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Evaluation of the paranasal sinuses dimensions in sex estimation among a sample of adult egyptians using multidetector computed tomography

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ABSTRACT

The identification of the skeletal and decomposing parts of human remains is still one of the most difficult skills in forensic medicine. An incomplete skeleton may represent a great challenge for forensic anthropologists. The aim of the present work has been to determine the accuracy of using the measurements of paranasal sinuses as a method for sex estimation, which uses Multi Detector Computed Tomography (MDCT). The study was carried out on 100 adult Egyptians (50 males and 50 females) who were referred to the Radio-Diagnosis Department of Alexandria University Hospitals in order to perform CT scans of the paranasal sinuses. For each participant, the lengths of 6 sphenoid sinus lines, maxillary sinus dimensions and frontal sinus dimensions were measured for both sides using MDCT. The study revealed that the mean lengths of right (Rt) lines 1, 3, 4, 5 and 6 and left lines (Lt) 1 and 4 of the sphenoid sinus were significantly larger in males than in females. Moreover, the mean lengths of the Rt depth, Lt depth and Lt height of the frontal sinus were significantly greater in males than in females. Additionally, the mean lengths of the Rt craniocaudal diameter, Rt depth, Rt width at the middle and inter-maxillary distance of the maxillary sinus were significantly greater in males than in females. Logistic regression analysis was performed for sex estimation with an overall accuracy of 77%. It was concluded that the maxillary sinus shows the highest level of accuracy in sex estimation followed by the frontal sinus and then the sphenoid sinus using MDCT.

1. Introduction

Identification is defined as an organized and systematic process that aims to establish the personal identity of an individual. The significance of the identification appears in natural or man-made mass disasters and in cases where the body is badly decomposed or dismembered, as in attempts to deliberately conceal the identity of the individual [1–3].

Despite the enormous progress in various diagnostic methods, identification of the skeletal and decomposing parts of human remains is still one of the most difficult responsibilities of forensic medicine. As the bones of a human body are the last to decay in the postmortem period (followed by the dental enamel), skeletal remains have been widely used for the estimation of sex. Sex estimation is one of the prime factors in producing a biological profile. In fact, accurate sex estimation of the human remains immediately eliminates 50% of the population during the process of identification [3–6].

Estimation of sex from bones depends on their morphological and morphometric features. The combination of both features usually gives the most accurate results. Among the human bones, next to the pelvis, the skull is the most easily sexed portion of the skeleton. In a mass disaster situation, the skull and other bones are recovered severely fragmented or incomplete. As a result, various parameters must be collected from a single bone [7–10].

The estimation of sex using radiological methods has a principal role in forensic medicine. Computerized Tomography (CT) is considered an excellent imaging technique and is the modality of choice for the evaluation of paranasal sinuses and craniofacial bones where precise measurement of paranasal sinuses dimensions could be provided [11–13].

The current study was designed to determine the reliability and accuracy of sphenoid, frontal and maxillary sinuses dimensions using MDCT as a method for sex estimation.

2. Materials and methods

2.1. Study design

The study was carried out on 100 adult Egyptians of both sexes (50

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Table 1
Distribution of the participants according to their age and sex (n = 100).

Age (years)	Sex				Test of Sig.	^{MC}P
	Female		Male			
	No	%	No	%		
< 30	18	36.0%	19	38.0%	$\chi^2 = 0.172$	0.917
30 to less than 40	20	40.0%	18	36.0%		
≥ 40	12	24.0%	13	26.0%		
Range	18–60		18–60		t = 0.361	0.719
Mean ± SD	33.5 ± 9.9		32.8 ± 9.5			

χ^2, p: χ^2 and p values for *Chi square test* for comparing between the two groups.
MCP: Mont Carlo exact probability.
t, p: t and p values for Student *t*-test for comparing between the two groups *: Statistically significant at p ≤ 0.05.

males and 50 females). They were referred to the Radio-Diagnosis Department of Alexandria University Hospitals to perform CT scans of the paranasal sinuses. The age of the participants ranged from 18 to 60 years with a mean age of 33.5 ± 9.9 years for females and 32.8 ± 9.5 years for males with no significant difference between them. (Table 1)

Subjects with a history of facial trauma, skull base or sinus surgery, and congenital developmental anomalies were excluded. Subjects with significant septal deviation, cleft palate and ectopic or supernumerary teeth were also excluded.

Scans of the paranasal sinuses were performed using a sixty four-detector row scanner. Multi slice (64slice) CT Philips (Best, Netherlands). Slice thicknesses of 0.1 mm, a focal size of 0.6 mm, a pitch of 0.8 mm, a rotation time of one second with milli-Ambers (mAs) of 240 and 120 kV were used.

The following measurements were obtained for both right and left sides. The *maximum* measurements were taken after going through different slices in sagittal, coronal and axial sections then the averages of the right and left measurements were calculated.

The following measurements were taken in mm:

I. Sphenoid Sinus
- Line 1: The vertical distance from the sphenoid sinus ostium to the sinus roof. [14,15] (Fig. 1)
- Line 2: The vertical distance from the sphenoid sinus ostium to the lowest point of the sinus base. [14,15] (Fig. 1)
- Line 3: The horizontal distance from the center of the sphenoid sinus ostium to the posterior wall of the sinus. [14,15] (Fig. 1)
- Line 4: The horizontal distance from the anterior wall of the sphenoid sinus to the lowest point of the sella. [14,15] (Fig. 2)
- Line 5: Maximum depth, which is the longest horizontal distance from the anterior wall of sphenoid sinus to the posterior wall. [14,15] (Fig. 2)
- Line 6: Maximum width. [15] (Fig. 3)

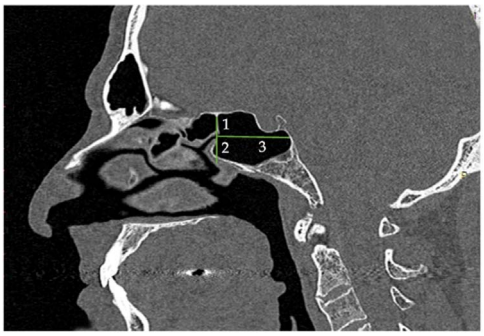

Fig. 1. Sagittal CT scan shows the left line 1of the sphenoid sinus (1), the left line 2 of the sphenoid sinus (2) and the left line 3 of the sphenoid sinus (3).

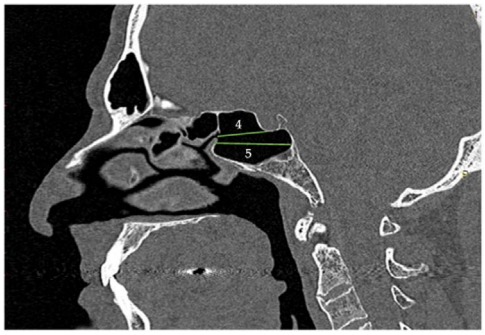

Fig. 2. Sagittal CT scan shows the left line 4 of the sphenoid sinus(4) and the left line 5 of the sphenoid sinus (5).

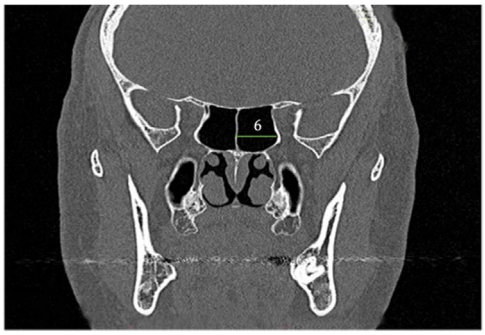

Fig. 3. Coronal CT scan shows the left line 6 of the sphenoid sinus (6).

All measurements from the sphenoid ostium were taken from the midpoint of the sphenoid ostium. All measurements were taken on sagittal images except in Line 6; the measurements were taken on coronal images.

II. Frontal Sinuses
- The frontal sinus transverse length (width) was measured from the axial image. [16,17] (Fig. 4)
- The frontal sinus anteroposterior length (depth) was measured from the axial image. [16,17] (Fig. 4)
- The height of the frontal sinus was obtained from the coronal section. [16,17] (Fig. 5)
- The distance between the highest points of the two sinuses was obtained from the coronal section (F. distance). [17] (Fig. 5)

III. Maxillary Sinuses
- Maximal craniocaudal diameter (CCD).[13] (Fig. 6)
- Maximal width. [13] (Fig. 7)
- The width at the middle of the maxillary sinus (width.mid). [13] (Fig. 7)

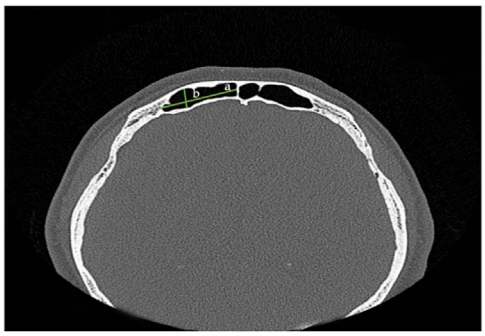

Fig. 4. Axial CT scan shows the right frontal sinus width (a) and the right frontal sinus anteroposterior length (b).