

Original Research

Sex identification using the maxillary sinus- A clinic-radiographic study

Dr. Pavan P N

Associate Professor, Department of Forensic Medicine and Toxicology, East Point College of Medical Sciences and Research Centre Bengaluru, Karnataka

Corresponding Author

Dr. Pavan P N

Associate Professor, Department of Forensic Medicine and Toxicology, East Point College of Medical Sciences and Research Centre Bengaluru, Karnataka

Received: 4 April, 2024

Accepted: 24 May, 2024

ABSTRACT

Background: Post-mortem identification, a forensic procedure, is difficult to perform and it is obligatory in terms of the law and social norms. The present study assessed sex identification using the maxillary sinus.

Materials & Methods: 90 healthy individuals without any pathology in the sinus above 20 years of age of either gender were subjected to CBCT scan using Vatech machine. The maxillary sinuses on the left and right were measured superoinferiorly in the coronal section and mediolaterally in the axial section in millimeter at the maximum dimension. The volumetric analysis of the maxillary sinus was done in a cubic centimeter (cm³) in the sagittal section.

Results: Out of 90 patients, 50 were males and 40 were females. Supero- inferior measurement of right maxillary sinus was 37.4 mm in males and 33.2 mm in females. Supero- inferior measurement of left maxillary sinus was 38.1 mm in males and 33.8 mm in females. Medio- lateral measurement of right maxillary sinus was 33.5 mm in males and 31.9 mm in females. Medio- lateral measurement of left maxillary sinus was 33.2 mm in males and 31.4 mm in females. Volume of right maxillary sinus was 17.2 mm in males and 13.6 mm in females. Volume of left maxillary sinus was 16.9 mm in males and 13.5 mm in females. The difference was significant ($P < 0.05$). % of males and % of females correctly classified in relation to right SI (mm) was 70% and 57.6%, left SI (mm) was 81% and 58.3%, right ML (mm) was 65% and 52%, left ML (mm) was 58% and 54%, right volume (cm³) was 78.4% and 57% and left volume (cm³) was 75% and 59% respectively. The difference was significant ($P < 0.05$).

Conclusion: Sex identification by analyzing the skeletal remains is instrumental in forensic investigations. Maxillary sinus measurements showed better predictability values in males as compared to females in the case of superoinferior measurement of left maxillary sinus and volume of the right maxillary sinus.

Keywords: Post-mortem identification, maxillary sinus, CBCT

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Introduction

Post-mortem identification, a forensic procedure, is difficult to perform and it is obligatory in terms of the law and social norms.¹ It is important to compare ante mortem and post-mortem records for the identification. Comparison of ante mortem and post-mortem medical records, such as dental documents, plays an important role in the identification of corpses.²

Establishing identification is necessary for unknown deceased person in homicide, suicide, accident, mass disasters, and for culprits hiding their identity.³ Various body parts are being used for gender identification such as skull, pelvis, long bones, foramen magnum, sella turcica, mandibular ramus and paranasal sinuses in unknown remains, which narrow down the personnel identification by 50%.⁴ The size and shape of, maxillary sinus and zygomatic bones remain intact although other bones

may be badly disfigured in victims who are incinerated and therefore, the maxillary sinuses can be used for identification. Gender determination is an important step in identification in forensic medicine.⁵ Maxillary sinus anatomy is of great importance to the dentist as it lies close to the maxillary dental arch, which could also prove beneficial to the dental surgeons to prevent undue complications during their surgical procedures. Besides this, it also plays an important role in forensics as it can be used for sex identification in unidentified corpses. The width, length, and height of maxillary sinus together can be used for gender determination when the whole skeleton is not available.⁶ The present study assessed sex identification using the maxillary sinus.

Materials & Methods

The study was carried out on 90 healthy individuals

without any pathology in the sinus above 20 years of age of either gender. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. All were subjected to CBCT scan using Vatech machine. The maxillary sinuses on the left and right were measured superoinferiorly in the coronal section and mediolaterally in the axial section in millimeter at the

maximum dimension. The volumetric analysis of the maxillary sinus was done in a cubic centimeter (cm³) in the sagittal section. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

Results

Table: I Distribution of patients

Total- 90		
Gender	Male	Female
Number	50	40

Table I shows that out of 90 patients, 50 were males and 40 were females.

Table: II Comparison of maxillary sinus

Parameters	Male	Female	P value
Right SI (mm)	37.4	33.2	0.04
Left SI (mm)	38.1	33.8	0.02
R ML (mm)	33.5	31.9	0.04
L ML (mm)	33.2	31.4	0.01
R V (cm ³)	17.2	13.6	0.01
L V (cm ³)	16.9	13.5	0.02

Table II, graph I shows that supero- inferior measurement of right maxillary sinus was 37.4 mm in males and 33.2 mm in females. Supero- inferior measurement of left maxillary sinus was 38.1 mm in males and 33.8 mm in females. Medio- lateral measurement of right maxillary sinus was 33.5 mm in males and 31.9 mm in females. Medio- lateral measurement of left maxillary sinus was 33.2 mm in males and 31.4 mm in females. Volume of right maxillary sinus was 17.2 mm in males and 13.6 mm in females. Volume of left maxillary sinus was 16.9 mm in males and 13.5 mm in females. The difference was significant (P< 0.05).

Graph I Comparison of maxillary sinus

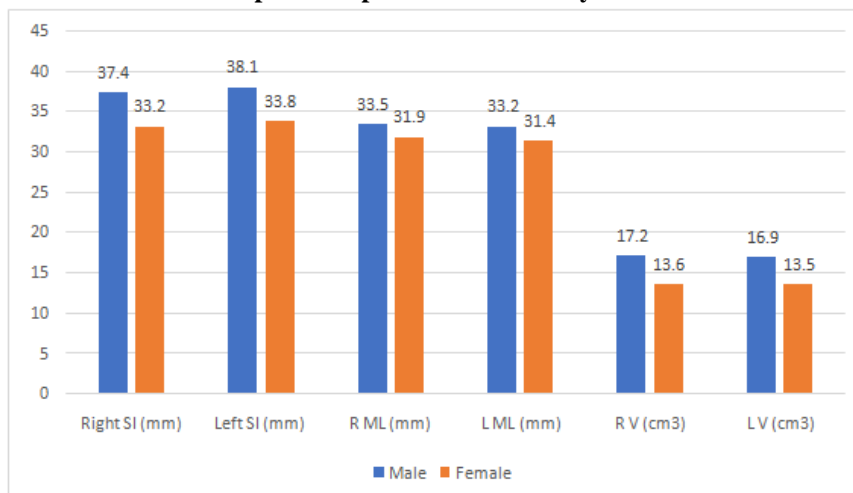


Table: III Discriminant function analysis for sex

Parameters	% of Male correctly classified	% of Female correctly classified	P value
Right SI (mm)	70%	57.6%	0.04
Left SI (mm)	81%	58.3%	0.02
R ML (mm)	65%	52%	0.04
L ML (mm)	58%	54%	0.01
R V (cm ³)	78.4%	57%	0.01
L V (cm ³)	75%	59%	0.02

Table III shows that % of males and % of females correctly classified in relation to right SI (mm) was

70% and 57.6%, left SI (mm) was 81% and 58.3%, right ML (mm) was 65% and 52%, left ML (mm) was

58% and 54%, right volume (cm³) was 78.4% and 57% and left volume (cm³) was 75% and 59% respectively. The difference was significant ($P < 0.05$).

Discussion

For legal purposes, people have been identified using a variety of techniques, whether they are living or deceased.^{7,8} It would be challenging to identify bodies or their components that were left over after natural or man-made calamities if they weren't found whole. Although the skull is the most dependable anatomical part after the pelvis, it cannot be fully trusted until a person reaches adolescence.⁹ In these situations, forensic science comes into play and uses a variety of techniques, including mandibular measures, cheiloscopy, rugoscopy, and paranasal sinuses, to identify a person's sex. In these techniques, rugoscopy is mostly utilized for personal identification as it makes very little contribution to sex identification, whereas cheiloscopy can be used for both sex determination and personal identification.¹⁰

We found that out of 90 patients, 50 were males and 40 were females. Abdulhameed A et al¹¹ conducted a study to determine the accuracy for gender determination by maxillary sinus dimensions. Total of 130 subjects (79 males and 51 females), between 20 - 80 years, with normal maxillary sinus CT anatomy, from head CT scans. The anteroposterior and transverse diameters were measured from axial images, while the craniocaudal diameter was measured from coronal and sagittal reformatted images. The discriminant analysis showed that the left anteroposterior diameter accurately identified 73 subjects (56%) i.e. (42 males (53.2%) and 31 females (60.8%)), the left cranio-caudal diameter accurately identified 55.4% of subjects i.e. 46 males (58.2%) and 26 females (51.0%). The Computerized tomography measurements of maxillary sinus dimensions may be helpful to support gender determination in forensic anthropology in addition to other methods of gender identification in unknown human specimen.

We found that supero- inferior measurement of right maxillary sinus was 37.4 mm in males and 33.2 mm in females. Supero- inferior measurement of left maxillary sinus was 38.1 mm in males and 33.8 mm in females. Medio- lateral measurement of right maxillary sinus was 33.5 mm in males and 31.9 mm in females. Medio- lateral measurement of left maxillary sinus was 33.2 mm in males and 31.4 mm in females. Volume of right maxillary sinus was 17.2 mm in males and 13.6 mm in females. Volume of left maxillary sinus was 16.9 mm in males and 13.5 mm in females. We found that % of males and % of females correctly classified in relation to right SI (mm) was 70% and 57.6%, left SI (mm) was 81% and 58.3%, right ML (mm) was 65% and 52%, left ML (mm) was 58% and 54%, right volume (cm³) was 78.4% and 57% and left volume (cm³) was 75% and 59% respectively. Nourbakhsh R et al¹² conducted a study to determine Sexual dimorphism in Cone Beam

CT images of an Iranian population" Several bones have been examined for identification and determining the sex in the corpses, such as skull bones. Nowadays, CBCT images have high importance, since they have ability to produce images in different designs, which increase the efficiency of diagnosis. Thus, the objective of this research was to evaluate the dimensional measurement of different anatomic skull structures in determining the sexual dimorphism accuracy in cone beam CT images in an Iranian population. In this descriptive-analytical study, 102 patients, admitted to Oral and Maxillofacial Radiology Department of Tabriz Faculty of Dentistry for evaluation by CBCT were examined. For this purpose, landmarks of frontal and maxillary sinus, mandible and foramen magnum were measured and finally analyzed by SPSS software to determine the sexual dimorphism accuracy of the measurements. The results of this research revealed that in terms of difference between males and females, the greatest difference belonged to different parts of the maxillary sinus. The results of different parts of the right and left frontal sinus in this research revealed no difference among them. Moreover, the sexual dimorphism accuracy from frontal sinus was estimated about 76.7% in this research. Images related to CBCT of frontal sinus, maxillary sinus, and mandibular landmarks can be helpful in sex determination. The results of sex determination accuracy by landmarks measured in this research revealed that the highest sex determination accuracy belonged to size of ramus height with 81%, and the lowest accuracy belonged to total width of the frontal sinus with 45%. In addition, considering all the variables at the same time, the predictive power was found 100%.

The shortcoming of the study is small sample size.

Conclusion

Authors found that sex identification by analyzing the skeletal remains is instrumental in forensic investigations. Maxillary sinus measurements showed better predictability values in males as compared to females in the case of superoinferior measurement of left maxillary sinus and volume of the right maxillary sinus.

References

1. Dangore- Khasbage S, Bhowate R. Utility of morphometry of maxillary sinuses for gender determination by using computed tomography. *Dent Med Probl.* 2018;55(4):411–417.
2. Xavier TA, Terada ASSD, Silva RAHD; Forensic application of the frontal and maxillary sinuses: A literature review; *Journal of Forensic Radiology and Imaging* 3(2015)105–110
3. Nayar A, Singh HP, Leekha S. Pulp tissue in sex determination: A fluorescent microscopic study. *J Forensic Dent Sci* 2014;6:77-80.
4. Ibrahim A, Alias A, Nor FM, Swarhib M, Bakar SNA, Das S; Study of sexual dimorphism of Malaysian

- crania: an important step in identification of the skeletal remains, *Anat Cell Biol* 2017;50:86-92.
5. Vidya C.S., Shamasun N.M., Manjunatha B., Raichurkar K. Evaluation Of Size And Volume Of Maxillary Sinus To Determine Gender By 3D Computerized Tomography Scan Method Using Dry Skulls Of South Indian Origin; *Int J Cur Res Rev*, Feb 2013 / Vol 05 (03)
 6. Won-Jin Lee, Seung-Jae Lee, Hyung-Seop Kim, Analysis of location and prevalence of maxillary sinus septa; *J Periodontal Implant Sci* 2010;40:56-60
 7. Abdulhameed Aliu, Shiitu Bello Sirajo, Jibrin Usman et al Sex Determination from Dimensions of the Maxillary Sinus using Computerized Tomography; *Journal of Applied Science*; 2018; 4 (4): 1-7
 8. GOPAL SK et al Role of 3 D Cone Beam Computed Tomography Imaging in Forensic Dentistry; *Indian Journal of Forensic Odontology*; 2018; 11 (2): 56-82
 9. Ewunonu EO and Anibeze CIP Anthropometric study of the Facial Morphology in a South-Eastern Nigerian Population. *Hum Bio Rev*, 2(4), 314- 323.
 10. Abu El- Dahab O, Dakhli I. The Role of Cone Beam Computed Tomography in Sex Identification of a Sample of Egyptian Population Using Maxillary Sinus Predictors. *Oral Surgery, Oral Medicine, Oral Radiology*, vol. 6, no. 1 (2018): 4-9.
 11. Abdulhameed Aliu, Shiitu Bello Sirajo, Jibrin Usman et al Sex Determination from Dimensions of the Maxillary Sinus using Computerized Tomography; *Journal of Applied Science*; 2018; 4 (4): 1-7.
 12. Nourbakhsh R, Razi S, Razi T. Evaluation of relation of dimensional measurement of different anatomic skull structures to determine sexual dimorphism in cone beam CT images of an Iranian population, *J Res Med Dent Sci*, 2018, 6 (3):33-38.