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EVALUATION OF SIZE AND VOLUME OF MAXILLARY SINUS TO DETERMINE GENDER BY 3D COMPUTERIZED TOMOGRAPHY SCAN METHOD USING DRY SKULLS OF SOUTH INDIAN ORIGIN

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ABSTRACT

In the field of forensic medicine, normally the available materials after sufficiently long period of death will be utilized to determine various body characteristics such as age sex etc for identification of individual. Identification of corpses is a difficult forensic procedure and it is mandated by laws and social rules. Comparison of ante mortem and post mortem medical records, such as dental documents, plays an important role in the identification of corpses. Gender has long been determined from the skull, the pelvis and the long bones with an epiphysis and metaphysis in unknown skeletons according to Krogmann. The methods such as 3D CT scan have been utilized to determine the gender.

Objective: The aim of the present study is to evaluate size and volume of maxillary sinus to determine gender by 3D CT Scan method. This work is of National importance in identifying the sex of a person in the forensic medicine and also for criminal investigations.

Method: The skulls of known sex were obtained from recently buried bodies. Initially skulls were scanned by 3D Multiaxial CT scan and dimensions and volume of maxillary sinuses were observed by using dedicated software.

Results: The preliminary analysis of data discriminative by CT method has been tabulated. The volume of the maxillary sinuses of both sides was significantly greater in males compared to female skulls. The p value of left width and right sided volume of maxillary sinuses 0.015 and 0.021 respectively were considered statistically significant. Computerized tomography measurements of maxillary sinuses may be useful to support gender determination in forensic medicine.

INTRODUCTION

Forensic pathologists may be asked to identify the ethnic group and gender of a cranium of unknown origin. [1] Forensic personal identification is a fundamental topic of forensic sciences and technologies to identify live subjects, recently deceased bodies and human remains often at a crime scene by using several appropriate techniques. It has been reported that computerized tomography is a suitable imaging method in the identification of unknown human

remains and presents a lot of advantages as compared with conventional radiographs. [2]

The volumes of maxillary sinuses are of interest to surgeons operating endoscopically as variation in maxillary sinus volume. Other surgical disciplines, such as dentistry, maxillo-facial surgery may benefit from this information. [3] This research was extended to predict the gender from an unknown cranium which will be applicable in the fields of forensic anthropology. The aim of the present study is to

evaluate size and volume of maxillary sinus to determine gender by 3D CT Scan method.

MATERIAL AND METHOD

The skulls of known sex were procured from the department of anatomy for the study. A sample size for the complete project was 80 skulls and at present 30 skulls were studied.

Macerated skulls were taken, cleaned thoroughly and subjected for 3D axial multislider, Siemens sensation cardiac 16 slice CT scan at Vikram hospital Mysore. Images were obtained with slice collimation of 1mm thickness. Axial and coronal images with slice thickness of 4mm were obtained for measurements of height, AP length and width of maxillary sinuses of both sides by using dedicated software (images 1,2). Volume of maxillary air sinuses of both sides were automatically estimated using syngovolume Siemens, by area length method using freehand interactive drawing of area in each axial sections.(image 3).

Statistical Analysis Statistical analysis was performed with Systat 13 package. Mean and SD to assess the level of the parameters in males and females were determined. Independent sample t – test. Differences with a p value, $p < 0.05$ were considered significant.

RESULTS

The preliminary analysis of data discriminative by CT and plastination method have been tabulated. The discriminative analysis will be done when 80 skulls are studied. The dimensions and volume of maxillary air sinuses are shown in Table 1.

The volume of the maxillary sinuses of both sides was significantly greater in males compared to female skulls. The p value of left width with and right sided volume of maxillary sinuses 0.015 and 0.021 respectively were considered statistically significant.

DISCUSSION

In the present study, all the measurements and volume of maxillary sinuses of both sides was significantly greater in male skulls compared to female skulls. By the above observations, analysis made by CT scan method, left width and right sided volume showed statistically significant values.

Teke HY and others in 2006 studied width, length and the height of the maxillary sinus in 127 adult patients by CT. the discriminative analysis showed that the accuracy of maxillary sinus measurements- ie , the ability to identify gender was 69.4% in females and 69.2% in males.[4]

Amusa YB et al in 2011 studied 24 dried skulls of Nigerians. The height, width , depth and volume of each of the sinuses were determined. In all the paranasal sinuses, the right side was found to be larger than the left except for the maxillary sinus whee the left side was found to be larger. The average volume on the right was 11.59 ± 5.36 cc and 14.98 ± 10.77 cc on the left. [5]

It has been reported that maxillary sinuses remain intact although the skull and other bones may be badly disfigured in victims who are incinerated and, therefore, that maxillary sinuses can be used for identification.[6]

Uthman A.T in 2011 studied maxillary sinus dimensions in 88 patterns between age group of 20-49 yrs by CT scan. The width, length and height of the maxillary sinuses in addition to the total disrtance across both sinuses were measured. Data were subjected to discriminant analysis for gender using multiple regression analysis. Maxillary sinus height was the best parameter that could be used to study sexual dimorphism with an overall accuracy of 71.6% . using multivariate analysis 74.4% of male sinus and 73.3% of female sinus were sexed correctly.[7]

Johnson PS and others studied dimensions of 120 maxillary and frontal sinuses from head CT

images. The mean value of the maxillary sinus volume was 15.7 ± 5.3 cm³ and significantly larger in males than in females. There was no statistically significant correlation between the volume of maxillary sinuses with age or side. [8] Kim HJ et al studied 33 hemisectioned Korean CT images. From the three-dimensional reconstructed images of the maxillary sinus, six categories of maxillary sinus were created, categorized according to their lateral aspects and shapes of the inferior walls. All measures ant-post length, height, width and volume of the sinus were larger in males than in females. The maximum a-p length of sinus was 39.3 ± 4.2 mm (male - 40.7 mm , female 37.4 mm) its maximum height was 37.1 ± 5.6 mm and max width was 32.6 ± 6.5 mm. the average volume of the sinuses was 15.1 ± 6.2 ml.[9]

In the present study, the measurements and volume of maxillary sinus of males were slightly more compared with females.

CONCLUSION

Gender determination is an important step in identification in forensic medicine. Computerized tomography is a significant advance in radiology and it is becoming increasingly available and replacing gradually the conventional radiographs. It gives the opportunity of avoiding the superimposition of structures beyond the plane of interest and allowing the visualization of small differences of density. Craniometric points can be precisely located and measurements can be more accurately performed than on conventional radiographs. This research work is of national importance in identifying the sex of a person in forensic anthropology and also for criminal investigations.

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Table 1 Shows Female: Male Distribution of the mean Value, SD and P Value of Maxillary Sinus Parameters by CT Scan Method

FEMALES (N=12)			MALES (18)		P value
PARAMETERS	MEAN	SD	MEAN	SD	
Left height	3.025	0.407	3.106	0.560	0.652
Left A-P	3.158	0.375	3.278	0.444	0.435
Left width	1.975	0.331	2.372	0.510	0.015
Left volume	10.908	3.31	13.5	6.513	0.171
Right height	2.825	0.367	3.022	0.545	0.246
Right A-P	2.858	0.345	3.100	0.499	0.128
Right width	1.883	0.307	2.194	0.556	0.059
Right volume	9.733	3.389	13.606	5.247	0.021

Image 1 : Shows measurements , width and antero-posterior length of maxillary sinus



Image 2 : Axial Section , Measuring Height of Maxillary Sinus

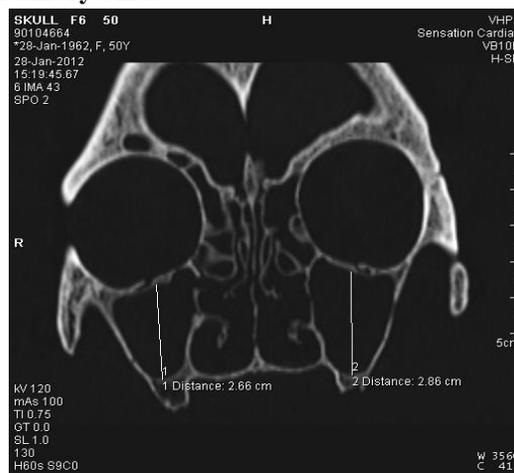


Image 3 : Estimation of volume by area length method of each slices

