Fig. (1) A photograph showing digital caliper.

Fig. (2) A photograph showing ICD measurement.

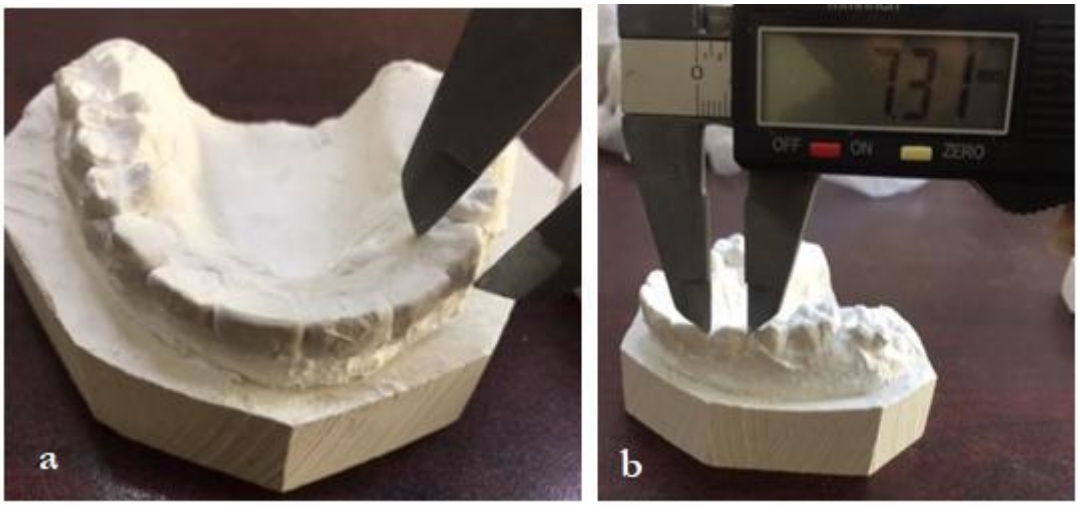

Fig.(3): (a) A photograph showing LL measurement. **(b)** A photograph showing MD measurement.

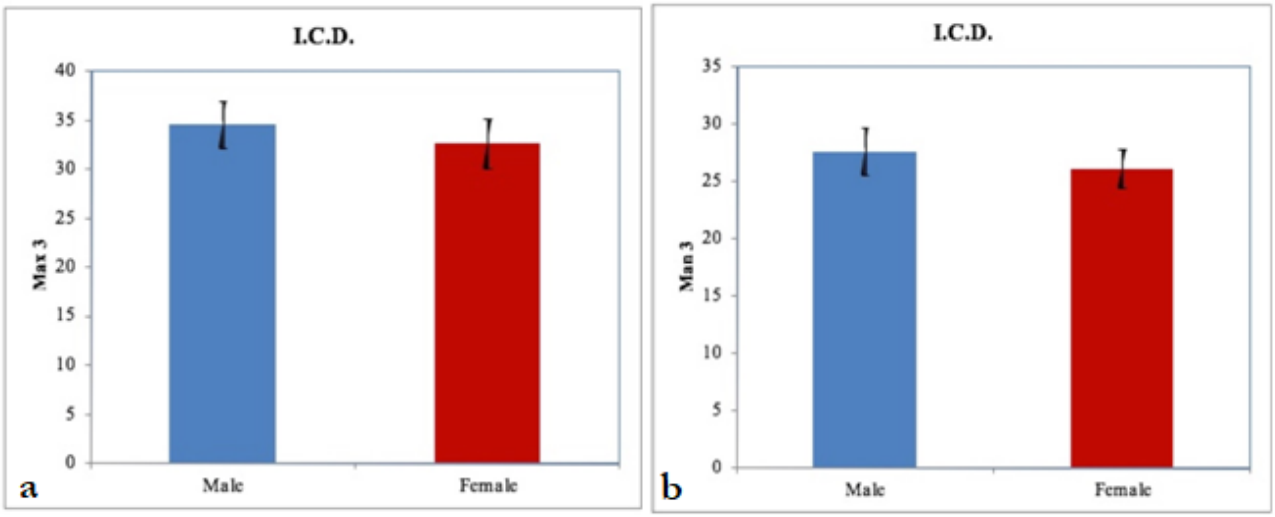

Fig. (4): (a) Error bar chart between male and female according to Max.3 at MD and LL **(b)** according to Max 3 at ICD.

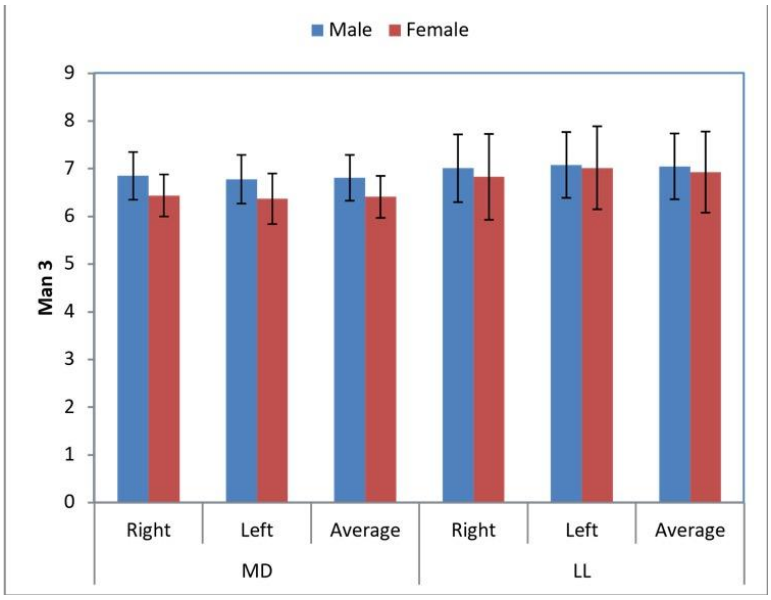

Fig. (5): Error bar chart between male and female according to Man3 at MD and LL.

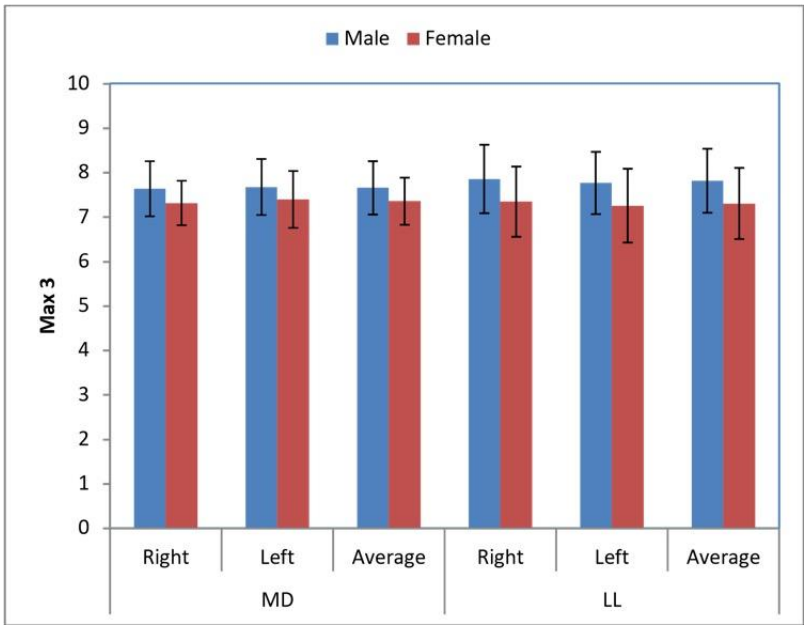

Fig. (6): Error bar chart between male and female according to Max3 at MD and LL.

Table (1): Comparison between male and female according to Maxillary canine (Max.3).

Max. 3	Male *(n=24)*	Female *(n=24)*	t-test	p-value
MD				
Right				
Mean±SD	7.64±0.62	7.32±0.50	6.669	0.024*
Range	6.3-8.6	6.23-8.04		
Left				
Mean±SD	7.68±0.63	7.40±0.64	4.068	0.041*
Range	6.5-8.42	5.85-8.84		
Average				
Mean±SD	7.66±0.60	7.36±0.53	5.719	0.032*
Range	6.47-8.51	6.04-8.3		
LL				
Right				
Mean±SD	7.86±0.77	7.35±0.79	8.866	0.012*
Range	6.2-9	5.45-8.54		
Left				
Mean±SD	7.77±0.70	7.26±0.83	9.109	0.011*
Range	5.92-8.87	5.44-8.6		
Average				
Mean±SD	7.82±0.72	7.31±0.80	9.311	0.011*
Range	6.06-8.84	5.45-8.54		
ICD				
Mean±SD	34.50±2.41	32.55±2.56	4.684	0.049*
Range	30.17-39.56	29.15-39.57		

t-Independent Sample t-test;

*p-value>0.05 NS; *p-value <0.05 S*

Table 1 shows statistically significant higher mean of male compared to female according to **Max. 3** at MD, LL and ICD.

The upper right canine demonstrated higher gender dimorphism when compared to left canine regarding MD dimension. However, LL dimension of canines did not differ significantly statistically on both sides among genders.

Table (2): Comparison between male and female according to mandibular canine (Man.3).

Man. 3	Male *(n=24)*	Female *(n=24)*	t-test	p-value
MD				
Right				
Mean±SD	6.85±0.50	6.44±0.44	15.820	<0.001**
Range	5.66-7.56	5.58-7.32		
Left				
Mean±SD	6.78±0.51	6.37±0.53	12.342	<0.001**
Range	5.64-7.5	5.22-7.54		
Average				
Mean±SD	6.81±0.48	6.41±0.44	16.029	<0.001**
Range	5.69-7.53	5.4-7.15		
LL				
Right				
Mean±SD	7.01±0.71	6.83±0.90	6.798	0.019*
Range	5.75-8.17	5.4-8.8		
Left				
Mean±SD	7.08±0.69	7.02±0.87	7.792	0.035*
Range	6.01-8.24	5.8-8.9		
Average				
Mean±SD	7.05±0.69	6.93±0.85	5.639	0.026*
Range	6-8.19	5.74-8.85		
ICD				
Mean±SD	27.59±2.04	26.08±1.69	3.943	0.024*
Range	22.24-31.47	23.75-30.26		

t-Independent Sample t-test;

*p-value>0.05 NS; *p-value <0.05 S;*

Table 2 shows statistically significant higher mean of male compared to female according Man 3 at MD, LL and ICD.

The mandibular right canine exhibited higher gender dimorphism when compared to left canine regarding LL dimension. However, the MD dimension of canines on both sides did not differ significantly statistically between genders.

4. Discussion

This research ensured a substantial male gender dimorphism in upper & lower canines in a sample of Egyptian adults aging between 20 and 45 years. The selected age group provided proper model for tooth dimensions due to less caries incidence or wearing of tooth structure in selected individuals [1].

In this study, the dimension-recording was preferred to be done on dental study

casts, as it was more convenient than measuring teeth directly intra-orally [17]. Dimension-recording directly from casts was easy and reliable. Moreover, Kaushal et al, stated that records performed on study casts were comparable to intra-oral records [18].

Many researchers showed great interest in gender dimorphism in MD tooth dimension, while LL and inter-canine dimension weren't sufficiently investigated, that's why this study made sure to complete previous researches done by others in this regard [3-7].

This study indicated the probability of male gender recognition to a degree of 95% if the MD dimension of upper canine is more than 8.29 mm and its LL dimension is more than 8.54 mm. In the lower arch, the probability of male gender recognition was established to a degree of 95% if the MD of the lower canine is more than 7.29 mm and its LL dimension is more than 7.77mm. These findings came in agreement with [3-7]. Yet, no significant difference existed between right and left canines regarding MD or LL dimensions.

The findings of this research matched those done on other populations such as Indians [18], Nigerians [19], and Brazilians [20], Lebanese [21], indicating that both upper and lower canine MD dimension was an important factor in gender recognition. Meanwhile, this research indicated also, that gender dimorphism was greater in upper right canine's MD dimension and in lower right canine's LL dimension, and this finding was not reported before, up to our knowledge and did not match those of other studies [21]. Hence, more investigations including larger sample size should be done to ensure the relation between these findings and the Middle Eastern population.

Some authors claimed that tooth-size differences between males & females could be attributed to ecological influences and eating habits. Others postulated that gender dimorphism in canine dimensions could be greatly affected by genetic influences, since X and Y chromosomes were involved according to many researchers. They stated that sexual dimorphism in tooth shape & size is due to the presence of relatively more dentine in the crowns of male teeth whereas the X chromosome might be responsible for controlling enamel thickness [21,22,23,24]. Another study by Saunders et al, (2007) found that males canines and premolars significantly showed greater amount of dentine than those of females, and also more dentine relative to overall crown size. The female canines and premolars showed significantly greater amount of enamel with respect to overall crown area than those of the males [8].

This research assessed the extent of gender dimorphism among Egyptians and ensured gender identification in forensic investigations concerning Egyptian population, which could be also used as a guide for Middle Eastern populations.

5. Conclusion

This research established that MD, LL dimensions & ICD of the upper and lower canines were significantly more in males. Both mandibular & maxillary right canines exhibited higher gender dimorphism when compared to left canines. This research also signified the probability of male gender to a degree as great as 95% when

the MD of upper canine is more than 8.29 mm, and its LL is more than 8.54mm. While in the lower arch, the probability of male gender to a degree as great as 95% when the MD of lower canine is more than 7.29 mm, and its LL is more than 7.77 mm. It can be stated that forensic investigations can use canines as a consistent and rapid technique for gender identification of an un-identified persons among Egyptian population.

Conflict of Interest & Sources of Funding:

Author declares absence of conflict of interests, and did not receive any funding for this work.

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