Section: Forensic Medicine and Toxicology

Original Research Article

SEXUAL DIMORPHISM OF MAXILLARY SINUS

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VL=volume of left MS, VR=volume of right MS, CT = Computerised Tomography, MS = Maxillary sinus.

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ABSTRACT

Background: Maxillary sinuses are pneumatic bones and delicate; hence, they are broken in skeletons. Hence, a metrical study of the maxillary sinus (MS) is done in young adults of both sexes because crimes are common in adults only. **Materials and Methods:** 30 male and 30 female adults aged between 20-40 years were studied with CT images to measure the mediolateral, superoinferior, and anteroposterior dimensions and the volume of the maxillary sinus in both genders and the obtained results were studied and compared statistically. **Result:** The mean value of MLR in males was 28.60 (SD ± 3.25); in females, it was 26.11 (± 5.30); the t-test was 2.20, and P < 0.01. The mean value of SIR was 39.14 (±4.60) in males and 34.22 (±5.40) in females, with a t-test of 3.79 and P<0.01. The mean value of APR in males is 43.55 (±2.60) and in females 37.03 (±3.05), with a t-test of 8.91 and p<0.001. The mean value of MLL in males was 28.03 (±4.02), in females 24.10 (±5.15), with a t-test of 3.29 and P<0.001. The mean value of SIL in males was 37.80 (3.30), in females 34.10 (±5.50), with a t-test of 3.15 and P<0.001. The mean value of APL males was 41.75 (1.60); for females, it was 38.12 (±1.90), the t-test was 8.00 and P<0.001. Mean values of volume of right MS in males 17.50 (±3.53), females 12.58 (±±4.12), t-test 4.96, P<0.001. The mean value of the left volume of MS in males was 16.15 (±2.80), in females 11.80 (±±3.85), the t-test was 5.00, and P<0.001. **Conclusion:** The present study's significant findings on the differences between male and female MS have anatomical, anthropological, and medico-legal importance in adults because the derivatives of mesodermal parameters are uncertain.

INTRODUCTION

There are many criteria to identify the sex, such as pubic angles, cranial index, cranial structure, sacrum, angle of mandible, and duration of ossification,[1] but the least data is available in the maxillary sinus. Maxillary sinuses are pneumatic bones well developed after puberty. They lighten the skulls and act as resonance of voice.[2] The maxillary sinuses (MS) are broken in the skeleton due to their delicacy and decompose or are delayed to be brought for autopsy because of environmental factors such as humidity, temperature, and exposure to microorganisms.[3] Nevertheless, post-mortem is obligatory in terms of the law and social norms.[4]

A healthy adult volunteer study gives accurate parameters of the CT maxillary sinus. Moreover, crime occurs in adults only; hence, an attempt is made to compare the maxillary sinus of both sexes because morphological studies of mesodermal derivatives are uncertain due to environmental and ethnic adaptations.

MATERIALS AND METHODS

30 male and 30 female adults aged between 20-40 years who were regularly visiting Sri Manakula Vinayagar Medial Medical College & Hospital, Pondicherry-605107 were studied.

Inclusion Criteria: The regular visitors did not have any pathology in the PNS (maxillary sinus) and the majority was healthy volunteers of both sexes selected for the study.

Exclusion Criteria: The patients who have pathology in the PNS; those who have undergone surgery of the PNS, children (below 18 years), and immune-compromised patients were excluded from the study.

Methods: Non-contrast CT scan was performed to study the morphometry of the maxillary sinuses in both sexes using a GE CT/e dual-slice CT scanner (GE Healthcare Technologies). Waukesha, WI, USA Prior to the scan, every patient was instructed to remove the metallic objects (jewelery, hairpins, etc.) from the head-to-neck region and positioned on the CT table in a prone position. The patient's neck was hyperextended with the chin resting on the pad for stabilization. Pads were inserted on both sides of the

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head. The gantry was angulated to make it perpendicular to the hard palate. 3 mm thickness was used on the preliminary scout view extending from the anterior margin of the frontal sinus to the posterior margin of the sphenoid sinus with a reconstruction matrix size of 512x512 at 20 kV, 100 mA. Coronal CT was performed after instructing the patient to remain steady during the entire procedure.
The measurements like ML and SI, were made in the maxillary sinus in the widest position with the help of the on-screen linear management tool on the CT workstation on the screen (Figure A). To measure the AP dimension of the maxillary sinus, the first and last appearances of the sinus were noted in the sequential coronal CT sections, and the number of sections between them was selected. Finally, selected sections were multiplied by 3 (thickness of a single section) to find the AP of the sinus. The maxillary sinus volume (MSV) was calculated by using the paint-on-slice tool on the workstation. To define a volume, the outline of the sinus was traced manually on each slice of the image stack using the on-screen mouse pointer in the coronal plane (Fig-B). Once tracing was complete, the workstation automatically segmented the entire volume of the sinus from the surrounding structure and the segmented portion could be visualized and manipulated in 3D.
At this point, switching to the "histogram" view on the workstation (fig. C) automatically reflected the volume of the sinus in cubic centimeters (CC) of both the right and left maxillary sinuses.
The duration of the study was from October 2023 to September 2025.

Statistical Analysis: The obtained parameters were studied in SPSS software on a computer.

RESULTS

Table – 1 Comparison of various dimension of maxillary sinus measured on CT in both sexes

- MLR (Right): 28.60 (SD±3.25) in males, 26.11 (SD±5.30) in females, t test value was 2.20 and p<0.001.
- SIR (Right): 39.14 (SD±4.60) in males, 34.22 (SD±5.40) in females, t test value was 3.79 and p<0.001.
- AP (Right side): 43.55 (SD±2.60) in males, 37.03 (SD±3.05) in females, t test value was 8.91 and p<0.001.
- ML (Left side): 25.03 (SD±4.02) in males, 24.10 (SD±5.15) in females, t test value was 3.29 and p<0.001.
- SIL (left side): 37.80 (SD± 3.32) in males, 34.10 (SD± 5.50) in females, t test value was 3.15 and p<0.001.
- APL (Life side): 41.75 (SD±1.60) in males, 38.12 (SD± 1.90) in females, t test value was 8.00 and p<0.001.

Table – 2 Comparison of dimension of Maxillary sinus of both sides in both sexes-

1. VR: 17.50 (SD±3.53) in males, 12.58 (SD± 4.12) in females, t test value 4.96 and p<0.001.
2. VL: 1615 (SD± 2.80) in males, 11.80 (SD± 3.85) in females, t test value 5.00 and p<0.001.

Table 1: Comparison of various dimensions of Maxillary sinuses measured on CT in both sexes

Sl No	Particulars	Male (30)	Female (30)	t test	P value
1	ML Right	28.60 (±3.25)	26.11 (±5.30)	2.20	P<0.01
2	SIR (Right)	39.14 (±4.60)	34.22 (±5.40)	3.79	P<0.01
3	AP Right side	43.55 (±2.60)	37.03 (±3.05)	8.91	P<0.01
4	ML left side	28.03 (±4.02)	24.10 (±5.15)	3.29	P<0.01
5	SIL (left side)	37.80 (±3.30)	34.10 (±5.50)	3.15	P<0.01
6	APL (left side)	41.75 (±1.60)	38.12 (±1.90)	8.00	P<0.01

ML Right Medio-lateral dimension of right side SIR Right Supero inferior dimension of Right side MX AP Right Antero posterior dimension of right sinus ML Left = Medio-lateral dimensions left maxillary sinus. SIL = Sup inferior dimension of left maxillary sinus, AP Left Anteroposterior dimension of left maxillary sinus.

Table 2: Comparison of dimensions Maxillary sinus of both sides in both sexes

Sl No	Particulars	Male (30)	Female (30)	t test	P value
1	VR	17.50 (±3.53)	12.58 (±4.12)	4.96	P<0.01
2	VL	16.15 (±2.80)	11.80 (±3.85)	5.00	P<0.01

VR – Volumes right maxillary sinus VL – Volumes of left maxillary sinus.

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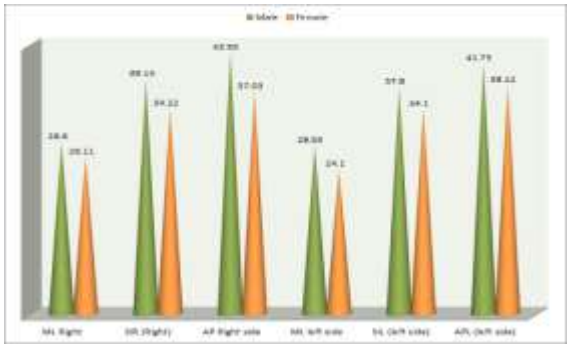

Figure 1: Comparison of various dimensions of Maxillary sinuses measured on CT in both sexes

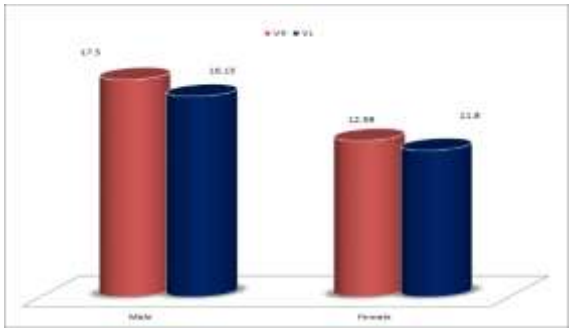

Figure 2: Comparison of dimensions Maxillary sinus of both sides in both sexes

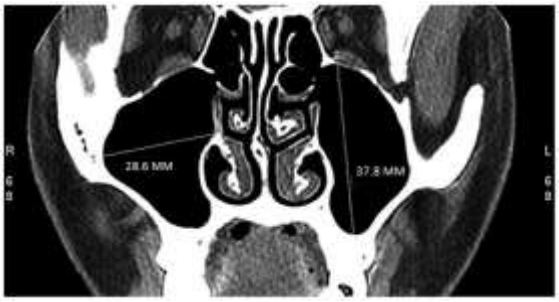

Figure A: Linear measurement of mediolateral and superoinferior dimensions of maxillary sinus

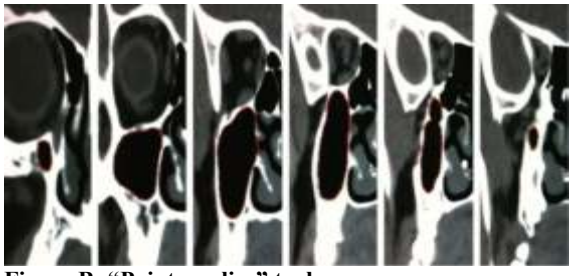

Figure B: "Paint on slice" tool

Figure C: Workstation showing the Maxillary sinus volume

DISCUSSION

Present study of sexual dimorphism of MS in the Pondicherry population. In the comparison of various dimensions of MS in both sexes, the mean value of MLR in males was 28.60 (±3.25), and in females it was 26.11 (±5.30); the t-test was 2.20, and the P-value was highly significant (P<0.01). In SIR mean values, males were 39.14 (±4.60), females 34.22 (±5.40), t-test 3.79, and P<0.01. In APR, the mean value of males is 43.55 (±2.60), and for females, it is 37.3 (±3.05), t -test was 8.01 and (P<0.01). MLL mean value in males was 28.03 (±4.02), female was 24.10 (±5.15), the t-test was 3.29, and P<0.01. SIL mean value of males was 37.80 (±3.30), females 34.10 (±5.50), the t-test was 3.15, and P<0.01. In APL, the mean value of males was 41.75 (±1.60), females was 38.12 (±1.90), t test 8.00 and P<0.01 (Table-1). In the comparison of volume of MS in both sides and both sexes, VR – mean values for males are 17.50 (±3.53) and for females 12.58 (±4.12), with a t-test of 4.96 and P<0.01. In VL, the mean value of males was 16.15 (±2.80); for females, it was 11.80 (±3.85), t test was 5.00 and P value was highly significant (P<0.01). (Table-2) These findings were more or less in agreement with previous studies.[5,6,7] This study will have great importance for gender determination because when any part of the crania or fragmented skeleton is brought before an anatomist or medico-legal expert, it is very difficult to predict the gender because MS is delicate, fragile, and difficult to keep intact.[8] Hence, only denser bones can remain intact by resisting fracture and incineration. The CT scan study of MS has different dimensions and is a robust method for sexual dimorphism.[9,10] The previous literature had mean values of MS measurements of 32, 25, and 35 mm in length, width, and height, respectively.[11] It was an established fact that the overall size or dimensions of MS are larger in males than females.[12]

Moreover, many factors are known to influence and modify the course of the bones development, such as deprivation of raw materials, vitamins, hormonal imbalances, and abnormal mechanical situations. But we have little idea how the genetic "blueprint" works. Contained in the nuclei of the osteo-progenitor cells is translated into action. These regional or ethnic variations might be due to ossification centers, because ossification centers may express their morphological individuality with astonishing persistence even though the bones that they represent have long ago ceased to be of any real functional importance. Hence, variations have regional and morphological significance.

CONCLUSION

The present study of sexual dimorphism of MS in the Pondicherry population is quite useful to anatomists, anthropologists, and medico-legal experts, but this demands further genetic, nutritional, environmental,

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and hormonal study because the factors that decide the ossification are still unclear.

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REFERENCES

1. Schlstrand Johnson P, Jennert M: Computed tomography measurements of different dimensions of maxillary and frontal sinus. BMC Med Imaging 2011, 11-18.
2. Arijiy, Ariji E: computed tomographic indices of maxillary sinuses size in comparison with the sinus volume dento maxillo fac. Radiol – 1996, 25, 19-24.
3. William PL, Bannister LH: Gray's Anatomy, 38th edition. Edinburgh: Churchill Livingstone, 1995, 1637-38.
4. Kawaraiy Fukushimak: Volume qualification of healthy paranasal cavity by three-dimensional CT imaging Acta Otolaryngol 1999, 540, 45-9.
5. J. Ernest Frazer: The Anatomy of the Human Skeleton. IIIrd edition. J & A Churchill, 40 Gloucester Place, Portman Square, 1933, 255–258.
6. Sidhu, R., Chandra, S., Devi, P.: Forensic importance of maxillary sinus in gender determination. A morphometric analysis from western Uttar Pradesh. Eur. J. Gen Dent. 2014, 3, 33-36
7. Masri AA, Yousuf A, Hassan RA: A three-dimensional computed tomography (3D CT): A study of maxillary sinus in Malays. CJBAS, 2013, 01, (02): 125.34.
8. Azar A Ibrahim G: CT scan images analysis for maxillary sinus dimensions as a forensic tool for sexual and racial detection in a sample of the Kurdish population. ESJ 2015, 2015, 11 (18), 271-81.
9. Tambawala SS, Kajodkar FR: Sexual dimorphism of maxillary sinus using cone beam computed tomography, Egypt J. Forensic Sci 2015. 6(2), 120-25.
10. Tanushri, Naeem A: Evaluation of gender by measuring the size of the maxillary sinus using computed tomographic scan in the Indian population. J 10H, 2015; 7(10): 88-92.
11. Take Hy, Duran S: Determination of gender by measuring maxillary sinus in CT scans. Radiol Anat 2007, 29 (1), 9-13.
12. Fernandez CL: Volumetric analysis of maxillary sinuses of Zulu and European crania by helical multi-slice computed tomography. J. Laryngol Otol 2004, 118, 877-81.

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