

Sexual Dimorphism of Maxillary Sinus

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Abstract

Background: Maxillary bones are pneumatic bones, which lighten the skull and play an important role in voice resonance. Maxillary sinuses are air filled cavities in the maxillae. Infection of these sinuses is quite common due to erect posture. Untreated maxillary sinus infection may spread to the meninges and brain as well. Moreover, variations in the diameters in both genders have medico-legal importance.

Method: 25 adult male and 25 adult female healthy volunteers were studied with CT images to measure the mediolateral, super inferior, and anteroposterior dimensions, and the volumes of both maxillary sinuses in both genders were studied and compared.

Results: ML (right), SIR (right), AP (right), ML (left), SIL (left), and APL (left) parameters were compared in both genders and have significant P-values ($p < 0.001$). Similarly, comparison of the dimension of the maxillary sinus (MS) was studied, and the p-value was highly significant ($p < 0.001$).

Conclusion: Present findings compared in both sexes have anatomical, anthropological, and medicolegal importance; moreover, these normal parameters can be compared with pathological MS in radiological studies.

Keywords: MS = Maxillary Sinus, CT = Computerised Tomography, VR=volume of right MS, VL=volume of left MS.

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Introduction

Maxillary bones are pneumatic bones. Maxillary sinuses are air filled cavities in the maxillae that develop well after puberty. The function of the maxillary sinus is to lighten the skull and act as a resonance of voice. Infection of the maxillary sinus (MS) is quite common due to erect posture [1]. The untreated infection of MS may spread to the meninges and brain as well. In the skeleton or buried crania, MS is broken, as it has delicate pneumatic bones [2].

Therefore, studying sexual dimorphism in MS becomes challenging. Hence, gender differences are studied in living adult volunteers radiologically [3], because many criteria are available for sexual dimorphism, like angle of mandible, well-marked superciliary arches, crania index, and pubic angles and sacral index, but the least data is available regarding sexual dimorphism of MS [4]; hence, an attempt is made to study the MS in young adults radiologically.

Material and Method

25 male and 25 female adult volunteers aged between 20 and 40 years who regularly visited

Navodaya Medical College, Raichur-584103, Karnataka, India, were studied.

Inclusion Criteria: The regular visitors did not have any pathology in the PNS (maxillary sinus), and the majority were 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: A non-contrast CT scan was performed to study the morphometry of the maxillary sinuses in both sexes prior to the scan, every patient was instructed to remove the metallic objects (jewelry, 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 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. 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. 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 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 June 2024 to June 2026.

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

Observation and Results

Table-1: Comparison of various dimensions of the maxillary sinus measured on CT in both sexes

- MLR (Right): 28.62 (SD±3.23) in males, 26.10 (SD±5.32) in females; the t-test value was 2.52 and $p < 0.001$.
- SIR (Right): 39.12 (SD±4.58) in males, 34.20 (SD±5.42) in females; the t-test value was 3.46 and $p < 0.001$.
- AP (Right side): 43.53 (SD±2.62) in males, 37.02 (SD±3.02) in females; the t-test value was 8.14 and $p < 0.001$.
- ML (Left side): 25.04 (SD±4.03) in males, 24.9 (SD±5.13) in females; the t-test value was 2.40 and $p < 0.001$.
- SIL (Left side): 37.82 (SD ± 3.32) in males, 34.12 (SD ± 2.12) in females; the t-test value was 4.69 and $p < 0.001$.
- APL (Life side): 41.76 (SD±1.62) in males, 38.10 (SD±SD±1.89) in females; the t-test value was 7.35 and $p < 0.001$.

Table-2: Comparison of dimensions of maxillary sinus of both sides in both sexes

- VR: 17.52 (SD±4.54) in males, 12.54 (SD±3.10) in females, t-test value 4.49, and $p < 0.001$.
- VL: 16.16 (SD ± 3.82) in males, 11.78 (SD ± 2.83) in females, t-test value 4.60 and $p < 0.001$.

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

SI No	Particulars	Male (25)	Female (25)	t-test	p-value
1	ML (Right)	28.62 (± 3.23)	26.10 (± 5.32)	2.52	P<0.001
2	SIR (Right)	39.12 (± 4.58)	34.20 (± 5.42)	3.46	P<0.001
3	AP (Right side)	43.53 (± 2.62)	37.02 (± 3.02)	8.14	P<0.001
4	ML (Left side)	28.04 (± 4.03)	24.90 (± 5.13)	2.40	P<0.001
5	SIL (Left side)	37.82 (± 3.32)	34.12 (± 2.12)	4.69	P<0.001
6	APL (Left side)	41.76 (± 1.62)	38.10 (± 1.89)	7.35	P<0.001

ML Right = Medio-lateral dimension of right side, SIR Right =Supero-inferior dimension of Right side, 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.

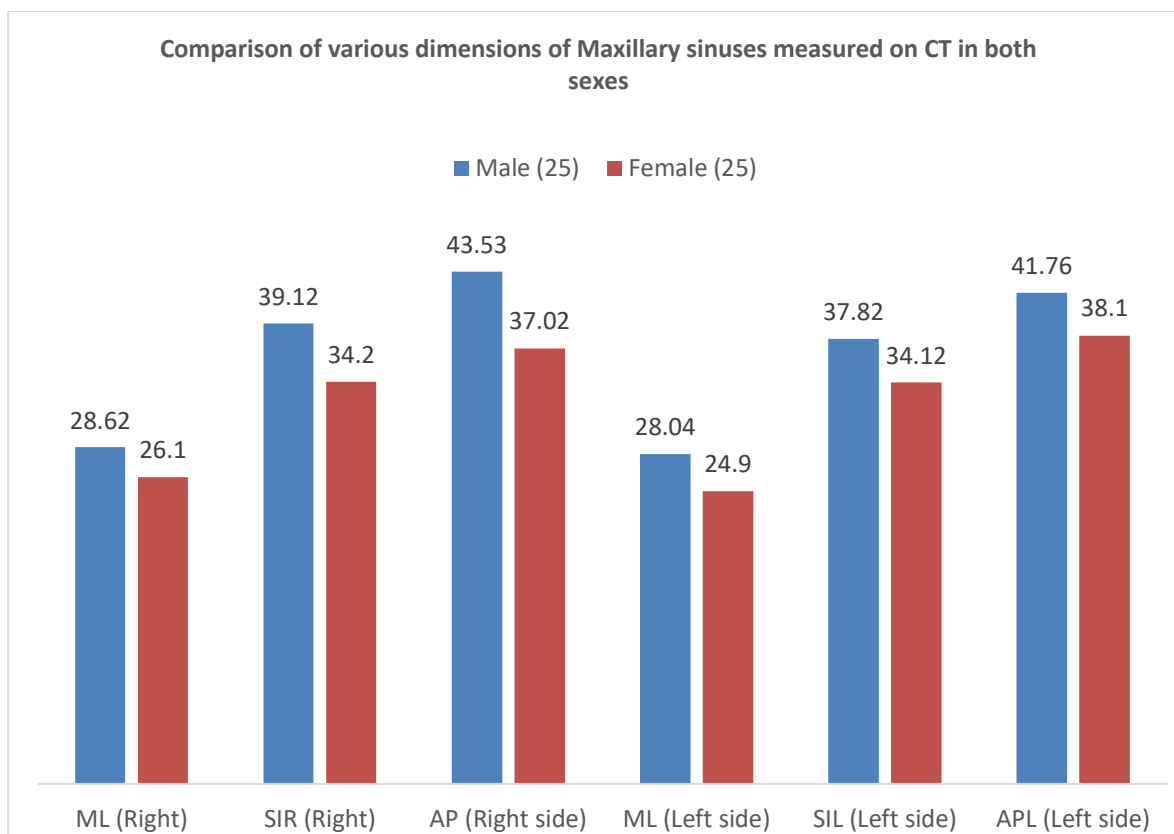


Figure 1: Comparison of various dimensions of Maxillary sinuses measured on CT in both sexes

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

SI No.	Particulars	Male (25)	Female (25)	t-test	P-value
1	VR	17.52 (± 4.54)	12.54 (± 3.10)	4.49	P<0.001
2	VL	16.16 (± 3.82)	11.78 (± 2.83)	4.60	P<0.001

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

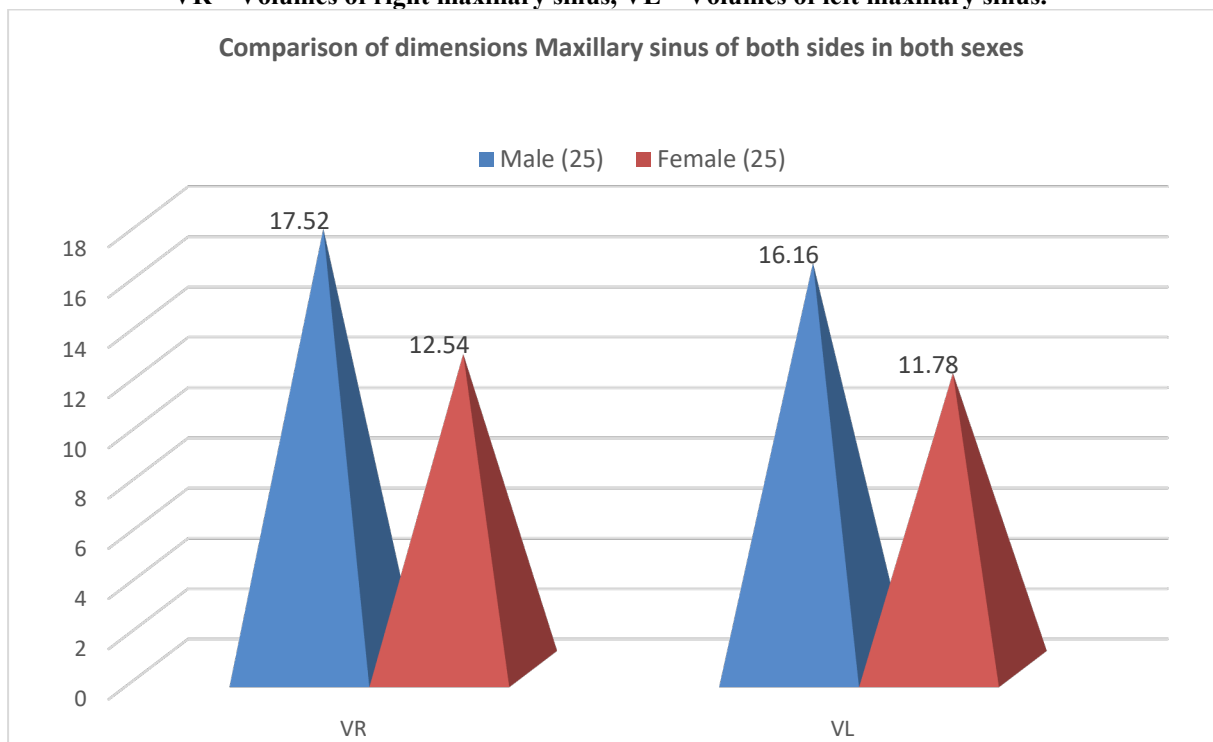


Figure 2: Comparison of dimensions Maxillary sinus of both sides in both sexes

Discussion

In the present study of sexual dimorphism in the crania of the north Karnataka population, various dimension parameters were compared in the crania of male and female Viz ML (right), SIR (right), AP (right side), ML (left side), SIL (left side), and APL (left side) and had a significant P-value ($p < 0.001$) (Table-1). Comparison dimensions of both sides of the maxillary sinus of male and female crania had a significant P-value ($p < 0.001$). These findings are 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 cranium 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, it 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 they represent have long ago ceased to be of any real functional importance. Hence, variations have regional and morphological significance.

Summary and Conclusion

The present study of sexual dimorphism of MS in the Karnataka population is quite useful to anatomists, anthropologists, and medico-legal experts, but this present study demands further genetic, nutritional, environmental, and hormonal study because the factors that decide the ossification are still unclear.

Limitation of study: Owing to the small number of volunteers and lack of the latest techniques, we have limited findings and results.

This research work is approved by the Ethical Committee of Navodaya Medical College Hospital, Raichur-584103, Karnataka, India.

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