Original Research Article

Journal of College of Medical Sciences-Nepal, Vol-20, No.4, Oct-Dec 2024

ISSN: 2091-0657 (Print); 2091-0673 (Online) Open Access

DOI: 10.3126/jcmsn.v20i4.71900

Measurement of Diameters of Maxillary Sinuses by Computed Tomography among Patients Attending a Teaching Hospital at Pokhara

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ABSTRACT

Background

Paranasal sinuses are air-filled spaces present within some bones around the nasal cavities. These sinuses are rudimentary, or even absent at birth. They enlarge rapidly during 6 to 7 years of age. The aim of this study was to assess the diameters of maxillary sinuses and correlate the diameters with the patient's age and sex.

Methods

Retrospective study was performed in the Department of Radiology and Imaging, Gandaki Medical College, Pokhara, Nepal during the period of December 2023 to March 2024. Data of 100 patients were collected who underwent CT PNS in which 56 were males and 44 were females. AP diameters, height, width and volume of both right and left maxillary sinuses were measured.

Results

Mean values of anteroposterior diameter, width, height and volume of right maxillary sinuses in males were 33.35 ± 3.45 mm, 20.41 ± 4.52 mm, 35.59 ± 5.73 mm and 12.57 ± 3.28 cc respectively and in left maxillary sinuses were 34.39 ± 3.53 mm, 21.89 ± 4.17mm, 36.02 ± 5.67mm, 13.76 ± 3.54 cc. Similarly, in females it were 31.46 ± 3.27mm, 18.10 ± 2.25mm, 35.57 ± 4.52mm ,10.74 ± 3.08 cc respectively and in left maxillary sinuses were 31.68 ± 3.29mm, 19.02 ± 3.16 mm, 35.73 ± 5.12 mm and 11.42 ± 3.64 cc.

Conclusions

There was statistically significant correlation with patient's gender, AP diameter, width and volume in male and female in both right and left maxillary sinuses except the right AP diameter of the maxillary sinuses. There was no statistical significant difference in male and female in height of both maxillary sinuses.

Keywords: AP diameters of maxillary sinuses; diameter of sinus; height; PNS CT; width of sinus.

INTRODUCTION

The maxillary sinuses are the largest of all paranasal sinuses that lies in the body of the maxilla.[1] It is pyramidal in shape and the apex directed laterally in the zygomatic process of maxilla.[2] Visualization of maxillary sinus and its surrounding structures by various radiographic modalities are pivotal for proper diagnosis and treatment.[3] The invasion of maxillary sinus is considered as a potential source of infection or irritation which can lead to inflammation of sinus membrane.[4] Use of computed tomography (CT) instead of plain radiography in the work-up of paranasal sinus pathology was recommended in the beginning of the 1990's.[5] Contrast enhanced CT scans are obtained only in patients who are acutely ill and suspected of having a complication of acute sinusitis.[6] Considering the anatomical variability, its intimate relation to the maxillary posterior teeth, the implications that pneumatization may possess, assessment of the dimensions of the maxillary sinus is of utmost usefulness for gender determination.[7] Measuring the dimensions and volume of maxillary sinus helps for gender deter-

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mination in forensic sciences.[8,9] Gender and age estimation is considered as an important problem in the identification of unknown skull.[10]

METHODS

This retrospective study was conducted in the Department of Radiology and Imaging Gandaki Medical College, Pokhara, from the period of December 2023 to March 2024 after getting the approval from IRC (Ref No. 18/080/081/F). All the CT-Scan cases that were conducted over last six to eight months duration were included until the sample size was reached.

Study group consisted 100 patients consisting 56 males and 44 females, age ranging from 20 years to 70 years. CT-Scan of all patients referred to department of radio-diagnosis and imaging for PNS were reviewed for the study. Patients with history of para nasal sinuses pathology or with previous surgery, Non-Nepalese patients, Uncooperative patients, significant image noise and distorted images were not included in the study. Scans were performed on Cannon Prime SP Aquilion 160 slice CT scanner with normal department protocol under standard guideline, patient preparation, procedure and technical adequacy in coronal and axial plane. Performa was made to collect the measured values of anteroposterior diameter (AP diameter) (Figure 1),

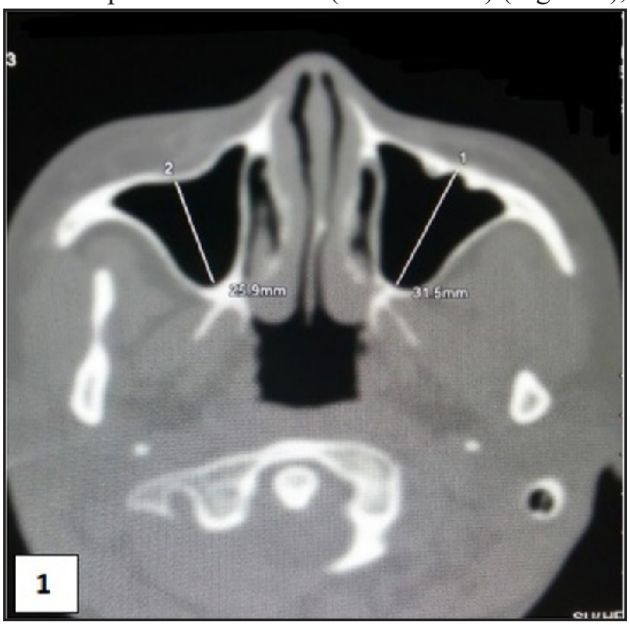

Figure 1. Measurement of AP diameter of both right and left maxillary sinuses in axial image.

height (Figure 3) and width (Figure 2) of maxillary sinuses. AP diameter and width were measured in axial plane while the height was measured in coronal plane, the volume of maxillary sinuses was measured by using the formula,

Volume =(AP diameter×height×width×0.5)

Statistical analysis was carried out with the help of SPSS version 24. The mean, standard deviation and correlation between diameters of maxillary sinuses among different age groups and gender were calculated.

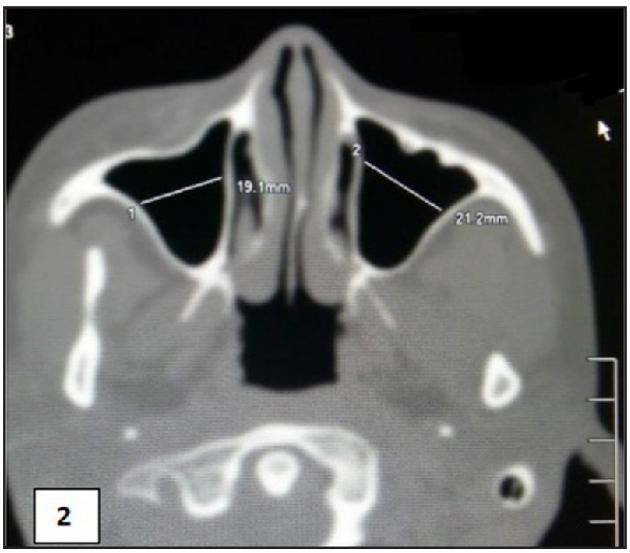

Figure 2. Measurement of width of both right and left maxillary sinuses in axial image.

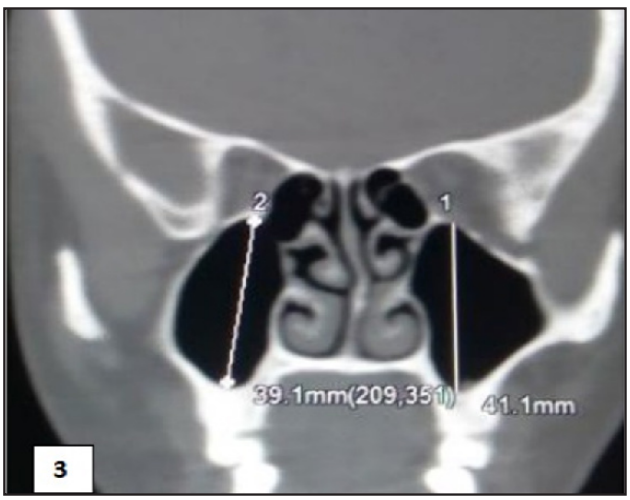

Figure 3. Measurement of height of both right and left maxillary sinuses in coronal image.

RESULTS

The study population comprised of 100 Patients 56 males (56%) and 44 (44%) females. Among those

40 (40%) were of age group 20-30 years, 34 (30%) were of age group 31-41 years, 5 (5%) were of age group 42-52 years, 18 (18%) were of age group 53-53 years and 3 (3%) were of 64 -70 years of age. The mean values of anteroposterior diameter (Table 1), width (Table 2), height and volume (Table 3) of right maxillary sinuses in males were found to be 33.35 ± 3.45 mm, 20.41 ±4.52mm, 35.59±5.73mm and 12.57±3.28cc respectively and in left maxillary sinuses were found to be 34.39±3.53 mm, 21.89±4.17mm,36.02±5.67 mm, 13.76±3.54 cc. Similarly the mean values of anteroposterior diameter, width, height and volume of right maxillary sinuses in females were found to be 31.46±3.27 mm, 18.10± 2.25mm, 35.57± 4.52mm, 10.74±3.08 cc

Table 1. Showing mean and standard deviation of AP Diameter of right and left maxillary sinuses (measured in mm) among gender.

Gender	Right AP diameter of the maxillary sinuses	Left AP diameter of the maxillary sinuses
Male		
Mean	33.3571	34.3982
Std. Deviation	3.49378	3.53967
Female		
Mean	31.4614	31.6864
Std. Deviation	3.27103	3.29606
Total		
Mean	32.523	33.205
Std. Deviation	3.51044	3.67556

Table 2. Showing mean and standard deviation of width of right and left maxillary sinuses (measured in mm) among gender.

Gender	Right width of the maxillary sinuses	Left width of the maxillary sinuses
Male		
Mean	20.4125	21.2893
Std. Deviation	4.52882	4.17127
Female		
Mean	18.1	19.0205
Std. Deviation	2.2543	3.16291
Total		
Mean	19.395	20.291
Std. Deviation	3.8643	3.91059

Table 3. Showing mean and standard deviation of height (measured in mm) and volume (measured in cc) of right and left maxillary sinuses among gender.

Gender	Height of the right maxillary Sinus	Height of the left maxillary Sinuses	Volume of the right maxillary sinuses	Volume of the left maxillary sinuses
Male				
Mean	35.5929	36.0232	12.5727	13.7655
SD	5.73781	5.67043	3.28336	3.54501
Female				
Mean	35.5705	35.7318	10.745	11.4275
SD	4.52161	5.12902	3.06657	3.64285
Total				
Mean	35.583	35.895	11.7685	12.7368
SD	5.21253	5.41392	3.30228	3.75581

Table 4. Showing mean and standard deviation of volume of right and left maxillary sinuses (measured in cc) among gender.

Parameter	Test	Age	Right AP diameter of the maxillary sinuses	Left AP diameter of the maxillary sinuses
Age	Pearson Correlation	1	0.016	0.024
	p-value		0.872	0.812
Right AP diameter of the maxillary sinuses	Pearson Correlation		1	0.747 **
	p-value			<0.001
Left AP diameter of the maxillary sinuses	Pearson Correlation			1
	p-value			

***Correlation is significant at the 0.01 level (2-tailed).*

Table 5. Showing Correlation and p-value of age, right and left volume of the maxillary sinuses with age.

Parameter	Test	Age	Volume of the right maxillary sinuses	Volume of the left maxillary sinuses
Age	Pearson Correlation	1	-0.156	-0.210 *
	p-value		0.121	0.036
Volume of the right maxillary sinuses	Pearson Correlation		1	0.812 **
	p-value			<0.001
Volume of the left maxillary sinuses	Pearson Correlation			1
	p-value			

**Correlation is significant at the 0.05 level (2-tailed).*

respectively and in left maxillary sinuses were found to be 31.68±3.29mm, 19.02±3.16mm, 35.73±5.12mm and 11.42±3.64cc. Correlation analysis of different variables was done with gender (Table 4) and age (Table 5). There was no any significant correlation between diameters and volume of right and left maxillary sinuses of males and females with age.

DISCUSSION

The objective of this study was to assess the different diameters and volume of left and right maxillary sinuses. Three diameters of maxillary sinuses are measured (i.e AP diameters, width and height) and volume was is measured by using the formula (AP diameters×height×width×0.5). AP diameters and width of right and left maxillary sinus were measured in axial plane whereas height of right and left maxillary sinuses were measured in coronal plane. Khanal UP, AdhikariA, Humagai MP [5] performed measurement of different dimensions of maxillary sinuses among people who were above 18 years. where they concluded that the mean volume of right and left maxillary sinuses among male was significantly larger than the female, as well as Mukul Prabhat et al [11] conducted a study based on forensic gender determination by measuring the size and volume of the maxillary sinuses, Various dimensions and volume of both the right and left maxillary sinuses of an individual was measured. The study concluded that the overall size of the maxillary sinus was larger in male than in female. Our Study showed that overall size of the both right and left maxillary sinuses in males are larger than in female in but there was insignificant differences between right AP diameter and height of maxillary sinuses between male and female. Also there was significant difference between the volume of right and left maxillary sinuses in males and females supporting our conclusion that the volume is larger in males than in females.Our study showed that dimensions and volume of right and left maxillary sinuses were significantly larger in males than in females. This was supported by the study carried by Dr. Ranjit Kumar Kanthem et al [8], and Balaji Babu Bangi et al [9] where sex determination was evaluated by using maxillary sinuses. This study indicated that the dimensions and volume of right and left maxillary sinuses was notably larger in male than in females. A study of morphometric evaluation of the maxillary sinuses using computer tomography images was peformed by Lakshmi N et al.[12] and Aya HA.[13] The statistical analysis for sex and age comparison for all the parameters was done. In her study significant difference was found in width, height and depth of the sinuses between males and female except the width of the right maxillary sinus which is not significant but the measurements of the maxillary sinuses of female were lower than that of males. Similarly, in this study there was significant differences between AP diameters, and width of both maxillary sinuses among male and female except right AP diameter and height of both maxillary sinus which was insignificant but the overall size is larger in males than in female. A comparison was made between the AP diameter, width, height and volume of right and left maxillary sinuses between males and females. It was found that there was significant difference between male and female in AP diameter, width and volume in both right and left maxillary sinuses except the AP diameter of right maxillary sinuses. There was no significant difference between the male and female height of both right and left maxillary sinuses. However, the volume of maxillary sinuses is greater in males than in females statistically.

CONCLUSIONS

There was statistically significant correlation with patient's gender, AP diameter, width and volume in male and female in both right and left maxillary sinuses except the right AP diameter of the maxillary sinuses. There was no statistical significant difference male and female in height of both maxillary sinuses.

Limitations

Despite adequate size of the sample, it was still small for the generalization of the study. The measurements were done manually which may not be accurate. Measurements were made on different patients and the measurements made for same variable may have been at different levels as they were done manually.

Recommendations

Further studies for measurement of maxillary sinuses with larger sample size are recommended for more accuracy in results.

Authors Contribution

SS designed the study, collected the data and did the manuscript writing, checked the referencing and editing of the study. GB did data analysis, analyzed the results, MT collected the reference articles; BRS defined the intellectual content, ES helped in collection of data.

Conflict of interest: None

Funding: None

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Citation: Singh S, Baniya G, Thapa M, Sharma BR, Sunar E. Measurement of Diameters of Maxillary Sinuses by Computed Tomography among Patients Attending a Teaching Hospital at Pokhara. JCMS Nepal. 2024; 20(4): 351-55.