

# Computerized tomographic study of frontal sinus patterns in skulls of South Indian Population

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**Abstract-** The frontal sinuses are a part of paranasal sinuses and they are located in the frontal bone above each orbits. The structure of frontal sinus can be variable from person to person and its sizes might be different in different populations. 50 macerated skulls (Males=28, Females=22) of age group 40-60 yrs are cleaned and subjected to 3D axial multislider CT scan. Axial and coronal images of slice thickness of 4mm were obtained. Frontal sinus ( symmetry and lobulations) were observed and classified. Frontal sinus symmetry was observed in 34 (68%) individuals, asymmetry in 15 (30%) individuals and frontal sinus was absent in 1(2%). The features of frontal sinus morphology make it most convenient part of the skeleton for forensic identification. Variations seen in the anatomy of frontal sinus will help otolaryngologists during surgical procedures involving frontal sinus and skull base.

**Index Terms-** Frontal sinus , CT scan , Skulls , Identification

## I. INTRODUCTION

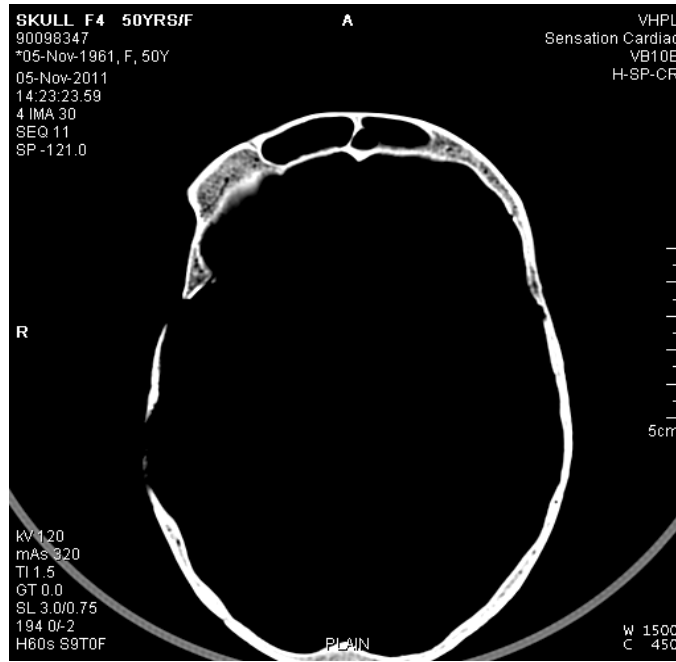
The frontal sinuses are two, situated in the posterior part of the superciliary arcs, between the external and internal faces of frontal bone , there is a septum between both, which usually deviates from the midline. Among the paranasal sinuses frontal sinus shows the maximum variations.<sup>1</sup> They are unique in every individual, even in monozygotic twins. They are not visible at birth, but begin to develop during the second year of life, become radiographically apparent at 5years of age<sup>2</sup>. The skull has been

shown as a useful indicator of sex- the various parameters on a skull's surface, such as the supraorbital ridge, nasal aperture and mastoid process, assist in identifying the sex of skeletal remains to high levels of accuracy<sup>3</sup>. CT is a suitable imaging method in the identification of unknown human remains and presents a lot of advantages as compared with conventional radiographs.<sup>4</sup> CT scans of frontal sinus have conventionally performed with continuous 3 mm coronal and axial slices for imaging in three planes. The present study was undertaken to examine and classify variations of frontal sinus as observed in CT imaging which can be used for personal identification.

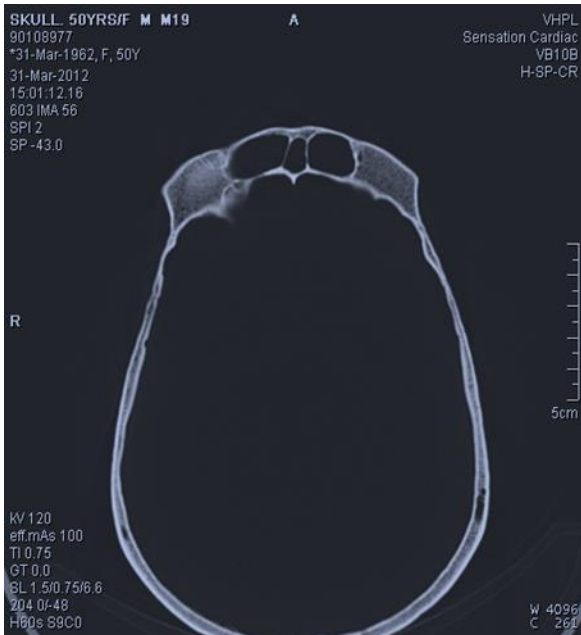
## II. MATERIALS AND METHOD

**Source of data:** 50 skulls (Males=28, Females=22) of age group 50- 60 yrs were obtained from the recently buried bodies. JSS Medical College has got Institutional ethical committee and with its permission, skulls were procured from the department of Anatomy.

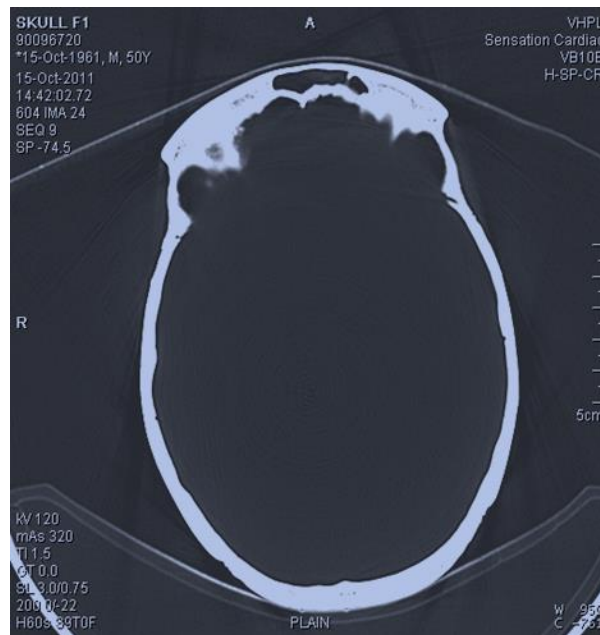
Macerated skulls were taken, cleaned thoroughly and subjected for 3D axial multislider , Siemens sensation cardiac 16 slice CT scan at Vikram hospital Mysore. Images were obtained with slice collimation of 1mm thickness. Axial and coronal images with slice thickness of 4mm were obtained. Frontal sinus (symmetry and lobulations) were observed and classified according to symmetry , right or left dominant asymmetry and unilateral and bilateral aplasia.



**Image 1: Normal pattern of frontal sinus**



**Image2 : presence of 2 septae and 3 lobulations**



**Image 3: absence of septa and one loculation**



**Image4:Single septum and unequal lobulations**

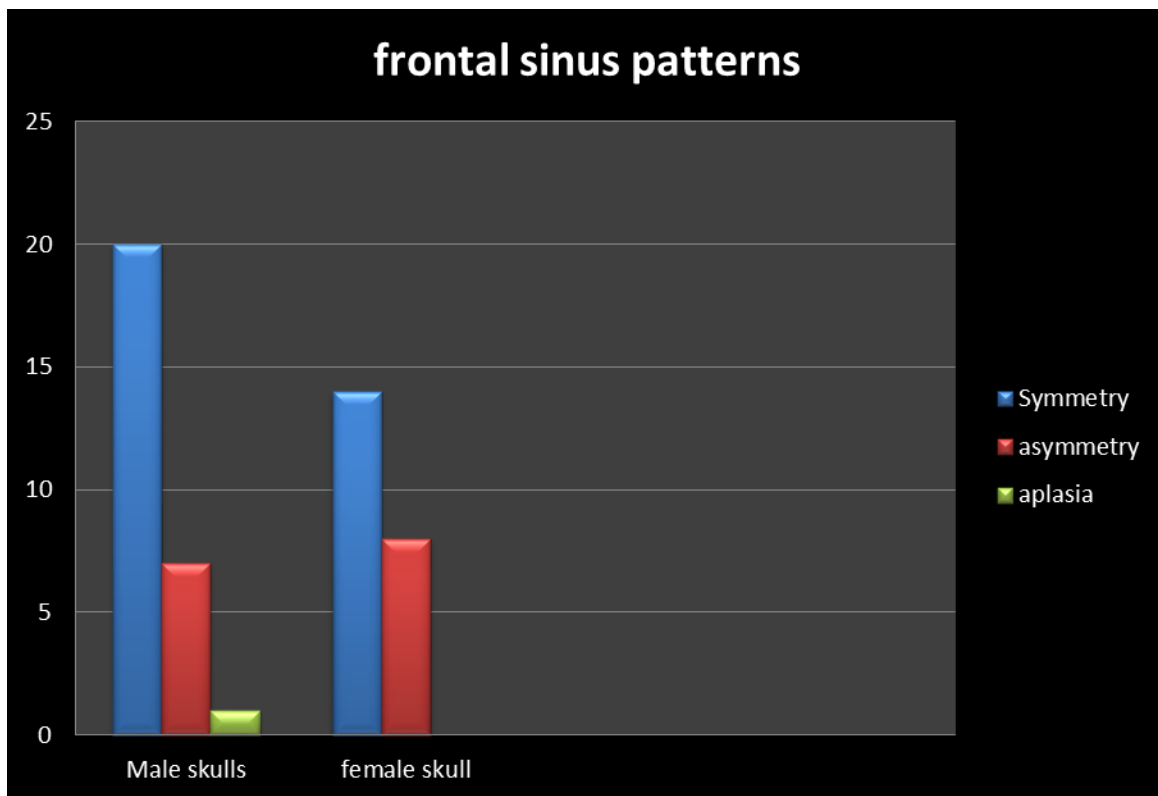


**Image5:Frontal sinus absent on both sides**

III. RESULTS

**Table1: Frontal sinuses pattern in 50 dry skulls**

Classification	No. of individuals		Percentage
	Males	Females	
<b>Symmetry total</b>	<b>20</b>	<b>14</b>	<b>68%</b>
<b>34</b>			
<b>Asymmetry</b>			<b>30%</b>
<b>Right</b>	<b>4</b>	<b>5</b>	
<b>Left</b>	<b>3</b>	<b>3</b>	
<b>Total</b>	<b>15</b>		
<b>Aplasia bilateral</b>	<b>1</b>	<b>0</b>	<b>2%</b>



#### IV. DISCUSSION

In the present study frontal sinus symmetry was observed in 34 skulls (20 males and 14 females) (68%), asymmetry in 15 skulls (7 males and 8 females) (30%) and frontal sinus was absent in 1(2%) in male skull.

David MP and others conducted a study on 50 individuals whose age ranged from 25 to 50 years. The radiographs were recorded using a KODAK 8000 C machine and Dental Imaging Software 6.3.4. Frontal sinus and Nasal septum patterns were observed and classified. It made use of two patterns which could be covered in one radiograph. When combined usage of both frontal sinus and nasal septum patterns were assessed, they obtained 41 unique combinations, and nine individuals whose patterns matched one of the patterns of 41 individuals. Thus authors observed that frontal sinus and nasal septum patterns had considerable individual variations. They also observed frontal sinus symmetry in 29 individuals (58%) and asymmetry in 16(32%), absent in 2 individuals (4%) and unilateral aplasia in 3 individuals (6%).<sup>5</sup>

Goyal M and others studied a total of 100 Paranasal sinus view radiographs of 50 males and 50 females each were evaluated for potential differences in frontal sinus configuration following the methods of Yoshino et al and Tang et al. The univariate Mann-Whitney U-test revealed statistically insignificant sexual dimorphism for Frontal Sinuses. Possible reasons for the low sexual dimorphism may be Frontal sinus' high inter-individual variability; also existing techniques that employ Frontal sinus classification systems may lead to a loss of information when features that require visual observation are grouped and assigned class numbers.<sup>6</sup>

Cameri and others analysed radiographic images of the skulls of 98 Italians aged between 17-98yrs for frontal sinus patterns. The aim of this study was to improve the performance of Yoshino's method for identifying unknown skeletal remains by replacing the first two morphological items, frontal sinus size and bilateral asymmetry, by  $SOR1 = \text{left frontal sinus area/left orbit area}$  and  $SOR2 = \text{right frontal sinus area/right orbit area}$ .<sup>7</sup>

#### V. CONCLUSION

Detailed understanding of variations seen in the anatomy of frontal sinus will help the surgeon to avoid unnecessary complications during surgical procedures involving the frontal sinus and skull base. From our study we could conclude that use of frontal sinus patterns, as seen on CT Images could be used as one of the aids for personal identification. It could be adjunct to other methods of personal identification. With use of larger samples we suggest further studies, with implementation of newer parameters for the determination of gender, age, and ethnicity.

#### ACKNOWLEDGEMENTS

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#### CONFLICTS OF INTEREST

No conflicts of interest for funding and from the staff members of the department for the present study.

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