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Sex discrimination of mastoid process by anthropometric measurements using multidetector computed tomography in Egyptian adult population

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KEYWORDS

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Abstract *Introduction:* Sex identification of different skeletal remains has been defiance for many forensic studies. Mastoid process of the skull has drawn great attention from many researchers. Sex differences of the mastoid process are investigated using traditional morphological and metric methods.

Aim: The aim of the present study was to use multidetector computed tomography (MDCT) to estimate sex from measuring the mastoid process of adult individuals.

Subjects and methods: Eighty adult subjects (40 males and 40 females) of the Egyptian population were included in the present study with a mean age of 32.8 + 12.98 and 28.9 + 10.1, respectively. Nine mastoid measurements were obtained on the mastoid and were subjected to statistical analysis using SPSS version 16. Accuracy of MDCT and cut-off points to estimate sex from mastoid process were then obtained.

Results: All mastoid dimensions except mastoid angles were larger in males than in females. Conventional mastoid height (cMH), oblique sagittal diameter (OSD) and mastoid volume with its three components, showed high accuracy (85–75%) in discriminating sex. As regards cMH and mastoid volume, the cutoff point was (**30.15**) with overall accuracy (**85%**) in cMH, whereas, in mastoid volume the cutoff point was (**7.77**) with overall accuracy of (**75%**).

Conclusion: It was concluded that the conventional mastoid height (cMH), and oblique sagittal diameter (OSD) and mastoid volume were more accurate for sex discrimination in the Egyptian population.

1. Introduction

Estimation of sex using human skeletal parts is of importance for both, the anatomical anthropologist, and in forensic medicine.[1] Many factors influence the accuracy of sex estimation from adult skeletal remains. Firstly, many of the anatom-

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ical differences between the skeletal elements of males and females are not significantly pronounced. In terms of skeletal dimensions, males and females differ only by approximately 8%.[2] Secondly, the validity of traditional morphological and metric approaches for sex estimation relies on a high degree of preservation and skeletal completeness, specifically of sexually dimorphic element of the skull and pelvis.[3] Mastoid process of the skull has attracted attention from various researchers, because of its protected position at the base of skull and relative compact structure, the mastoid process usually remains in one piece.[4,5] The mastoid process is typically more robust in males. Sex differences in the shape and size of the mastoid process are investigated using traditional morphological and metric methods. Advances in technologies such as computed tomography (CT) scanning, Magnetic Resonance Imaging (MRI), computer based anthropometry, and biochemical analyses are significantly improving the accuracy of skeletal analyses especially in sex estimation.[6] Virtual anthropology (VA) is best characterized as a multidisciplinary approach to study anatomical data representations in three dimensions. It is a fundamental tool for anthropological analysis that allows researchers to deal with problems that could not be solved using traditional anthropological approaches.[7]

1.1. Aim of the work

The aim of this study was to assess the sexual dimorphism of the mastoid process as measured on multidetector computed tomography (MDCT) in living subjects and drive a cutoff point that would be useful in the estimation of sex in adult Egyptian population.

2. Subjects and methods

2.1. Sample size calculation

Before the study, the number of patients required in each group was determined after a power calculation according to data obtained from pilot study. Pilot study reported a mean volume in female of 9.2 with standard deviation (SD) of 1.7 and reported a mean volume in male of 10.9 with standard deviation (SD) of 3.9. A sample size of 40 patients in each group was determined to provide 80% power for two-tail '*t*' test at the level of 5% significance. (Sample size calculated using G power 3.1.9.2 software) (Table 1).

This retrospective observational analytic study was conducted on eighty adult subjects (forty males and forty females) at department of Diagnostic Radiology, Faculty of Medicine, Minia University, using a 16-detector CT scanner (BrightSpeed 16; GE Medical Systems, GE Healthcare-America: Milwaukee, USA): during the period from July 2015 to November 2015, and after being approved by the Medical Ethics Committee.

Imaging studies were done as a part of clinical work up for ear problems, after approval from hospital research Ethics Committee office.

The study sample included, helical CT studies of the head that have complete imaging coverage, and intact mastoid process with the following parameters: 120 KVp, 100 mAs, a helical pitch of 0.562:1, 16×0.625 mm detector configuration, and 0.625 mm helical slice thickness.

Table 1 Independent sample *t* test.

	Males (n = 40)	Females (n = 40)	*P* value
cMH	31.37 ± 2.71	26.80 ± 2.47	**< 0.001***
tMH	39.15 ± 3.43	34.74 ± 3.45	**< 0.001***
ctMH ratio	0.8 ± 0.03	0.77 ± 0.04	**0.004***
OSD	23.86 ± 4.22	20.76 ± 3.57	**0.001***
OCD	13.62 ± 3.07	11.89 ± 3.27	**0.018***
OSD max	31.56 ± 3.22	26.46 ± 4.07	**< 0.001***
OCD max	20.01 ± 3.28	16.85 ± 3.11	**< 0.001***
Volume	13.09 ± 3.61	8.43 ± 3.31	**< 0.001***
ad angle	61.09 ± 4.78	61.33 ± 5.09	0.832
a Inc. angle	70.73 ± 3.59	72.48 ± 4.31	0.052
m Inc. angle	72.93 ± 9.17	76.01 ± 11.17	0.182

* means significance when comparing between male and female and *P* value < 0.001.

Exclusion criteria of, pediatric age group, mastoid process destruction, and previous surgical mastoid operation, were obtained for the study sample. As all cases were CT imaging samples, so the sex and the age were known.

All studies were transferred to an Advantage Workstation (AW) Volume Share 2 (GE) Healthcare, for post-processing and image reconstruction. The axial source images were aligned in a plane parallel to the infra-orbito-metal line or Frankfurt plane. Image reconstruction was then performed, to obtain multiplanar reformatted images (MPR) images in coronal and sagittal planes perpendicular to the created axial images with helical slice thickness:1.25 mm and reconstruction interval: 0.625 mm. Three-dimensional (3D) volume-rendered images of the skull in right and left profile views were created.

The following mastoid measurements were taken on mastoid process of both sides:

1. Conventional mastoid height (cMH): a vertical line connecting the mastoid tip with and perpendicular to the Frankfort plane, is measured on 3D volume rendered profile images Fig. 1.
2. True mastoid height (tMH): a vertical line from the mastoid tip to tegmen mastoidium measured on a coronal plane Fig. 2.
3. Oblique sagittal diameter (OSD): long axis (oblique antero-posterior) diameter of the mastoid at the level of the mastoid groove measured on an axial plane Fig. 3.
4. Oblique coronal diameter (OCD): short axis (oblique transverse) diameter at the level of the mastoid groove measured on an axial plane. Fig. 3.

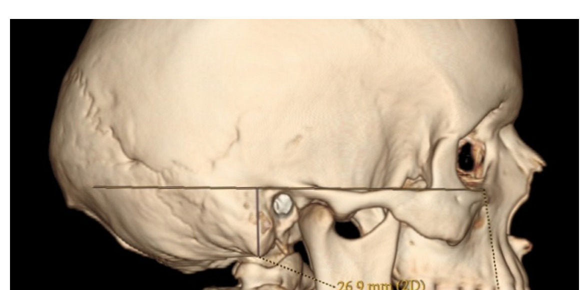

Figure 1 Showing Frankfort plane and cMH.

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