

A Study on Measurements of Different Dimensions by Computed Tomography Paranasal Sinus in Adult Nepalese Population

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ABSTRACT

The aim of the study was to quantify the different dimensions of maxillary sinus and anterior wall (AW) thickness of maxillary sinus in normal Nepalese population by computed tomography (CT). Various dimensions of 90 patients were measured in CT paranasal sinuses (PNS) using syngo.via software. Anteroposterior (AP) diameter, width, and AW thickness were measured in axial images and height was measured in coronal images. The mean volume of maxillary sinuses in the study of male population on the left and right side was $17.09 \text{ cm}^3 \pm 3.89$, $17.19 \text{ cm}^3 \pm 4$, respectively, whereas in female was $15.64 \text{ cm}^3 \pm 3.5$ and $15.21 \text{ cm}^3 \pm 3.2$, respectively, as shown in Table 1. This shows that the volume of male was significantly larger than female with P-value = 0.012 (<0.05). Similarly, the thickness of AW of maxillary sinus was also measured in this study, and the mean value of the left and right side in male was $0.16 \text{ cm} \pm 0.04 \text{ cm}$ and $0.15 \text{ cm} \pm 0.03 \text{ cm}$, respectively, and in female was $0.12 \text{ cm} \pm 0.04 \text{ cm}$ and $0.14 \text{ cm} \pm 0.02 \text{ cm}$, respectively. This study showed that CT is a reliable method for the measurement of different dimensions of the maxillary sinus. The result showed greater mean value of volume in male than female with significant differences. Hence, this study concluded that the measurement of volume of maxillary sinus can be of clinical significance and in the identification of gender which can be very useful for forensic sciences.

Key words: Computed tomography paranasal sinuses, gender identification, maxillary sinus, volume

INTRODUCTION

The paranasal sinuses (PNSs) are complex anatomical structures with a significant interindividual variation. The use of computed tomography (CT) instead of plain radiography in the workup of PNS pathology was recommended in the beginning of the 1990s.^[1]

Individual identification is a subtle concept, and often, one of the most important priorities in mass disasters, road accidents, air crashes, fires, and even in the investigation of criminal cases. Matching specific features detected on the cadaver with data recorded during the life of an individual is an important aspect in forensics, and can be performed by fingerprint analysis, deoxyribonucleic acid matching, anthropological

methods, radiological methods, and other techniques which can facilitate age and sex identification. Sinus radiography is one such method that has been used for the determination of the sex of an individual. Hence, an attempt is being made to use the different dimensions of the maxillary sinus in the determination of sex using coronal and axial sections of plain CT scan.^[2]

Maxillary sinus is the largest of PNS located in the body of maxilla. There are various shapes of maxillary sinus, that is, triangular, leaf, scapular, and renal shaped.^[3] It varies greatly in size, shape, and position not only in different individuals but also in different sides of the same individuals. Hence, maxillary sinus can be used for gender determination.^[2]

This study helps to find out the normal dimensions of maxillary sinus in different age groups and sex groups and hence helps to

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determine the upper limit of the normal dimension of maxillary sinus. Measuring the dimensions and volume of maxillary sinus helps for gender determination in forensic sciences.

CT scanning is a non-invasive diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce horizontal, or axial, images (often called slices) of the body. CT scans are more detailed than conventional X-rays. In conventional X-rays, a beam of X-rays is aimed at the body part being studied. A detector behind the body part captures the variations of the energy beam after it passes through skin, bone, muscle, and other tissues. While much information can be obtained from a conventional X-ray, detail information of internal organs and other structures is not available. In CT, the X-ray beam moves in a circular pattern around the body. This allows many different views of the same organ or structure. The X-ray information is sent to a computer that interprets the X-ray data and displays it in a two-dimensional form on a monitor. CT scans may be done with or without contrast media. Patient should be in supine position with head first with arms beside the trunk for CT scan of PNS. Topogram is taken in lateral position 2–3 cm anterior to the tip of nose for coronal, level of the vertex for axial, including from the level of the hard palate to the upper limit of frontal sinus.

MATERIALS AND METHODS

This was descriptive, prospective, and quantitative study carried out at the Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Kathmandu, Nepal, during the period from June 2017 to September 2017. Sample was taken through random sampling method. A total of 99 patients were included in this study, > 18 years referred for CT PNS but without pathological findings. Patients of both genders were selected. Patients having any pathology or trauma, facial asymmetry or septal deviation, or who has undergone surgical procedures were excluded from the study. In this study, dimensions of maxillary sinus were measured in axial and coronal sections of CT PNS.

In axial slices, the width at the middle of the maxillary sinus was taken shows in Figure 1. Maximal depth (anteroposterior [AP]) diameter was noted and the Figure 4 shows that thickness of the bony AW (at canine fossa) was measured.

In Figure 2 coronal slices, maximal height of the maxillary sinus was noted after measuring all three dimensions, volume of the maxillary sinus was calculated using the following formula: Maxillary sinus volume = Width × anteroposterior × craniocaudal diameter × 0.5.^[1]

Data analysis

Statistical analysis was carried out with the help of SPSS version 20 and Microsoft Excel.

RESULTS

A total of 90 patients were enrolled in this study. Among them 46 patients were male and 44 of them were female [Figure 2].

Measurements statistics

Different data obtained during the course of study have been summarized in the Table 1.

DISCUSSION

The aims of this study were to estimate the different dimensions of the maxillary measured on CT PNS, define a cutoff values for the normal upper and lower limits of the different measured structures. Four dimensions of maxillary sinus were measured (i.e., AP diameter, anterior wall thickness (AWT), craniocaudal diameter, and width). The sample of the study consisted of 90 patients with normal maxillary sinus. Among 90 samples, 46 were male and 44 were female consisting of 52–48%, respectively, which is shown in Figure 3. Descriptive

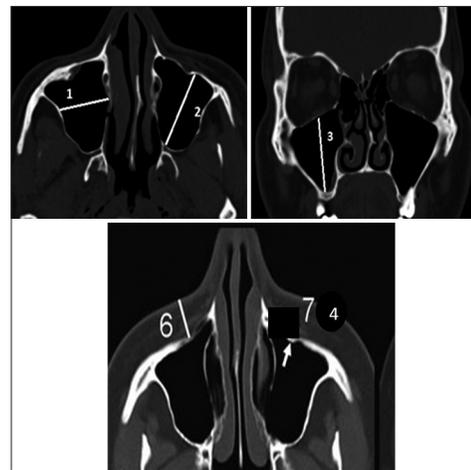


Figure 1: Measurements; 1: Width, 2: Anteroposterior diameter, 3: Height, 4: Anterior wall thickness

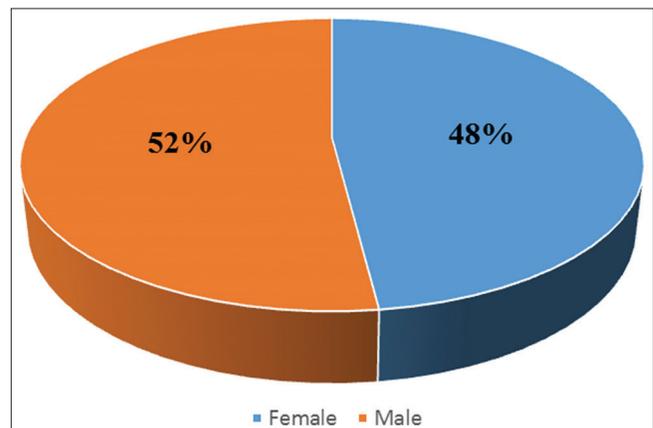


Figure 2: Gender distribution of population

Table 1: Male and female distribution of mean value, SD, median, and range

Gender\ Measurements	Volume		AWT		AP diameter		Height		Width	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Male										
Mean±SD	17.19±4	17.09±3.89	0.15±0.03	0.16±0.04	3.5±0.31	3.51±0.31	3.5±0.3	3.49±0.32	2.76±0.32	2.75±0.26
Median	14	15	0.15	0.15	3.4	3.4	3.57	3.5	2.69	2.7
Range	10.5–29.6	10.5–29.6	0.09–0.27	0.1–0.33	3–4.3	3–4.5	2.9–4.1	2.8–4.2	2.2–3.8	2.3–3.3
Female										
Mean±SD	15.21±3.2	15.64±3.5	0.14±0.02	0.13±0.02	3.39±0.25	3.39±0.29	3.33±0.22	3.34±0.21	2.66±0.31	2.71±0.32
Median	16	16	0.14	0.13	3.5	3.6	3.3	3.4	2.61	2.65
Range	10.4–24.8	10.5–24.6	0.11–0.1	0.11–0.1	2.9–3.85	2.9–3.82	2.8–3.8	2.88–3.7	2.2–3.6	2.1–3.7

SD: Standard deviation, AWT: Anterior wall thickness, AP: Anteroposterior

Table 2: P-value of volume one-way ANOVA

Volume	P-value
Left and right side of female	0.54
Left and right side of male	0.89
Left side of both male and female	0.012
Right side of both male and female	0.012

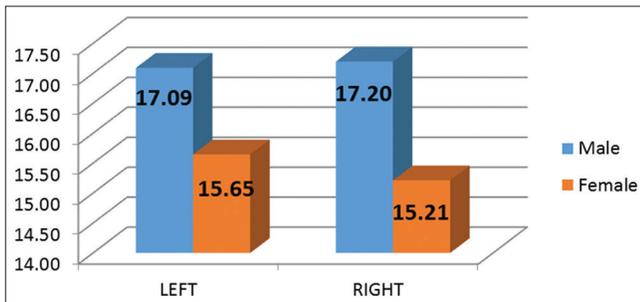


Figure 3: Distribution of mean volume of both the left and right side in male and female

statistics of different measured variables were presented in Table 1. P-value of the volume of male and female in different sides was calculated using one-way ANOVA which was presented in Table 2. Moreover, by comparing the mean volume of both sides between male and female, a significant difference between male and female was shown with P-value 0.012 at 95% confidence interval. However, the comparison of volume between the left and right side of both genders did not show significant difference. Similarly, the thickness of AW measured at canine fossa was larger in male than female.

This result agreed with the result of the study conducted by Sahlstrand-Johnson *et al.*,^[1] and whose results were larger dimensions of maxillary sinus in male than female. The mean value of the maxillary sinus volume was $15.7 \pm 5.3 \text{ cm}^3$ ($P = 0.04$).^[1] The average volume in female was 13.92 cm^3 (Standard deviation [SD] = 4.29) and male was 15.031 cm^3 (SD = 5.15).^[15] In this study, the mean volume of male in the

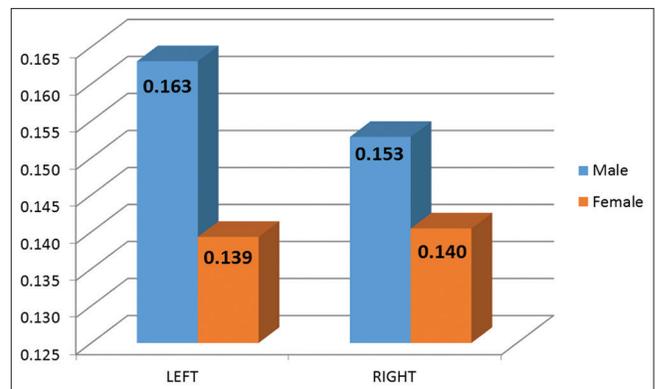


Figure 4: Distribution of the mean value of anterior wall thickness of both the left and right side in male and female

left and right side was 17.09 cm^3 and 17.19 cm^3 , respectively, whereas in female was 15.64 cm^3 and 15.21 cm^3 , respectively, as shown in Table 1. This shows that the volume of male was significantly larger than female with $P = 0.012$ (<0.05). This shows that the result of the maxillary sinus measurements is consistent with the previous report.

Similarly, the thickness of AW of maxillary sinus was also measured in this study and the mean value of the left and right side was $0.15\text{--}0.14 \text{ cm}$, respectively. The measurement of AWT can be very useful for the decision-making in surgical intervention.

CONCLUSION

This study showed that CT is a reliable method for the measurement of different dimensions of the maxillary. The result showed greater mean value of volume in male than female with significant gender wise differences. Hence, this study concluded that the measurement of volume of maxillary sinus can help in the identification of gender which can be very useful for forensic sciences. This type of study should be done in larger number of normal adult population to make the study more reliable.

REFERENCES

1. Sahlstrand-Johnson P, Jannert M, Strömbeck A, Abul-Kasim K. Computed tomography measurements of different dimensions of maxillary and frontal sinuses. *BMC Med Imaging* 2011;11:8.
2. Kanthem R, Guttikonda V, Yeluri S, Kumari G. Sex determination using maxillary sinus. *J Forensic Dent Sci* 2015;7:163.
3. Chandra S, Devi P, Taneja N, Sah K, Kaur N. Forensic importance of maxillary sinus in gender determination: A morphometric analysis from Western Uttar Pradesh, India. *Eur J Gen Dent* 2014;3:53.
4. Sharma S, Jehan M, Kumar A. Measurements of maxillary sinus volume and dimensions by computed tomography scan for gender determination. *J Anat Soc India* 2014;63:36-42.
5. Available from: <http://www.ojhas.org/issue61/2017-1-5.pdf>. [Last cited on 2017 Nov 02].

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