

## APLASIA OF FRONTAL SINUS: CT STUDY

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### ABSTRACT

**Aim:** The paranasal sinuses are subject to large variety of lesions. Congenital malformations and normal anatomic variations are important in this region To find out prevalence of frontal sinus aplasia in normal healthy population and to discuss its clinical importance.

**Materials and Methods:** A cross-sectional analysis is performed on CT scans of head & neck region of patients visiting Radio-diagnosis Department of Era's Lucknow Medical College.

**Results:** Frontal sinus aplasia was observed in 6.6% of target population.

**Conclusion:** It is important for surgeons to be aware of variations in sinuses that may predispose patients to increased risk of intraoperative complications and help avoid possible complications and improve success of management strategies.

**KEY WORDS:** Frontal Sinus, Diploic Space, Aplasia, Meatus, Ostium, Frontal Recess, Ethmoid Infundibulum, Ethmoidal Air Cell.

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### INTRODUCTION

The paired frontal sinuses are situated posterior to superciliary arches, between the outer and inner tables of frontal bone. These are funnel shaped structure; their aeration varies from patient to patient and from side to side in individual patients. Some sinuses are small and occupy only the diploic space of the medial frontal bone, while other sinuses can be large

enough to extend through the floor of the entire anterior cranial fossa. In general, central septum separates the left and right sides; however, often there may be several septations. The floor of the frontal sinus slopes inferiorly toward the midline. Close to the midline, the primary ostium is situated. The frontal sinus opens into the middle meatus medial to the uncinat process in 88% of the patients and lateral to the uncinat

process in 12% of the patients [1]. The frontal recess is the narrowest anterior air channels that communicate with the frontal sinus. The walls of the recess are formed by the agger nasi anteriorly, the lamina papyracea laterally, and the middle turbinate medially. This recess opens into the middle meatus in 62% of subjects and into the ethmoid infundibulum in 38% [2]. On coronal Computed tomographic (CT) scan, this recess is identified superior to the agger nasi cell [3]. CT is an excellent cross-sectional imaging technique that is used to map sinus anatomy prior to surgical intervention to limit morbidity.

The frontal sinus develops as a direct continuation of embryonic infundibulum and frontal recess superiorly during the 16<sup>th</sup> week of intra uterine life. It can also develop by upward migration of anterior ethmoidal air cells to penetrate the inferior aspect of the frontal bone between its outer and inner tables. Pneumatization of frontal bone is a very slow process. The frontal sinus in fact remains as a small blind sac within the frontal bone till the child is about 2 years of age. Secondary pneumatization begins from the age of 2 and proceeds till the child becomes 9 years old. Pneumatization of the frontal sinus will become significant in early adolescence, and complete in the late teens. The right and left frontal sinuses develop independently, and are often asymmetrical [4].

The aim of the present study was to determine the presence and prevalence of frontal sinus aplasia in North Indian population and to make an attempt to correlate the observations with clinical conditions.

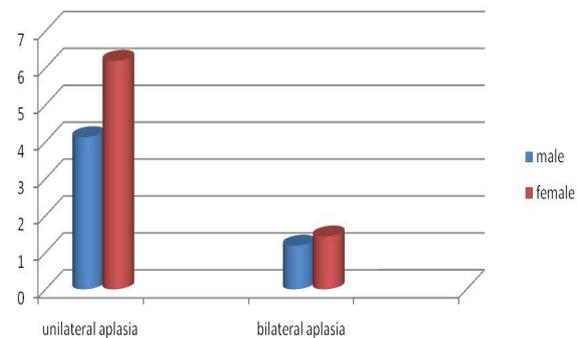
## MATERIALS AND METHODS

Adult subjects referred for CT of head and neck region to Department of Radiodiagnosis in Era's Lucknow Medical College and Hospital, Lucknow with non-sinus pathology were selected as subjects in this cross-sectional study. Tomograms of patients who underwent previous surgery/trauma or had invasive disease of the concerned region were excluded from study. Study subjects were selected randomly and included both male and female adults fulfilling the inclusion criteria. All CT Scans were obtained with Siemens

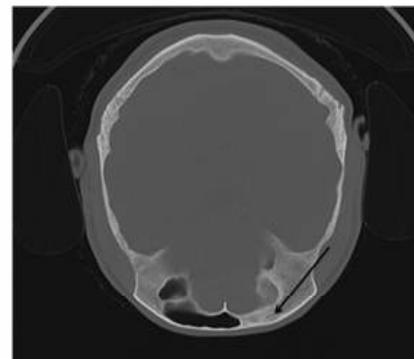
Somatom Emo spiral CT scanner (Germany) with optimal exposure settings. After taking consent the preliminary topogram of the skull were obtained, the area of scanning was defined to include the region from roof of frontal sinus upto the hard palate. Coronal as well as axial sections were taken with slice thickness of 5 mm. The scan parameters were same in both planes. Radiological investigation of anatomical variants of frontal sinus was performed in bony windows of all CT scan films using Saksham Dicom software, and results were reported in data-sheet. Statistical analysis was done using SPSS.

## RESULTS

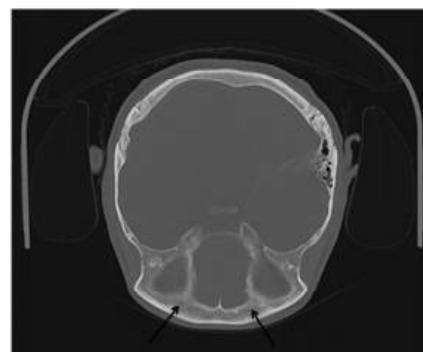
**Fig. 1:** Genderwise distribution of prevalence of unilateral & bilateral aplasia.



**Fig. 2:** Axial scan showing unilateral aplasia of frontal sinus (arrow).



**Fig. 3:** Axial scan showing bilateral aplasia of frontal sinus (arrows).



**Table 1:** Frontal Sinus Aplasia.

	Total (n=380)		Male (n=170)		Female (n=210)		Significance of gender wise	
	No.	%	No.	%	No.	%	$\chi^2$	P
Unilateral aplasia	20	5.3	7	4.12	13	6.19	0.81	0.368
Left sided	16	80	5	71.43	11	84.62	0.587*	
Right sided	4	20	2	28.57	2	15.38		
Bilateral aplasia	5	1.3	2	1.18	3	1.43	1.000*	

\*Fisher exact test

A total of 380 subjects aged >18 years of either gender with non –sinus pathology were included in the study. Frontal sinus was bilaterally present in 355 cases whereas 25 cases displayed unilateral/bilateral aplasia (agenesis)(Table-1). Gender wise distribution of unilateral & bilateral aplasia cases are graphically represented in Figure -1. Out of total 380 cases, 20 cases displayed unilateral aplasia (7 males; 13 females) (Figure-2). Left sided aplasia was displayed by both males & females in higher proportion as compared to right sided aplasia. Bilateral aplasia (Figure-3) was found in 5 cases (2 males; 3 females).

## DISCUSSION

The variations in the anatomy of the frontal sinus may be critical for morphological or forensic investigations. Variant anatomy of frontal sinus is also important to neurosurgeons performing pterional or supraorbital craniotomy because of the proximity of the sinus to the orbit and the anterior skull base [5]. Frontal sinus aplasia has been variably defined either as the absence of frontal bone pneumatization due to lack of ethmoid cell extension above a line tangential to the supraorbital margin (horizontal line) or as an oval-shaped sinus with the lateral margin medial to a vertical line drawn through the middle of the orbit (vertical line) with a smooth superior margin and an absence of the sinus septa [6]. Out of 380 cases studied frontal sinuses displayed variant anatomy in the form of aplasia in 25 cases (6.6%). The incidence of a unilateral absence of the frontal sinus has been reported to be between 0.8% and 7.4% [7-9]. In present study absence of frontal bone pneumatization above a line tangential to the supraorbital margin (horizontal line) was considered frontal sinus aplasia. As per our

criteria frontal sinus findings revealed aplasia in 6.6% subjects which included unilateral involvement in 5.3% whereas bilateral involvement in 1.3%. The prevalence of unilateral frontal sinus agenesis was higher in females (6.19%) as compared to males (4.12%). Both males and females showed preponderance of left sided aplasia. In contrast to our findings Yoshino et al. [10] reported unilateral sinus absence as 14.3% for males and 7.1% for female and they reported a higher frequency of right sided aplasia in both males and females. Our findings contradicted Nowak and Mehls [11] who also reported unilateral absence of the frontal sinus more commonly on right (4.2%) as compared to left (3.2%). Bilateral absence of the frontal sinus has been reported in 3% to 10% of several populations [7]. However Alaskan Eskimos displayed significantly higher prevalence of agenesis i.e 25% in males and 36% in females. 43% male and 40% female Canadian Eskimos also had bilateral frontal sinu [12,13]. In present study bilateral agenesis of frontal sinus was observed in 1.3% cases and was found with equal frequency in both males and female. There were no statistically significant differences in observed variations of frontal sinus between the two genders. The frequency of bilateral and unilateral agenesis of the sinuses in this study differed from frequencies reported for most ethnic populations. The discrepancy between the frequency in our population and that in other populations may be due to the number of patients examined, the patient sample, and the difference in the examining techniques and equipment. In addition, ethnic impacts and environmental factors control frontal sinus configuration within each population and contribute to the abnormal development of the frontal sinus.

## CONCLUSION

Frontal sinus anatomy was normal in majority and aplasia was displayed only in 6.6% of population. Frontal sinus aplasia was found more frequently unilateral than bilateral. Bilateral frontal aplasia was almost equally represented in males and females whereas unilateral aplasia was more common in females (6.19%) as compared to males (4.12%). Left sided aplasia was encountered more frequently (80%)

and was more common in females (5.2%) as compared to males (2.9%). Right sided aplasia was encountered with almost equal frequency in males and females. The low percentage of the frontal sinus aplasia must be taken into consideration during the pre-surgical planning related to the sinus. The preoperative recognition of the frontal sinuses is a prerequisite for any successful surgical procedure because of individual anatomic variations.

**Conflicts of Interests: None**

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