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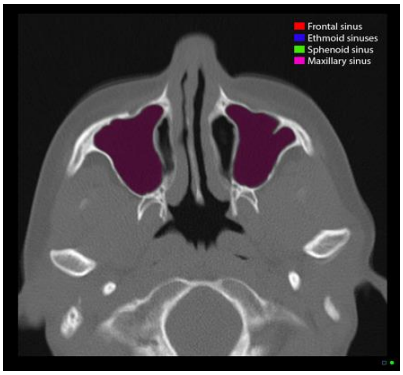
A study of morphometric evaluation of the maxillary sinuses in normal subjects using computer tomography images



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Abstract:

Introduction: Maxillary sinuses (MS) are two air filled bony cavities situated in the body of maxilla on either side of nasal cavity and can be of different sizes and shapes. It can be used for identification of individual and gender determination. CT is most reliable method for measurements of maxillary sinus dimensions.

Aim: The present study was conducted to evaluate the anteroposterior and mediolateral diameter of Maxillary Sinus (MS) in determining gender by computed tomography (CT) scan.

Material and methods: This study was performed in 46 adults (18-75 years) divided into 2 groups 24 females (52%) and 22 males (47%) retrospective review of the archives in Department of Radiology of the Ibn -Sina hospital in Benghazi – Libya.

Result: The right and left MS (width and length) was measured and compared between males and females. The mean parameters of the MS of the females were found to be statistically insignificant equal in comparison to males. Classification function coefficients and accuracy level for each parameter in determining gender was done. The final result of the analysis shows that the mean of males and females approximately equal.

Conclusion: The result of the present study shows there was no difference between male and females regarding to width and length of the MS. However, it has been found that the size of MS is decreasing with increasing the age of the case.

INTRODUCTION

Paranasal air sinuses are complex anatomical structures situated within the frontal, maxilla, ethmoid and sphenoid bone and shows a significant inter-individual variation. Maxillary sinus is the largest paranasal sinus.(1)

Maxillary sinuses (MS) are two air filled bony cavities situated in the body of maxilla on either side of nasal cavity and can be of different sizes and shapes. Their walls are thin. The apex is directed towards the zygomatic bone and base (medial wall) towards the lateral wall of nose while roof is formed by floor of the orbit and floor by alveolar and palatine processes of the maxilla and the anterior wall is formed by the anterior surface of the maxilla covered by the cheek. (2) It drains into middle meatus (Hiatus semilunaris) of nose. (3)

The maxillary sinuses appear at the end of second embryonic month. They extend to the roots of the permanent teeth when deciduous teeth fall off. The maxillary sinuses originate as invaginations of the nasal mucosa into maxilla bone. This unique development describes the massive quantity of anatomical variation. (4)

The computed tomography (CT) provides significant anatomical information about the size of maxillary sinus and hence it has been used to determine the anatomical variations of the nose and paranasal sinuses. (4)

The maxillary sinus exhibits dimorphic features therefore it can be used for identification of an individual.(5). In forensic medicine identification of individuals from skeletal remains and decomposing parts is one of the most difficult tasks. For gender determination long bones, bony pelvis and skull are conventionally used. (6).

The shape and size of maxillary sinus differ between males and females and in various populations. [7]. The methods for measuring the dimensions of maxillary sinus have been changed from cadaveric skull measurements to Computed Tomography and Magnetic Resonance Imaging (MRI) with the advances in medical techniques [8]

Because of loss in mucosa and other soft tissue in cadavers, the volume measurement of maxillary sinus from cadaveric skull will be larger than the actual size. Measurements of maxillary sinus can be more accurate with CT as craniometric points can be precisely located Therefore, the present study was conducted to find out the normal dimensions of the maxillary air sinus. [9]

CT scan is considered gold standard method to evaluate sinonasal cavities as they provide accurate dimension assessment owing to anatomic complexity of paranasal sinuses. [10]

The aims of the study was to measure bilaterally different Parameters of maxillary sinus [Antero-posterior diameter (APD), Transverse diameter (TD)] in male and female subjects by axial computed tomography.

Method and material:

This was retrospective review of the archives in Department of Radiology, Ibn -Sina hospital Benghazi – Libya , from 1st April 2021 to 31st June 2021.

CT images of 46 adults (18-75 years) of either sex were obtained out of which 22 were males and 24 were females. The image was done using computerized tomography (CT) scanner by siemens. CT images of patients with fractures of face and paranasal sinus, chronic sinusitis, sinonasal malignancy, were excluded from the study. MS were determined on axial reconstructed image; the length was the longest distance antero-posteriorly from (A to B). (longest distance between the most anterior point to the most posterior point) of Right (R) and Left (L) sinuses were measured in axial images. (Fig. 1) Further, the width was obtained on axial reconstructed images, the longest distance perpendicular to medial wall of the sinus to the outermost point of lateral wall of the lateral process of the maxillary sinus. (C to D) (Fig. 1)

Data collection

A record sheet was used to collect data, which included: age, gender, length and width of maxillary sinus. All of these parameters were recorded from the right and left maxillary sinuses.

Administrative Approval

The approval of the director of the center was taken before reviewing the records and collection of required data.

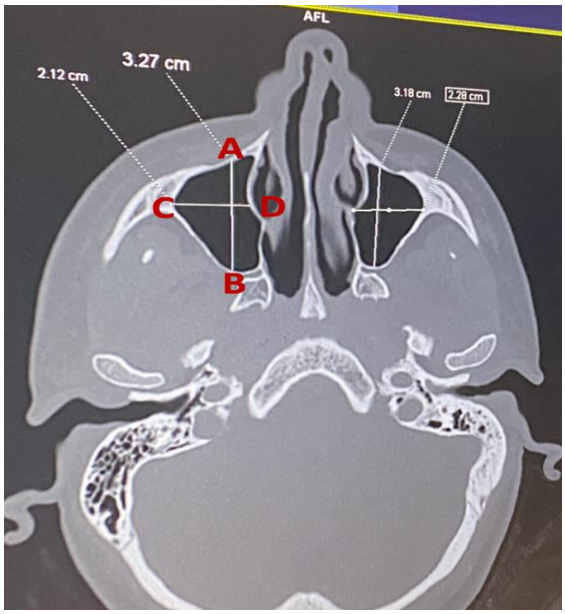

Figure 1: Measurement of MS in axial section (Shows measurements of maximum AP diameter of maxillary sinus in axial view**.** Point A: Most anterior point of maxillary sinus. Point B: Most posterior point of maxillary sinus. Point C: Most lateral point of maxillary sinus. Point D: Most medial wall of maxillary sinus).

Statistical analysis:

Statistical analysis was done by calculating descriptive statistics the mean and standard deviation of both MS measurements which were calculated and compared, in addition the independent sample t-test and correlation was done to assess statistical difference between measured parameters of maxillary sinuses between males and females. All statistical analysis were performed using statistic package for social science (SPSS). The measured parameters data was then subjected to discriminant statistical analysis to determine gender. The p-value was considered significant when it was <0.05.

Result:

A sample size of 22 males and 24 females was considered for the study with their ages ranging between 18-75 years (Fig-2,3) The right and left MS (width and length) was measured and compared between males and females. The difference in mean value of the different parameters between males and females was not found to be statistically significant ($p>0.05$)

The left MS parameters were measured and compared between males and females. The difference in mean left MS width (cm) between males and females was not found to be statistically significant.

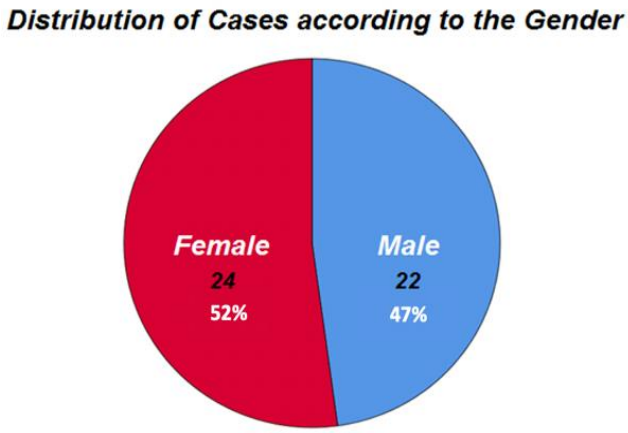

Figure 2: Distribution of cases according to gender

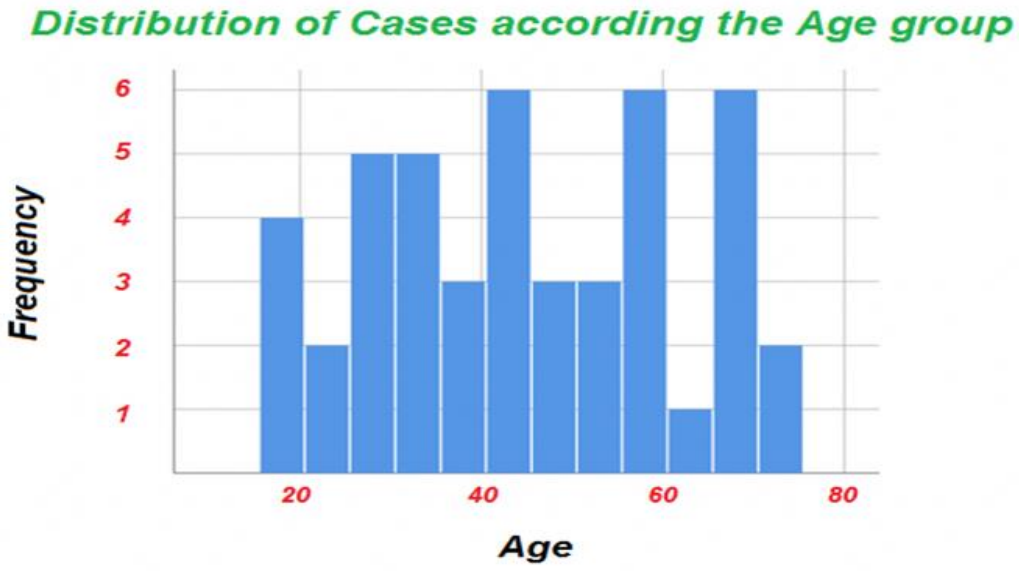

Figure 3: Distribution of cases according to age

Maxillary sinus length:

The mean values of maxillary sinus length for both right and left side of males were (3.47 ± 0.70, 3.50 ± 0.73) cm. And females (3.41 ± 0.44), (3.51 ± 0.42) cm [Table 1,2] respectively with p-value for the right side 0.561 and left side 0.615. [Table3].

Maxillary sinus width

The mean value of maxillary sinus width on right and left side of male group was (2.30 ± 0.50, 2.43 ± 0.57) cm respectively. Female group was (2.39 ± 0.41, 2.30 ± 0.43) cm. [Table 1,2]. P-value for the right side 0.160 and left side 0.297. [Table3].

Classification function coefficients and accuracy level for each parameter in determining gender was done, the left and the right MS was approximately equal.

Descriptive Statistics

	N	Mean	Std. Deviation
Right-W	22	2.3077	0.50031
Right-L	22	3.4773	0.73838
Left-W	22	2.4341	0.57504
Left-L	22	3.5073	0.57329
Valid N (listwise)	22		

Table 1: Shows the descriptive statistics for males

Descriptive Statistics

	N	Mean	Std. Deviation
Right-W	24	2.3971	.41935
Right-L	24	3.4133	.44463
Left-W	24	2.3054	.43258
Left-L	24	3.5129	.42437
Valid N (listwise)	24		

Table 2: Shows the descriptive statistics for females

Significance Relation with Gender

		Sig.
Left-L	Equal variances assumed	0.615 ***Not Significant***
Left-W	Equal variances assumed	0.297 ***Not Significant***
Right-L	Equal variances assumed	0.561 ***Not Significant***
Right-W	Equal variances assumed	0.160 ***Not Significant***

Table 3: Comparison between length and width of both gender

Discussion:

In the past many researchers worked on morphomeric study of maxillary sinuses by various radiological techniques but more accurate measurements of various parameters of maxillary sinuses obtained by computed tomography images and their significant role in sinus surgery and determination of gender. In our study all the parameters of the maxillary sinus statistically insignificant differences on both the right and left sides.

CT measurements of MS that is, the length and width may be useful to support gender determination in forensic medicine; therefore, dimensions of maxillary sinus together with other bones can be used for gender determination when the whole skeleton is not available for more accurate results. [(11)]

A study by Tambawala SS et al., for comparison between male and female groups demonstrated that the female group had statistically significant lower values for both the left and right MS in context to the length, height and width dimensions. [(5)]

In contrast to Saccucci M et al., conducted a study on gender determination using MS by means of CBCT. No statistical difference was found in patient's MS volumes between genders, and they concluded that it is not possible to use the MS to discern sexual difference in corpse identification. [(12)]

Similarly, in the present study all the parameters of the maxillary sinus statistically insignificant differences on both the right and left sides for both males and females.

Study	Dimension	Males	Females
Sharma SK et al., [6] (2014)	AP diameter	R=34.89 ± 3.256 mm L=35.03 ± 3.559 mm	R=33.20±2.943 mm L=33.59±2.915 mm
Kim HJ et al., [13] (2002)	AP diameter	40.7 ± 4.5 mm	37.4±3.0 mm
Prabhat M et al., [14] (2016)	AP diameter	42.60 ± 3.79 mm	36.00±4.09 mm
Souza AD et al., [15] (2016)	AP diameter	R=38.6 ± 4.5 mm L=39.0 ± 3.6 mm	R=37.2±2.1 mm L=37.1±3.0 mm
Present study (2021)	AP diameter	R=34.77 ± 7. 38 mm L=35.07 ± 5. 73 mm	R=34.13 ± 4.44 mm L=35.12 ± 4.24 mm

Table 4: Comparison of maximum AP diameter of maxillary sinus with previous studies.

Most authors have reported significant differences in the measurements of MS between males and females [5,6,11] Whereas, Saccucci M et al., reported no such differences. [12]

Sharma SK et al. [6] reported that the left maxillary sinus is larger than the right sinus in both males and females. Thus, the variations in some of the results of MS dimensions and volume in these studies are probably due to combination of many factors e.g.: different ethnic and racial groups with differences in body stature, skeletal size, height, and physique; genetic and environmental factors; anatomical variations of sinus and pneumatization process of sinus. [6]

Otherwise, it has been reported that diseases, infections and environmental factors can affect the sizes of MS, considering this factor the patients with disease conditions were excluded from the study.

However, decreasing in size were found of the MS, these changes are seen in older adults of the cases, due to deformity of jaw or edentulous. [Fig-4].

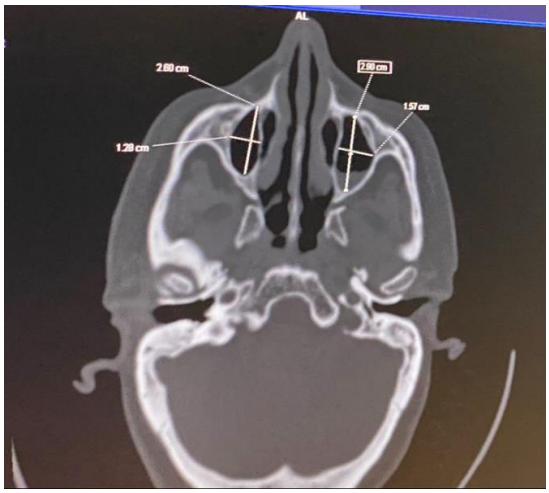

Figure: 4 Shows measurement of MS height in axial section "MS size of 71 years old male".

Limitation:

The limitation of this study are the small sample size due to study duration. And paranasal sinus inflammation, chronic sinusitis, and other diseases related to the nasal cavity were excluded from the study. Further, studies on larger sample size are needed to confirm the finding of the present study.

Conclusion:

Variability in the morphology of the MS has practical significance during surgical procedures conducted by maxillofacial surgeons or otolaryngologists. The knowledge about the variations in the lateral wall of the nasal cavity is also crucial during the endoscopic interventions and for functional endoscopic sinus surgeries. The result of the present study there was no difference between male and females regarding to width and length of the MS. However, it has been found that the size of MS is decreasing with increasing the age of the case.

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