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Original Article

# Role of Computed Tomography in Assessing Anatomical Variants of Nasal Cavity and Paranasal Sinuses in Chronic Sinusitis

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## Abstract

**Introduction:** Chronic sinusitis is an inflammation of the nasal cavity and paranasal sinuses (PNS) that lasts for at least 12 weeks.

**Purpose:** The aim of the study is to assess anatomical variants of nasal cavity and PNS in chronic sinusitis using 32 slice computed tomography.

**Materials and Methods:** A total of 100 patients with symptoms of chronic sinusitis were included in the study. All the patients in this study underwent computed tomography scan. The image was acquired in axial plane and coronal, sagittal planes were reconstructed.

**Results:** Among the sample with symptoms of chronic sinusitis which was monitored under computed tomography, radiological evidence of sinusitis was noted in 92% of patients, in this study, anatomical variants are key factors in causation of chronic sinusitis. Most common anatomical variants are deviated nasal septum, concha bullosa, and hypertrophied inferior turbinate.

**Conclusion:** Thus the study suggests that radiologists must pay close attention to anatomical variations in chronic sinusitis which can be better diagnosed using Computed Tomography.

**Key words:** Anatomical variants, Chronic Sinusitis, Computed Tomography, Deviated nasal septum, Paranasal sinuses

## INTRODUCTION

Chronic sinusitis is defined as a long-term inflammation of the nasal cavity and paranasal sinuses (PNS). It occurs due to viral, bacterial, or fungal activities. Allergy, nasal polyposis, and mucosal vasomotor dysfunction are all possible conditions which occur in chronic sinusitis.[1] Computerized tomography (CT) scan can be used to examine the structure of the nasal cavity and PNS, as well as their drainage.[2]

Many staging systems for determining the severity of chronic sinusitis are based on CT scan imaging. By partitioning the PNS and staging them according to their opacity and mucosal thickness, CT can be utilized to estimate the severity of chronic sinusitis.[3] CT imaging is used to assess the anatomical variations in the nasal cavity and PNS, as well as the extent of the disease.[4]

A fundamental knowledge of the PNS anatomy is essential not only for the diagnosis of chronic sinusitis but also for the pre-operative planning before sinus surgery. However, orientation of the PNS still remains a challenge among otolaryngologists due to the anatomic variations and diversity of prevalence among different ethnicity. Divided anatomical variants into those with potential impact on sinus drainage and operative safety.[5]

A brief overview of PNS architecture is not only required for the diagnosis of chronic sinusitis, but also for pre-operative planning before sinus surgery.[5] The anatomic variants and diversity of frequency among different ethnicities make orienting the PNS a problem for otolaryngologists.[6] Anatomical variants were divided

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into those that could have an impact on sinus drainage and operation safety.[7]

Concha bullosa, paradoxical middle turbinate, congenital absence of middle turbinate, pneumatized or absent uncinate process, septal pneumatisation, and bulla ethmoidalis are some of the conditions that affect sinus drainage.[8] Several of these anatomic anomalies can substantially block the osteomeatal complex.[9] As a result of these differences, normal mucociliary outflow in the sinuses is obstructed, increasing the risk of chronic sinusitis.[10] Anatomical anomalies that restrict the free flow of mucociliary movement have been associated to greater mucus viscosity and weakened mucosal immunity to sinus infections, according to the study. This explains the link between structural features of the PNS, such as size, location, and mucosal contact, and the progression and severity of chronic sinusitis in patients.[11] The aim of the study is to assess anatomical variants of nasal cavity and PNS in chronic sinusitis.

## MATERIALS AND METHODS

This study was conducted in Department of Radiology and Imaging Technology, A.C.S Medical College and Hospital, Chennai, from period of January 2021 to July 2021 after getting clearance from Institutional Ethical Community; informed consent was obtained from all patients before investigations. In this study, 100 patients of both genders with a history of SINUSITIS were included. Patients were identified from those who were clinically diagnosed with SINUSITIS with symptoms of running nose, heaviness of head, sneeze, nasal blockage, facial pain, loss of smell, and fatigue were advised CT scan of PNS. Patients who had facial metallic implants and those who underwent functional endoscopic sinus surgery were excluded from the study. CT scan was done with field of view from frontal sinus to maxillary sinus on 32 slices (SEIMENS SOMATOM SCOPE). The study was acquired in axial plane and coronal and sagittal plane was reconstructed, the CT scan evaluated both sinonasal cavity and anatomical variants.

### Statistical Methods

The recorded data were compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS version 21.0. Categorical variables were summarized as frequencies and percentages. Graphically, the data were presented by bar diagrams. Chi-square test was employed for comparing anatomical variants and age group. $P < 0.05$ was considered statistically significant.

## RESULTS

A total of 100 patients who presented to the Department of Radiology, ACS medical College Hospital with diagnosis of chronic sinusitis were enrolled in the study. Among 100 patients, the age group of the patients was from 13 to 62 years. The youngest patient was 13-years-old and the oldest patient was 62-years-old [Figure 1]. The maximum number of patients with sinusitis was among the age group of 19–35 years accounting to 64% of the total cases [Table 1]. Regarding the gender, 67 were males and 33 were females in which male patients were more prone to chronic sinusitis when compared to females.

Running nose, nasal blockage, and headache were the most prevalent clinical complaints among the study participants, accounting for 30%, 23%, and 17%, respectively [Figure 2]. Under computed CT, the pathological states of 100 patients with long-term complaints were monitored. In the study population, radiological evidence of sinusitis was found in

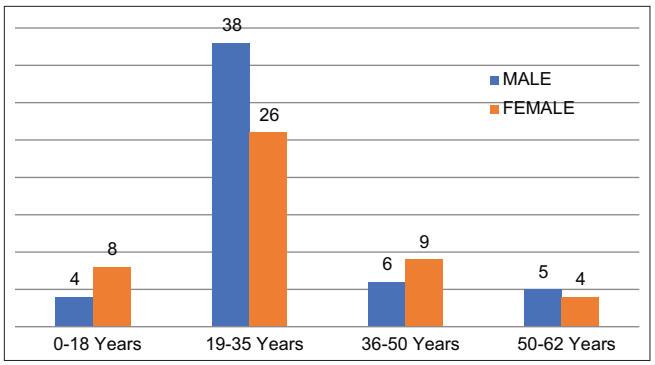


**Figure 1: Age and sex distribution with condition of chronic sinusitis**

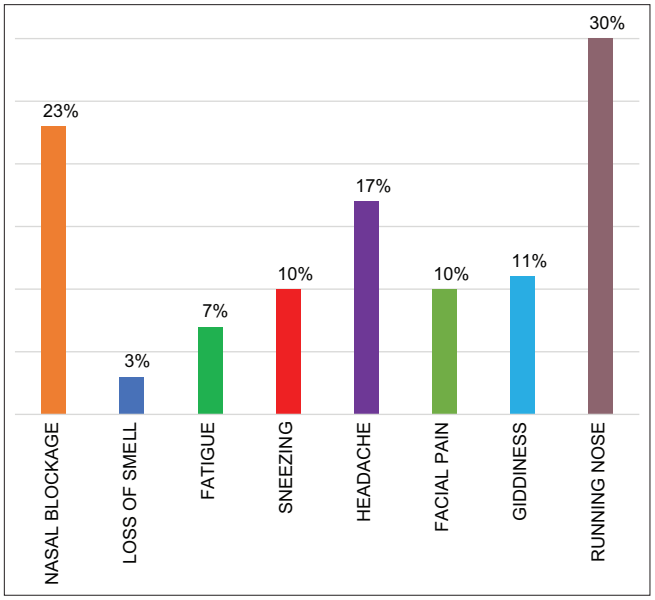


**Figure 2: Symptoms of the patients included in this study**

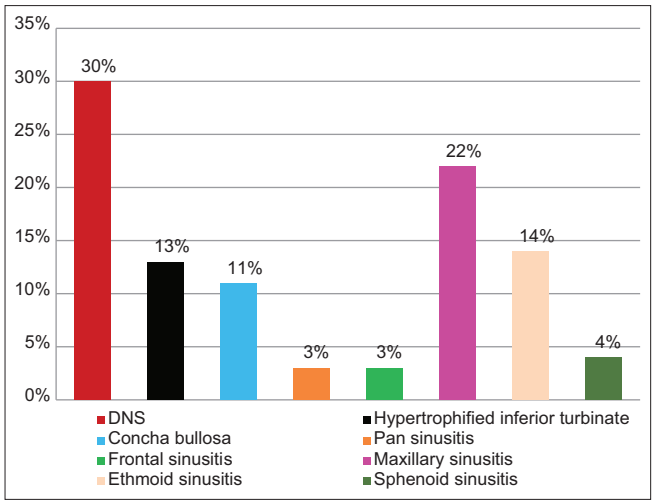


**Figure 3: Conditions over a study group of 100 patients with prolonged symptoms**

46% of the participants, with at least one of the PNSs being present. Deviated nasal septum (30%), bilateral maxillary sinusitis (22%), right ethmoid sinusitis (16.32%), ethmoid sinusitis bilateral (14%), hypertrophied inferior turbinate (13%), and concha bullosa (13%) were the most prevalent disorders with chronic symptoms (11%) [Figure 3]. About 46% patients who had only sinus pathology had maxillary sinusitis accounting for 22% [Table 2]. There is no significant association with sinus pathology and the age group of the study population ($P = 0.577$) [Table 3].

In the study, all the patients had at least one anatomical variant. Among the anatomical variants deviated nasal septum, hypertrophied inferior turbinate, and concha bullosa were the most common anatomical variants. About 56% patients who had only anatomical variants had deviated nasal septum accounting for 30%. In our study, DNS was the commonest variant (60%), followed by Concha Bullosa (26%) and hypertrophied inferior turbinate (22%). DNS were categorized into the left and right, left-sided DNS (31%) and right-sided DNS (20%) [Table 4]. There is no significant association with anatomical variants and the age group of the study population ($P = 0.947$) [Table 5].

## DISCUSSION

Chronic sinusitis is a disorder that impairs the quality of life of more than 5% of the population and is caused mostly by anatomical blockage, infections, or allergies. According to the literatures, some of the region in PNS is at risk for injuries with consequential intra-operative complications. Hence, the knowledge on these PNS anatomical variants is essential for endoscopic surgeons as well as for radiologists for pre-operative evaluation and

**Table 1: Age and sex distribution with condition of chronic sinusitis**

| Age (in years) | Male | Female |
|---|---|---|
| 0–18 | 4 | 8 |
| 19–35 | 38 | 26 |
| 36–50 | 6 | 9 |
| 50–62 | 5 | 4 |

**Table 2: Sinusitis conditions which were classified into the left, right, and bilateral sinusitis**

| Classification of sinusitis | Percentage |
|---|---|
| Left frontal sinusitis | 2 |
| Right frontal sinusitis | 2 |
| Bilateral frontal sinusitis | 2 |
| Left ethmoid sinusitis | 2 |
| Right ethmoid sinusitis | 16 |
| Bilateral ethmoid sinusitis | 14 |
| Left sphenoid sinusitis | 2 |
| Right sphenoid sinusitis | 5 |
| Bilateral sphenoid sinusitis | 5 |
| Left maxillary sinusitis | 14 |
| Right maxillary sinusitis | 12 |
| Bilateral maxillary sinusitis | 24 |

**Table 3: Significance between sinusitis and age group**

| Sinusitis | 0–18 years | 19–35 years | 36–50 years | 50–62 years |
|---|---|---|---|---|
| Frontal sinusitis | 3 | 7 | 1 | 1 |
| Maxillary sinusitis | 5 | 17 | 10 | 12 |
| Ethmoid sinusitis | 2 | 12 | 8 | 6 |
| Sphenoid sinusitis | 1 | 5 | 1 | 1 |

to avoid iatrogenic complications. Some of these variants are found to be associated with chronic sinusitis, possibly by obstructing drainage pathways from the sinuses and nasal cavity. Appropriate radiologic imaging and accurate interpretation of anatomical variants play an important role in the diagnosis and management of this chronic sinusitis.

CT provides comprehensive sinonasal anatomy for surgery and reveals great anatomical soft tissue and bone details, which aids in diagnosis. CT scans aid in determining the severity of sinus pathology as well as identifying anatomical abnormalities and their critical relationships with the PNS. In our study, we have observed about male patients were commonly prone to chronic sinusitis when compared to female; most male patients were in the age of 19–35 category. Surapaneni *et al.* 2016,[12] to evaluate the underlying cause, clinical features, and therapeutic impact on chronic sinusitis patients, found that 41.7% of chronic rhinosinusitis patients were between the ages of 16 and 30, which was similar to our findings. Another study by Gibelli *et al.* 2017[13] found that the affected age group for chronic

**Table 4: Anatomical variants which were classified into left, right and bilateral variants**

| Anatomical variants | Percentage |
|---|---|
| Dns left | 31 |
| Dns right | 20 |
| Hypertrophified inferior turbinate left | 6 |
| Hypertrophified inferior turbinate right | 9 |
| Bilateral hyper trophified inferior turbinate | 11 |
| Right concha bullosa | 6 |
| Left concha bullosa | 11 |
| Bilateral concha bullosa | 6 |

**Table 5: Significance between anatomical variants and age group**

| Anatomical variants | 0–18 years | 19–35 years | 36–50 years | 50–62 years |
|---|---|---|---|---|
| Deviated nasal septum | 3 | 15 | 7 | 5 |
| Hypertrophied inferior turbinate | 2 | 5 | 3 | 3 |
| Concha bullosa | 2 | 6 | 2 | 1 |

sinusitis was 21–40 years old, accounting for 65.3% of the study population.

In our study, we have observed about male patients were commonly prone to chronic sinusitis when compared to female which is similar to the study done by Mathuram *et al.*, 2019[14] revealed that males were more commonly affected with chronic sinusitis accounting for 58% and females accounted for 42%. This is also similar to the study conducted by Surapaneni *et al.* 2016[12] which had reported the incidence of male candidates affected to be 60% and females 40%. The most of the previous studies performed by Vinodhini *et al.*,[15] Dua *et al.*,[16] Iseh *et al.*,[17] and Gibelli *et al.*[13] had showed male preponderance with 66%, 57.5%, 52%, and 63%, respectively.

Numerous authors noted that certain anatomical variants have been associated with the pathophysiology of sinusitis particularly in sinus drainage. In our study, the most common clinical symptoms were running nose (30%), nasal obstruction (23%), headache (17%), and sneezing (10%). In the study conducted by Sandhu *et al.*, 2017,[18] the most common clinical symptoms were nasal obstruction (96%), headache (72%), and sneezing (60%). In our study, deviated nasal septum (30%) is the most common variant which is similar to the study done by Mathuram *et al.*, 2019,[14] among all the anatomical variants, deviated nasal septum is the most common variant, found in 142 study population accounting for 71% of cases. Most of the recent previous studies by Adeel *et al.*, 2013,[19] Aramani *et al.*, 2014,[20] and Suri *et al.*, 2016[21] had also showed that deviated nasal septum as most common anatomical variant accounting for 26%, 74.1%, and 75%, respectively. In a study done by Mamtha *et al.*,[22] prevalence of deviated nasal septum in chronic sinusitis cases was reported to be 60% and 65%, respectively. In our study, deviated nasal septum to the left was more common than to the right side, accounting for 31% which was similar to the study done by Marutham *et al.*, 2019,[14] which revealed that deviated nasal septum to the left was more common than to the right side, accounting for 40% on the left side. Similar to our study, the study done by Moorthy *et al.* in the year 2014[23] showed deviation of nasal septum to the left side (54%) more common than the right side (36.5%). Surapaneni *et al.* 2016[12] had concluded that CT scans to be valuable tool in diagnosing the disease which is similar to our study. The importance of anatomical variations in the development of chronic sinusitis has been questioned. Although the evidence suggests that anatomical variations increase the risk of developing chronic sinusitis.

## CONCLUSION

CT plays an important role in the visualization of anatomical variants in PNS, and our study reemphasizes the concept that anatomical variations particularly in key factors are the causation of sinusitis. CT of the PNS has improved the visualization of PNS anatomy and has allowed greater accuracy in evaluating PNS disease. The PNS anatomical variants are highly variable as proved by various previous studies.

In our study, the most common anatomical variant was deviated nasal septum, followed by hypertrophified inferior turbinate and Concha Bullosa and most common sinusitis were maxillary sinusitis followed by ethmoid sinusitis. CT helps in evaluating the complex anatomy of PNS which is not possible with plain radiographs. We suggest that the radiologist must pay close attention to anatomical variants in the pre-operative evaluation and help avoid possible complications and improve success of management strategies.

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