

# Use of Computed Tomography (CT scan) for delineating anatomy and variation of frontal Sinus before Functional Endoscopic Sinus Surgery

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Date of Submission: 08/11/2021

Date of Review: 24/11/2021

Date of Acceptance: 06/12/2021

## ABSTRACT

**Introduction:** For Functional Endoscopic Sinus Surgery (FESS), the surgeon needs an accurate depiction of the anatomy of paranasal sinuses and their variations. Computed tomography (CT Scan) fulfills this requirement by providing detailed anatomy, the anatomical variants, and the extent of the disease in and around the Para nasal sinuses. The aim of this study is to show the anatomy of the Frontal sinus as delineated by the computed tomography.

### Materials and Methods:

**STUDY DESIGN:** Cross section Descriptive Study. Out of 337 patients above 12 years of age who were referred for computed tomography of paranasal sinuses in the Dept. of Radio- Diagnosis, Govt. Medical College and Hospital from December 2015 till October 2017, 200 adults (males and females) were randomly selected. Of the 200 subjects studied 37 (18.5%) subjects had hypoplastic/ non or poorly pneumatized frontal sinuses of which 31 (15.5%) were bilateral and 6 (3%) were unilateral i.e. on right side.

### Observations and results:

Intra frontal cell were seen in about 64 (32%) subjects of which 26 (13%) on right side, 24 (12%) were on left side and 14 (7%) were bilateral. Extension of pneumatization into crista galli was seen in 16 (8%) subjects and into orbital roof was seen in 6 (3%) subjects.

### Conclusion:

The findings in this study show that anatomical variations in the Para nasal sinuses and nasal cavity are common. Computed tomography is fundamental radiologic investigation for diagnosis of the Sino nasal lesions or pre and post-surgical assessment.

**KEYWORDS:** CT scan, Frontal Sinus, Functional Endoscopic sinus surgery

## INTRODUCTION

Para nasal sinuses (PNS) are air-containing spaces in the skull. Various imaging modalities are available for the evaluation of the paranasal sinuses like Conventional radiography which provides useful information in the diseases of maxillary and frontal sinuses. [1] For Functional Endoscopic Sinus Surgery (FESS), the surgeon needs an accurate depiction of the anatomy of paranasal sinuses and their variations along with the extent of pathology preoperatively to avoid Intra-operative complications. [2, 3] Additionally, the approach to FESS becomes more complex because of different anatomic variations of Para nasal sinuses and changes in pneumatization of sinuses may disturb sinus ventilation. [4-6] Computed tomography (CT Scan) fulfills this requirement by providing detailed anatomy, the anatomical variants, and the extent of the disease in and around the Para nasal sinuses. [5, 7] The Frontal sinus lies in the diploe space between the outer and inner tables of the frontal bone. The two sinuses are commonly unequal in size and extent and are separated by a bony septum in the midline draining via frontal recess into the middle meatus in 62% or into the ethmoid infundibulum in 38%. [8] The anatomic variants include Frontal sinus hypoplasia which is poorly or non-pneumatized frontal sinuses in adults and rarely both aplastic frontal sinuses, and another one is Frontal sinus hyper pneumatization which is extension of pneumatization high into frontal bones, orbital roof and crista galli. [5]

The aim of this study is to show the anatomy of the Frontal sinus as delineated by the computed tomography among Indians and to describe the variants which not only predispose to chronic sinusitis but may lead to complications in endoscopic sinus surgery. To study normal anatomy of frontal sinus on computed tomography. study the anatomical variations of frontal sinus on computed tomography.

## MATERIALS AND METHODS

**STUDY DESIGN:** Cross Sectional Descriptive study.

**STUDY POPULATION:** Study was conducted in Dept. of Anatomy and Radio-Diagnosis, Govt. Medical College and hospital, after ethical clearance and completing all formalities.

**Sample size:** Among 337 patients above 12 years of age who were referred for computed tomography of paranasal sinuses in the Dept. of Radio- Diagnosis, Govt. Medical College and Hospital from December 2015 till October 2017, 200 adults(males and females) were randomly selected. The patients with Sino nasal anatomy alteration or obscuration due to inflammatory diseases (Obscured bony detail by polypoidy mucosal disease), Previous Sino nasal surgery, Facial trauma, Para nasal sinus neoplasm, and younger age of the patients (<12 years) were excluded.

**Data Collection Procedure:**

Examination was done on 64 slice GE (General Electronics) Computed Tomography scanner. The patient was placed on CT table and the head was centralized for correct alignment to reduce blurring of images. A scout image was taken to confirm correct position of patient. Base line images were obtained in axial sections taking orbito-meatal line as reference. Parallel scans were made upwards from the upper dental arch to the roof of the frontal sinuses.

Data was recorded on data record sheets and entered in MS Excel and presented as numbers and percentages. All statistical analysis is done using Epi Info 7, a database and statistics program for public health professionals. CDC, Atlanta, GA, USA, 2011.

**RESULTS**

Total 200 patients (136 males and 64 females) were enrolled. Majority of subjects (n=127, 63.5%) were in age group of 21 to 40 years Table 1 with mean age of 31 years (SD ±8.5).

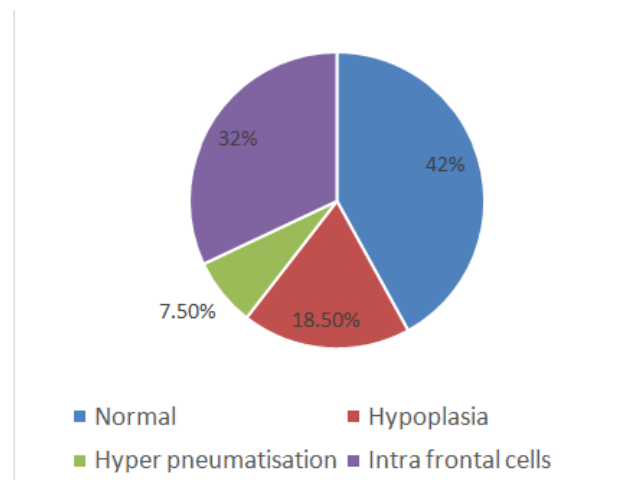
Age / sex	Male NO. (%)	Female NO. (%)	Total NO. (%)
13 to 20 years	26 (19.1)	12 (18.8)	38 (19)
21 to 30 years	53 (39)	21 (32.8)	74 (37)
31 to 40 years	38 (27.9)	15 (23.4)	53 (26.5)
41 to 50 years	8 (5.9)	5 (7.8)	13 (6.5)
51 to 60 years	8 (5.9)	6 (9.4)	14 (07)
More than 60	3 (2.2)	5 (7.8)	8 (04)
Total	136 (68)	64 (32)	200 (100)

**Table 1: Age and sex distribution of subjects (N=200)**

**Anatomy of Frontal sinus :**

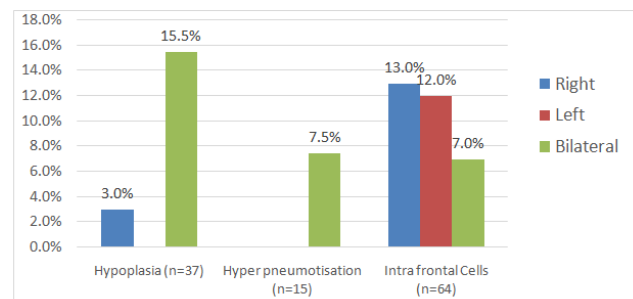
Of the 200 subjects studied, 84 (42%) subjects had normal bilateral frontal sinuses.37(18.5%) subjects had hypo plastic/

non or poorly pneumatized frontal sinuses, 64 (32%) had intra frontal cells and 15 (7.5%) had hyper pneumatization. Figure 1



**Figure 1: Anatomical Variations frontal sinuses in subjects (N=200)**

Of 37 subjects with hypoplasia of frontal sinuses, 31 (15.5%) were bilateral and 6 (3%) were unilateral i.e. on right side and of 64 subjects with intra frontal cells, 26 (13%) on right, 24 (12%) on left and 14 (07%) were bilateral. All 15 (7.5%) subjects with hyper pneumatization were bilateral. Figure 2



**Figure 2: Affected sides of anatomical variants of frontal sinuses (N=116)**

Extension of pneumatization into Crista Galli was seen in 16 (8%) subjects and into Orbital Roof in 6 (3%) subjects. There is no significant difference in anatomic variants of frontal sinuses between male and female subjects in the study. Table 2

**DISCUSSION**

Anatomical variations are best viewed and appreciated in the coronal plane on Computed tomography scan. Statistical comparison of anatomic variations did not show any significance between the two sexes, different ages or even between the two sides. The same findings were reported by R Lingaiah (2016) [6] of 100 cases with no gender wise significant difference.

Anatomical Variants of Frontal Sinuses	Male No. (%)	Female No. (%)	Total No. (%)
Normal	58 (42.6)	26 (40.6)	84 (42)
Hypoplasia	26 (19.1)	11 (17.2)	37 (18.5)
Hyper Pneumatisation	10 (07.4)	5 (07.8)	15 (07.5)
Intra Frontal Cells	42 (30.9)	22 (34.4)	64 (32)
Total	136 (100)	64 (100)	200 (100)

Pearson Chi-Square,  $X^2 = 0.30$ ,  $p = 0.95$

**Table 2: Anatomical variants of frontal sinuses in male and female subjects (N=200)**

Anatomic variations in Para nasal sinuses can lead to recurrent sinusitis, mainly due to impaired sinus drainage and ventilation. Therefore, it is imperative to understand the different variations and locations of para nasal sinuses.

#### Frontal sinus variants

Of the 200 patients studied, 37 (18.5%) had hypo plastic/non pneumatized frontal sinuses of which 15.5% were bilateral and 3% were unilateral i.e. on right side. R C Onwuchekwa (2017) [8] noted hypoplasia in 3.64% of the participants and extended pneumatization in 0.91% whereas in 10.6% of patients in a study in Iran by Mohammad H D et al (2007) [9] and in 8.4% of patients in the study by Stallman J (2004) [10] in Germany. R Lingaiah (2016) [6] noted frontal sinus hypoplasia in 17% in which 3% were bilateral. Extension of pneumatization into crista galli was seen in 8% of patients and into orbital roof was seen in 3% patients. R C Onwuchekwa (2017) [8] noted pneumatized crista galli in 9 (8.18%) cases. This prevalence is similar to findings of Basic et al. [11] who used CT scans in 212 patients and reported pneumatization of the crista galli in 2.4% and another study by Som P et al. [12] reported similar percentages 2.4% of pneumatized crista galli.

#### CONCLUSION

The findings in this study show that anatomical variations in the Para nasal sinuses and nasal cavity are common. Computed tomography is the gold standard and has a fundamental role in the radiologic diagnosis and pre and post-surgical assessment of the Para nasal sinuses. Its capability in delineating the anatomical variants in Para nasal sinuses protects against iatrogenic injury to essential structures around the Para nasal sinuses and recurrent diseases from extramural cells. It is of paramount importance that computed tomography of the Para nasal sinuses in three dimensions of axial, coronal and sagittal imaging be acquired and adequately reviewed prior to functional endoscopic sinus surgery (FESS) or other skull base surgeries.

**Acknowledgement:** Author is thankful to Dean IIMSR medical college and Dean GMC Aurangabad for allowing us to conduct study.

#### ACKNOWLEDGEMENTS

Author is thankful to Dean IIMSR medical college and Dean GMC Aurangabad for allowing us to conduct study.

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**How to cite this article:** Syed SAH, Khan ST, Syed JAH. Use of Computed Tomography (CT scan) for delineating anatomy and variation of frontal Sinus before Functional Endoscopic Sinus Surgery. Perspectives in Medical Research. 2021;9(3):54-57  
DOI: [10.47799/pimr.0903.13](https://doi.org/10.47799/pimr.0903.13)

**Sources of Support:** Nil , Conflict of Interest: None Declared :