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Evaluation of Gender Wise Variations in Volume of Maxillary Sinus Using CBCT.

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**Conflicts of Interest:** Nil

## Abstract

**Aim:** The aim of this study was to identify the variations in volume of maxillary sinus among males and females.

**Methodology:** 92 CBCT images of maxillary sinus of patients above 20 years of age, equally distributed among males and females were selected from the archives of Department of Oral Medicine and Radiology, Yenepoya Dental College, was used to measure the volume of the maxillary sinus. The volume of maxillary sinus represented by the air space volume was measured in cm<sup>3</sup> using a specialized tool in Romexis software of the Planmeca promax 3D Mid CBCT machine. It was verified for accuracy in all anatomical planes.

**Results**: The data collected was subjected to statistical analysis. Independent t-test was used to compare volume

between males and females. In our study the mean volume of left maxillary sinus in females was 12.1966 cm<sup>3</sup> with a standard deviation of 2.92207 whereas it was 13.8976 with a standard deviation of 4.98551 in males. The right maxillary sinus showed a mean volume of 11.8447 with a standard deviation of 2.99691 in females and 14.1937 with a standard deviation of 4.86942 in males. Males are found to be having larger sinus volume compared to females.

### Conclusion

Our study shows highly significant variation among males and females, hence maxillary sinus can be used as a tool for identification of gender in forensic medicine.

Keywords: CBCT, Maxillary Sinus, Forensic, Volume.

#### Introduction

Forensic dentistry is the proper handling, examination and evaluation of dental evidence, which will be then presented in the interest of justice. The identification is a systematic and organized process, in which primary function is to establish the identity. In the Forensic Sciences, different methods have been developed for human identification based on comparisons between ante and post mortem data<sup>1</sup>. Gender determination is one of the important parameters in forensic identification. A forensic study is very important in the identification of gender especially when the body of deceased has been destroyed as a result of physical injury due to weapons, fire or strong chemicals.

In human identification, there are cases of wide body degradation, such as charred, skeletonised or in advanced stages of decomposition<sup>1</sup>. Radiological identification of gender is employed when body is decomposed and fragmented. Various body parts are being used for gender determination such as skull, pelvis, long bones, foramen magnum, sellatursica, mandibular ramus and paranasal sinuses in unknown remains. But in many instances those bones are recovered either in fragmented or incomplete state where gender determination is difficult to perform. As most bones used for identification are recovered in incomplete state, it is often necessary to use bones that are recovered intact e.g., the maxillary sinus<sup>2</sup>. The maxillary sinus remains intact even when the skull and other bones may be badly disfigured in victims who are incinerated, thus it can be used for identification<sup>3.</sup> So it is key to use denser bones that are often recovered intact such as maxillary sinus.

The size, shape, and wall thickness of this anatomic structure vary from one individual to another<sup>4</sup>. Various studies have been conducted using two-dimensional radiography on maxillary sinus for the identification.

In the present era of three-dimensional imaging, Cone Beam Computed Tomography (CBCT) can provide precise information about complex anatomical structures, as it is characterized by rapid volumetric image acquisition with high resolution<sup>2</sup>. Literature survey shows a very few three dimensional studies conducted on maxillary air sinus. Most of the studies reported are based on linear measurements. The present study is done using a specialised volume tool in Romexis software, which is easier. So this CBCT study for the variation of morphology of maxillary air sinus can be helpful in many ways.

#### **Materials And Methods**

A retrospective radiographic study was carried out of in the department of Oral Medicine and Radiology, Yenepoya Dental College. The CBCT images were selected from the image archives of Department of Oral Medicine &Radiology, who underwent CBCT examination for other reasons that were not related to the maxillary sinus.The CBCT images were obtained using Planmeca-mid-CBCT machine and Romexis software.

This study includes 92 images of right and left maxillary sinuses, selected based on convenient samplinig, which was divided equally among males and females. All images were analyzed in different anatomical planes. The images with developmental disorders, any syndrome affecting head and neck region, with maxillofacial fractures or history of fracture or surgeries on maxillary sinus were excluded from the study.

The volume of maxillary sinus represented by the air space volume was measured in cm<sup>3</sup>. It was verified for accuracy in all anatomical planes .Volumetric measurements were made using the "ellipse" feature of Romexis software in coronal, sagittal and axial reconstructions.

## **Results And Observation**

The mean volume of left maxillary sinus in females is  $12.1966 \text{ cm}^3$  with a standard deviation of 2.92207 wheres as it is 13.8976 with a standard deviation of 4.98551 in males. The right maxillary sinus shows a mean volume of 11.8447 with a standard deviation of 2.99691 in females and 14.1937 with a standard deviation of 4.86942 in males.

Independent t-test is used to compare volume between males and females.

We observe that there is significant difference in volume between males and females with a p value of < 0.05. Males are having higher volume than females.

Multiple logistic regression was performed and propose following equation for prediction as males or females from right and left measurements with cutoff value as 0.5.

# Sex=1.819+0.074\*(LEFT)-0.215\*(RIGHT)

Accordingly, when an individual got a score >0.5 is predicted as female and <0.5 is predicted as male. From the table we observe that 65.2% males are correctly predicted as males and 71.7% females are correctly predicted as females.

Accuracy of prediction is 68.5%.

## Discussion

The maxillary sinus, one of the paranasal sinuses first identified by ancient Egyptians, has been well studied, especially its structure, vascular anatomy, and relationship with the teeth<sup>5.</sup> It is pyramidal in shape and is the largest of the paranasal sinuses<sup>6</sup>. The maxillary sinuses generally extend between 28.9 mm and 47.6 mm in the anteroposterior diameter<sup>7</sup>. Detailed knowledge of maxillary sinus anatomy has become increasingly important for sinus augmentation procedure, implantology, and sinus surgeries. Computed tomography (CT) and cone beam computed tomography (CBCT) are often considered the radiographic gold standard for imaging the sinuses<sup>8,9.</sup>

The procedures for measuring the volume of the maxillary sinus have been changed with advances in medical techniques. For example, from cadaveric skull measurements, plain radiographs to CT and MRIs. A disadvantage of measuring cadaveric skulls is in the inaccurate information about them, such as, measurements will be larger than true size because of the loss in cadavers of mucosa of the maxillary sinus and the other soft tissues<sup>10</sup>. The disadvantage of using plain radiographs is that the images may be different from actual size and that the boundary for the images of the maxillary sinus and adjacent structures overlaps and cannot be determined precisely<sup>11, 12</sup>. CT/CBCT scans efficiently distinguish the maxillary sinus from the adjacent structures with a high resolution.CBCT can accurately capture, display and provide 3-dimensional visualization of maxillofacial anatomy and pathology<sup>13</sup>.

With no magnification, 1:1 representation of the images and also being less severely affected by metallic artefacts than the conventional  $CT^{14}$ , this imaging technology has the potential to be used as a tool for sex determination in mass disasters or when badly decomposed and incinerated bodies are available. CBCT could thus prove advantageous and serve as an accessible alternative to CT in many cases of forensics<sup>15</sup>.

The aim of our study was to evaluate the variation of volume of maxillary sinus among gender. A retrospective analysis was done in 92 CBCT images, equally divide among males and females. In our study the mean volume of left maxillary sinus in females is 12.1966 cm<sup>3</sup> with a standard deviation of 2.92207 wheres as it is 13.8976 with a standard deviation of 4.98551 in males. The right maxillary sinus showed a mean volume of 11.8447 with a

standard deviation of 2.99691 in females and 14.1937 with a standard deviation of 4.86942 in males.

The mean value of the maxillary sinus volume has been studied by several researchers using linear measurements, such as multiplying length, breadth and height. However our study introduces an easier and accurate method for determining the volume. Males are found to be having larger sinus volume compared to females. Our results were similar to the the study conducted by Johnson et al in 2011<sup>11</sup>. The volume was significantly larger in males than in females.

Another similar study<sup>16</sup> conducted for a period of June 2013 to May 2014 to evaluate sexual dimorphism of maxillary sinus dimension using CBCT showed that the overall values of the parameters were significantly greater in the males as compared to the females.

These differences among males and females can be attributed to multiple global factors among various ethnic and racial groups, including special body stature, skeletal size, height and physique of an individual; environmental conditions and pneumatization process of sinus in varying age and sex groups.

These factors can also be attributed as a limitation of present study. This mean volume cannot be generalized in males and females due to smaller sample size and difference in body skeleton status. The results can be generalized only after incorporating these parameters.

Our study shows highly significant variation among males and females, hence maxillary sinus can be used as a tool for identification in forensic medicine.

Multiple logistic regression was also performed and proposed following equation for prediction from right and left measurements with cutoff value as 0.5.

The equation is Sex=1.819+0.074\*(LEFT)-0.215\*(RIGHT). When we analyse the above equation with our data collected we can observe that 65.2% males are correctly predicted as males and 71.7% females are correctly predicted as females. This difference can be due to the smaller sample size in our study.

### Conclusion

The present CBCT study was designed to evaluate the variations in volume of maxillary sinus among males and females. The limitation of 2d imaging has been overcome by the advent of CBCT. The result showed that the volume of maxillary sinus is higher in males as compared to females. The mean volume of left maxillary sinus in females was 12.1966 cm<sup>3</sup> with a standard deviation of 2.92207 whereas as it was 13.8976 with a standard deviation of 4.98551 in males. The right maxillary sinus showed a mean volume of 11.8447 with a standard deviation of 2.99691 in females and 14.1937 with a standard deviation of 4.86942 in males. A highly significant variation in sinus volume was seen in this study. Hence maxillary sinus can be used as a tool for identification of males and females in forensic medicine.

#### References

- Xavier T, Therada A, Silva R. Forensic Application of the frontal and maxillary sinuses: A literature review. J Forensic Radiol Imaging. 2015; Jun;3(2):105-10
- Ayeesha Urooge, Bharati A Patil.Sexual dimorphism of Maxillary Sinus: A morphometric analysis using Cone Beam Computed Tomography Clin Diagn Res.2017 Mar;11(3):ZC67-70.
- Masri A, Yusuf A, Hassan R. A Three dimensional computed tomography (3D-[2] CT): A study of maxillary sinus in Malays. CJBAS. 2013; 01(02):125-34.
- R. Koymen, N. Gocmen-Mas, U. Karacayli, K. Ortakoglu, T. Ozen, et al. Anatomic evaluation of maxillary sinus septa: surgery and radiology. Clinical Anatomy, 2009; 22(5)563–570.

# Dr Veena K.M, et al. International Journal of Dental Science and Innovative Research (IJDSIR)

- Mavrodi A, Paraskevas G. Evolution of the paranasal sinuses' anatomy through the ages. Anat Cell Biol 2013;46:235-8.
- Standring S. Gray's anatomy: the anatomical basis of clinical practice. 41st ed. London: Elsevier Health Sciences; 2015.
- von Arx T, Lozanoff S. Clinical Oral Anatomy: A Comprehensive Review for Dental Practitioners and Researchers. Basel, Switzerland: Springer; 2017. p. 170.
- Bhattacharyya N, Fried M. The accuracy of computed tomography in the diagnosis of chronic rhinosinusitis. Laryngoscope. 2003;113:125-129.
- Xu J, Reh DD, Carey JP, Mahesh M, Siewerdsen JH. Technical assessment of a cone-beam CT scanner for otolaryngology imaging: image quality, dose, and technique protocols. Med Phys. 2012;39:4932-4942.
- 10. Maresh MM. Paranasal sinuses from birth to late adolescence. Am J Dis child 1940;60:55-78.
- Pernilla Sahlstrand-Johnson, Magnus Jannert, Anita Strombeck, Kasim Abdul- Kasim. Computed tomography measurements of different dimensions of maxillary and frontal sinuses. Sahlstrand-Johnson et al. BMC Medical Imaging 2011;11(8).
- Vinter I, Krmpotic-Nemanic J, Jalsovec D. Does the alveolar process of the maxilla always disappear after loss of teeth? Laryngorhinootologie 1993;72 (606).
- Elwakeel EE, Ingle E, Elkamali YA, Alfadel H, Alshehri N, et al (2017) Maxillary Sinus Abnormalities Detected by Dental Cone-Beam Computed Tomography. Anat Physiol 7: 252.
- 14. Von See C, Bormann KH, Schumann P, Goetz F, Gellrich NC, Rucker M. Forensic imaging of projectiles using cone-beam computed tomography. Forensic Sci Int 2009;190(1–3):38–41.

- Sarment DP, Christensen AM. The use of cone beam computed tomography in forensic radiology. J Forensic Radiol Imaging 2014;2(4):173–81.
- Thambawala S, Karjodkar F, Sansare K, Prakash N.Sexual dimorphism of maxillary sinus using cone beam computed tomography. Egypt J Forensic Sci.2016 Jun;6(2):120-25.

#### **Legends Figure and Table**









# Dr Veena K.M, et al. International Journal of Dental Science and Innovative Research (IJDSIR)

	Female		Male		
	Mean	Std. Deviation	Mean	Std. Deviation	
Left	12.1966	2.92207	13.8976	4.98551	
Right	11.8447	2.99691	14.1937	4.86942	

Table 1: Shows the average volume of left and rightmaxillary sinuses of males and females:

Shows the mean volume of maxillary sinuses in males and females calculated using descriptive statistics.

The mean volume of left maxillary sinus in females is  $12.1966 \text{ cm}^3$  with a standard deviation of 2.92207 wheres as it is 13.8976 with a standard deviation of 4.98551 in males.

The right maxillary sinus shows a mean volume of 11.8447 with a standard deviation of 2.99691 in females and 14.1937 with a standard deviation of 4.86942 in males.

	Female		Male		
		Std.	Std.		p-
	Mean	Deviation	Mean	Deviation	value
Left	12.1966	2.92207	13.8976	4.98551	0.049
Right	11.8447	2.99691	14.1937	4.86942	0.007

 Table 2: Comparison between males and females in right

 and left

Independent t-test is used to compare volume between males and females.

We observe that there is significant difference in volume between males and females with a p value of < 0.05. Males are having higher volume than females.

		В	S.E.	Wald	df	p-value	Exp(B)
Step 1ª	LEFT	.074	.108	.472	1	.492	1.077
	RIGHT	215	.109	3.909	1	.048	.806
	Constant	1.819	.820	4.924	1	.026	6.164

a. Variable(s) entered on step 1: LEFT, RIGHT

		Predicted			
			G		
	Observed		MALE	FEMALE	Percentage Correct
Step 1	G	MALE	30	16	65.2
		FEMALE	13	33	71.7
	Overal	l Percentage			68.5

a. The cut value is .500

Table 3: Classification table giving the prediction.

Multiple logistic regression was performed and propose following equation for prediction as males or females from right and left measurements with cutoff value as 0.5. Sex=1.819+0.074\*(LEFT)-0.215\*(RIGHT)

Accordingly, when an individual got a score >0.5 is predicted as female and <0.5 is predicted as male. From the table we observe that 65.2% males are correctly predicted as males and 71.7% females are correctly predicted as females.

Accuracy of prediction is 68.5%.

Chart 1: Representing the mean volume of left maxillary sinus in males and females.



Chart 2: Representing the mean volume of right maxillary sinus in males and females.

