



GENDER DETERMINATION USING MAXILLARY SINUS DIMENSIONS - A DIGITAL RADIOGRAPHIC STUDY

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ABSTRACT

Background and Objectives: Paranasal sinus anatomy is complex and rather variable from person to person. Gender determination is an important step in human identification in forensic medicine. Radiographs are used in forensic medicine for the identification of humans especially in cases where the body is decomposed, fragmented, or burned. The maxillary sinus is the largest of the four paranasal sinuses and its measurements are valuable in studying sexual dimorphism. Maxillary sinuses remain intact, although the skull and other bones may be badly disfigured in victims who are incinerated. Therefore, this study was undertaken to examine and measure dimensions of maxillary sinus as observed on maxillary sinus radiographs and propose the use of the same, as an aid in gender determination. **Materials and Methods:** Maxillary sinus views of 50 healthy patients (25 males and 25 females) were taken using Kodak 8000 C Digital and Panoramic and Cephalometric system (73 Kvp, 12mA, 10.7s) and measurements made using Master View 3.0 software. **Results:** The total studied sample composed of 50 patients; the results were based on two study groups: the male group (composed of 25 patients) and female group (composed of 25 patients). In the current study, the size of the maxillary sinuses of the female was found to be smaller than those of men. The width of right maxillary sinus, the height of right maxillary sinus and left maxillary sinus and the total width across right and left maxillary sinus showed statistically significant differences at a p value of .007, .020, .008 and .005 respectively. The present study showed that the accuracy rate for identification of males was 76% and for females was 60%. **Conclusion:** From the observations of our study, we found significant differences in dimensions of maxillary sinuses between males and females. We therefore conclude that maxillary sinus dimensions are useful and can be used as an aid in gender determination.

KEYWORDS : Maxillary sinus, Gender determination, Forensic identification, Maxillary sinus view.

INTRODUCTION

Anthropological sex determination is an important part of the identification process when developing a biological profile of an unknown deceased individual¹. Gender determination is an important step in identification in forensic medicine. Craniometrical features are included among these characteristics which are closely connected to forensic dentistry, because they can be used to aid in identifying an individual from a skull found detached from its skeleton. Skeletal remains have been used for sexing the individual, as bones of the body are last to perish after death, next to enamel of teeth².

Radiography is used in forensic medicine for the identification of humans especially in cases where the body is decomposed, fragmented, or burned. The skull, pelvis, and femora are the most useful for the radiological determination of gender. Radiology can assist in giving accurate dimensions for which certain formulae can be applied to determine gender². Paranasal sinus anatomy is complex and rather variable from person to person. Significant differences in the structure between the two sides may also exist in the same person³. The maxillary sinus is the largest of the four paranasal sinuses⁴. When measured at birth averages 6-8 cm³, and it can be recognized radiographically in a standard anteroposterior view by 5 months after birth⁵.

MATERIALS AND METHODS:

The following study was conducted among the patients visiting O.P.D of the Department of Oral Medicine and Radiology, M.R. Ambedkar Dental College and Hospital, Bangalore. The sample size consisted of 50 healthy patients inclusive of 25 males and 25 females between the ages of 25 and 45. The exclusion criteria for the study were patients who had a history of trauma to the face, syndromic patients and

people suffering from sinusitis. Maxillary sinus radiographs were taken using KODAK 8000C Digital Panoramic and Cephalometric system (73 Kvp, 12mA, 10.7s) following radiation protection protocols after obtaining an informed consent. The radiographs were observed, and measurements were made using Masterview 3.0 software. The measurements included were the width of right and left maxillary sinuses, the height of right and left maxillary sinuses, the intersinus distance and the total width across right and left maxillary sinuses. The data collected were subjected to statistical analysis using discriminant functional analysis.

RESULTS:

The total studied sample composed of 50 patients; the results were based on two study group:

Male group (composed of 25 patients) and Female group (composed of 25 patients).

Table 1: Distribution Of Linear Measurements Of Maxillary Sinuses And Their Standard Deviations

	MALES (n = 25)		FEMALES (n = 25)	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
Width of right maxillary sinus	81.0364	12.33580	71.9548	10.13326
Width of left maxillary sinus	79.9328	8.73278	75.9012	8.43209
Height of right maxillary sinus	85.6808	11.98265	77.8568	10.91332
Height of left maxillary sinus	87.2192	13.47897	78.0292	9.52268
Intersinus	76.8028	21.60652	68.0176	12.07383

distance				
Total width across sinuses	2.3899	39.12943	2.0981	31.20997

Table 2 – Tests of Equality of Group Means

	Wilks'	Lambda	F	Df1	Df2	Sig.
W.rt max sinus	0.856		8.090	1	48	0.007
W.lt max sinus	0.946		2.757	1	48	0.103
Ht.rt max sinus	0.892		5.826	1	48	0.020
Ht.lt max sinus	0.861		7.752	1	48	0.008
Inter sinus dist	0.938		3.150	1	48	0.082
Total W. across sinuses	0.850		8.500	1	48	0.005

Table 3 – Classification Results^{b,c}

		Sex	Predicted Group Membership		Total
			Male	Female	
Original	Count	Male	19	6	25
		Female	10	15	25
	%	Male	76.0	24.0	100.0
		Female	40.0	60.0	100.0

In the current study, the size of the maxillary sinuses of the males was found to be larger than those of females. (Table-1) The width of right maxillary sinus, the height of right maxillary sinus and left maxillary sinus and the total width across right and left maxillary sinus showed statistically significant differences at a p value of .007, .020, .008 and .005 respectively. (Table-2)

The present study showed that the accuracy rate for identification of males was 76% and for females was 60%. (Table-3)

DISCUSSION:

In the 21st century, people across the world are victims of mass disasters more than ever, either in the form of natural calamities like tsunami or due to ill-minded human intentions like terrorism. In all such cases identification of skeletal remains holds prime importance. The main attributes of biological identity are sex, age, stature, and ethnic background of the individual, which are also called the 'Big Four' in forensic context^{6,7}. Non-mutilated remains do not pose difficulty in identification. The challenge lies in identifying mutilated body parts, when only a part of skeleton or bone is found. The skeletal components consist of hard tissues which may escape or sustain a good number of extreme conditions and yet retain valuable information. The significant factors which play role in dimorphic features in the bones are duration of growth spurts, growth pattern and strength of muscular attachments to the bone⁸. Prominence of bony ridges and processes is significant in gender differentiation⁹. As DNA analyses are not systematically applicable (due to conservation and contamination bias), methods of sex determination based on cranial remains are still useful. Numerous studies have shown that classical anthropological cranial sexual dimorphism analysis has an accuracy rate of approximately 85-95%¹.

Maxillary sinuses are two spaces, which are filled with air, located in the maxillary bone and can be in various sizes and shapes. The maxillary sinuses appear at the end of the second embryonic month. They extend to the roof of the permanent teeth when deciduous teeth fall off. According to Jovanic, the maxillary sinuses reach their mature sizes at the age of about 20 years, when the permanent teeth fully develop¹⁰. During adulthood, their shapes and sizes change especially due to loss of teeth. It has been reported that genetic diseases, post infections and environmental factors can affect the sizes of maxillary sinuses³.

In the current study, the size of the maxillary sinuses of the

males was found to be larger than those of females. This finding is consistent with studies conducted by Fernandes CL who also found that maxillary sinuses are significantly larger in males than in females¹¹.

In the present study, the width of right maxillary sinus, the height of right maxillary sinus, height of left maxillary sinus and the total width across right and left maxillary sinus showed statistically significant differences at a p value of .007, .020, .008 and .005 respectively. Our observations were similar to the results of the study conducted by Asma Uthman et al which showed that the maxillary sinus exhibits anatomic variability between genders. A significant sex difference was found in relation to maxillary sinus width, length, and height². Gender determination from CT measurements of maxillary sinus by Teke et al found the overall accuracy rate for left maxillary sinus height measurement to be only 63.8%¹². A study done by Asma Uthman et al showed the left maxillary sinus height to be the best discriminate variable between genders².

Our study showed that the total width across the right and left maxillary sinuses was the most statistically significant parameter with a p value of (p= .005).

The present study showed that the accuracy rate for identification of males was 76% and for females was 60%. On the other hand, the study done by Asma Uthman et al recorded the accuracy rate for both sinuses measurements to be 74.4% for men and 73.3% for women with overall accuracy of 73.9%². Teke et al reported lower accuracy rates for the same measurements which was 69.3% for men and 69.4% for women with overall accuracy of 69.3%¹². In a study by Lee Fernandes C about gender determination from measurements of the maxillary sinuses, it has been noted that the volume of the maxillary sinuses was larger in males than in females and that the accuracy rate was 79.0%. Moreover, the maxillary sinuses of males were found to be wider when compared with those of females in Europe, but narrower in males than in females in Zululand¹¹.

CONCLUSION:

Maxillary sinuses remain intact although the skull and other bones may be badly disfigured in victims who are incinerated and, therefore, they are valuable in forensic identification. From the observations of our study, we found significant differences in dimensions of maxillary Sinuses between males and females with the total width across right and left maxillary sinuses being the most significant variable. We therefore conclude that maxillary sinus dimensions are useful and can be used as an aid in gender determination.

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