# SINONASAL ANATOMICAL VARIATIONS NOTED IN CT PNS OF PATIENTS WITH CHRONIC RHINOSINUSITIS

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**ABSTRACT**

**BACKGROUND**

Chronic rhinosinusitis is a disease characterised by inflammation of nose and paranasal sinuses persisting for more than 12 weeks. It has been shown to have correlation with sinonasal anatomical variations. Hence this knowledge can be used for diagnosis as well as management of this condition.

**MATERIALS AND METHODS**

This is a prospective study conducted among 73 patients who came to ENT OP of TSC hospital who were clinically diagnosed as chronic rhinosinusitis. Objectives of this study are 1. To know the prevalence of sinonasal anatomical variations in these patients and 2. Using this knowledge in planning treatment of these patients.

**RESULTS**

CT PNS of 73 patients were studied and the most common variation noted was septal deviation (73.97%) followed by agger nasi (41.09%) and concha bullosa (39.7%). Least commonly noted was Onodi cell and bent uncinate process (2.73%). Other variations noted include Haller cell (9.58%) and paradoxical MT (19.17%).

**CONCLUSION**

Anatomical variations are a common finding in patients with CRS. Keystone area in the pathology of CRS is OMC and any variation which obstructs OMC and hampers mucociliary drainage of sinuses needs to be specifically addressed during surgery (FESS) and hence knowledge of these variations can help in deciding management of these patients.

**KEYWORDS**

Rhinosinusitis; Sinonasal Anatomical Variation; Tomography; Paranasal Sinuses.

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## BACKGROUND

Chronic rhinosinusitis is defined as inflammation of nose and paranasal sinuses persisting for more than 12 weeks. CRS can present as CRS with polyps, CRS without nasal polyp or AFRS. It is a disease which significantly impacts patient's quality of life and results in physical, functional and emotional impairment. CRS is typically diagnosed in association with predisposing conditions such as asthma, allergy, dental disease, cystic fibrosis, polyposis and immunodeficiency syndromes. Microbes noted in CRS is different from ARS. Most frequently isolated pathogens include Staph Aureus, Pseudomonas, Coagulase negative Staph etc. Different etiological factors implicated in CRS include anatomical variations, environmental factors, allergy, genetic disorders. Ciliary activity in the sinuses directs the flow of mucous towards these ostia. Every episodes of rhinosinusitis hampers the ciliary movement and resulting in stasis of mucous inside the sinuses. Sinonasal mucosa becomes engorged thus closing the ostia. This process is usually reversible and once the osteomeatal complex is reopened, the secondary disease within the larger maxillary and frontal sinuses usually resolve spontaneously. If, however there is an anatomical variant that narrows this key area, then a minimal amount of mucosal oedema may predispose the patient to recurrent infection and may result in chronic inflammatory changes in the mucosa. Considering the relative preponderance of anatomical variation in nasal structures, relation between anatomy and rhinosinusitis could be highly relevant. Anatomical variations studied here include:

- Septal deviation
- Concha bullosa
- Paradoxical curvature of middle turbinate
- Agger nasi
- Onodi and Haller cell
- Bent uncinate process

Currently, computerized tomography scan of paranasal sinuses (CT PNS) is the gold standard in evaluation of sinonasal anatomy since it offers a detailed study of

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anatomical variations that can affect the mucociliary clearance and contribute to pathogenesis of CRS. Variations and tomographic signs of sinonasal disease occurring on the same side reinforce the likelihood of interference with the mucus drainage process.

## MATERIALS AND METHODS

**Study Design:** prospective prevalence study

**Study Population:** Includes 73 patients who came to ENT OP department of TSC hospital, Kulathoor between December 1st, 2016 to May 1st 2018 clinically diagnosed as chronic rhinosinusitis to know the prevalence of sinonasal anatomical variation from CT PNS of these patients.

Clinical diagnosis of chronic rhinosinusitis was based on criteria proposed by on AAO-HNS task force criteria revised in 2002 by sinus allergy health partnership taskforce (SAHP)[1-3]

**Diagnostic criteria for CRS**:

**Major Symptoms**

- Nasal obstruction/blockage
- Nasal discharge/purulence/discoloured post nasal discharge
- Hyposmia/anosmia
- Facial congestion/fullness
- Facial pain/pressure

**Minor Symptoms**

- Fever
- Halitosis
- Headache
- Cough
- Fatigue
- Dental pain
- Ear pain/ear pressure/fullness

According to clinical guidelines[1-3] patient should have 2 major symptoms or 1 major symptom with 2 or more minor symptom or nasal purulence on examination. Facial pain is not considered a symptom if not accompanied by any other symptom of sinusitis. The signs and symptoms should be present for atleast 12 weeks to qualify criteria for CRS.

**Clinical diagnostic criteria of CRS Revision (2002 SAHP Task Force**)[1-3]

1) Duration of disease is qualified by ongoing symptoms more than 12 weeks or more than 12 weeks of physical findings (signs will support the symptom time duration).
2) One of these signs of inflammation in association with symptoms:
   a. Discoloured drainage, nasal polyp or polypoid swelling on physical examination with anterior rhinoscopy or nasal endoscopy
   b. Oedema or erythema of middle meatus as identified by nasal endoscopy
   c. Generalized oedema, erythema or granulation tissue (if it does not involve middle meatus or ethmoid bulla, radiological imaging is required.)
   d. Imaging modalities for confirming the diagnosis: CT scan demonstrating mucosal thickening, bone changes or air fluid level.

Each patient was assessed taking a detailed clinical history, and clinical examination (anterior rhinoscopy) using nasal speculum. Once a provisional diagnosis of CRS was made, after taking consent from the patient DNE was done using 0-degree 4mm endoscope and patient was sent for a non-enhanced CT examination. Unenhanced CT was performed in axial and coronal planes. Direct scans 3 mm in thickness were made, from the anterior walls of the frontal sinuses to the posterior wall of the sphenoid sinus. For the axial scans, which were 5 mm thick, the orbitomeatal line was taken as reference with the patient in supine position. Sinonasal anatomical variations noted in CT for study include:

- DNS, Concha Bullosa, Onodi Cells, Haller Cells, Agger Nasi Cells, Bent Uncinate Process, Paradoxical Middle Turbinate.
- Extent of Involvement of sinuses in CT PNS was also studied.

**Inclusion Criteria**

1. All patients clinically diagnosed as CRS satisfying AAO-HNS criteria; both males and females.
2. Age group between 16 to 75.
3. Only those patients who gave written consent.
4. Willingness to undergo diagnostic nasal endoscopy and CT PNS.

**Exclusion Criteria**

1. Age less than 16 yrs. and more than 75 yrs.
2. History of RTA.
3. History of sinonasal malignancy.
4. Those not willing for nasal endoscopy/CT examination.
5. History of previous nasal surgery.
6. Nasal mass other than polyps.

**Statistical Analysis**

Done using SPSS version 16.

## RESULTS

73 patients participated in the study out of which 40 were males and 33 females. Thus, the male: female ratio is 1.21. The age group of males ranged from 21 to 68 and females from 17 to 63 years.

| Age Group | Male | Female |
|---|---|---|
| 16-25 | 6 | 4 |
| 26-35 | 7 | 6 |
| 36-45 | 13 | 12 |
| 46-55 | 8 | 6 |
| 56-65 | 3 | 5 |
| 66-75 | 3 | 0 |

***Table 1. Age Distribution of Study Population***

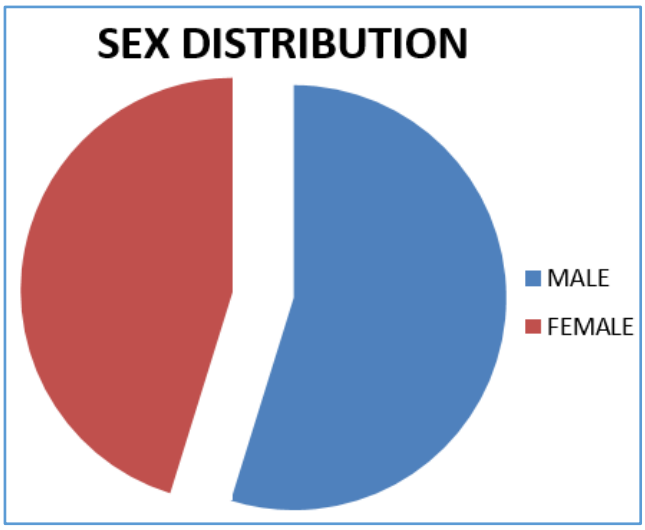


***Diagram 1. Sex Distribution of Study Population***

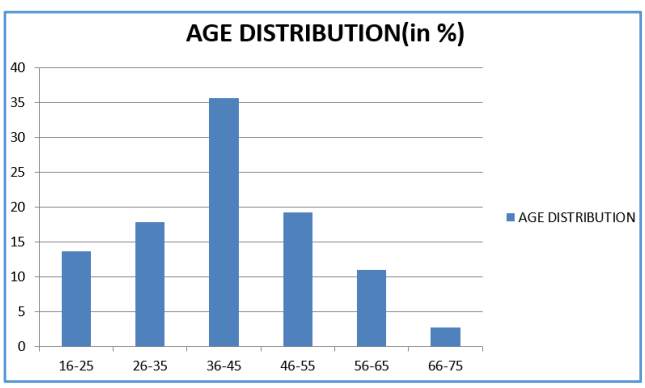


***Diagram 2. Age Distribution of Study Population***

Sinonasal anatomical variations were studied from CT PNS of patients and the results are as follows;

| CT Scan Findings | No. of Patients | Percentage |
|---|---|---|
| DNS | 54 | 73.97 |
| Concha Bullosa | 29 | 39.7 |
| Onodi Cell | 2 | 2.73 |
| Haller Cell | 7 | 9.58 |
| Agger Nasi Cell | 30 | 41.09 |
| Bent Uncinate Process | 2 | 2.73 |
| Paradoxical MT | 14 | 19.17 |

***Table 2. Sinonasal Anatomical Variations Noted in CT PNS of Study Population***

| CT Scan Findings | No. of Patients | Percentage |
|---|---|---|
| Maxillary Sinus | 50 | 68.49 |
| Ethmoidal Sinus | 31 | 42.46 |
| Sphenoidal Sinus | 25 | 34.24 |
| Frontal Sinus | 43 | 58.9 |
| Isolated Maxillary | 17 | 23.28 |
| Isolated Ethmoidal | 5 | 6.8 |
| Isolated Sphenoidal | 3 | 4.1 |
| Isolated Frontal | 13 | 17.8 |
| Pansinusitis | 9 | 12.32 |
| Involvement of Multiple Sinuses (2 or more) | 46 | 63.01 |
| None of The Sinuses Involved | 1 | 1.3 |

***Table 3. Involvement of Sinuses in CT PNS of Study Population***

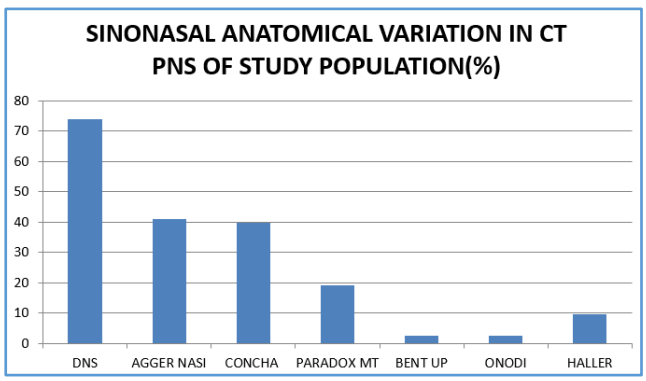


***Diagram 3. Sinonasal Anatomical Variation in CT PNS of Study Population***

**Anatomical Variations**

The most common variation noted was septal deviation which was found in 73.97% of study population followed by agger nasi (41.09%) and concha bullosa (34.24%). Onodi cells (2.73%) and Haller cell (9.58%) was rarely noted among patients. Similarly bent uncinate process also noted only in 2.73%. However paradoxical curvature of middle turbinate was noted in 19.17% of study population.

**Involvement of Sinuses in CT PNS**

Involvement of sinuses in CT was also studied. Maxillary sinus was the most common sinus to be involved both isolated and along with one or more other sinuses. 68.49 % showed maxillary sinusitis and isolated involvement of maxillary sinus was noted in 23.28% of population.

The second most common is frontal sinus involvement in 58.9 percentage of the patients and its isolated involvement was noted in 17.8 percentage 42.46 percentage had ethmoidal sinusitis and it was involved solely in about 6.8 percentage.

Least common sinus to be involved was sphenoid; in 34.24 percentage. Isolated involvement of sphenoid sinus was noted only in 4.1% of population.

**DISCUSSION**

Because of the importance of CT PNS in medical as well as surgical management of chronic sinusitis; several studies were performed in the past based on same topic as well as correlation of CT findings with intraoperative findings. Correlation between anatomical variations and extent and severity of disease has also been a research topic. However here we have tried mainly to study prevalence of anatomical variations in clinically proven cases of CRS and also have studied extent of disease.

**Deviated Nasal Septum**

Deviated nasal septum causes a decrease in the critical area of the osteomeatal unit predisposing to obstruction and related complications. In our study 73.97 of cases had DNS, similar finding were observed by Perez et al.,[4] who reported the prevalence of deviated nasal septum to about 80%. Stallmann, et al.[5] also reported lesser prevalence of 60% deviated nasal septum in chronic rhino sinusitis cases. Deviated nasal septum was noted in 45 (65.2%) patients by Gupta, et al.[6]; 55.7 % in study by Maru and Gupta[7] and 44% by Dua et al[8]; 21% by zeinreich et al[9]; 38% by Asruddeen et al[10] and 44% by Bolger et al.[11]

**Agger Nasi Cells**

Agger nasi cells lie just anterior to the anterosuperior attachment of the middle turbinate and frontal recess. These can invade the lacrimal bone or the ascending process of maxilla. Agger nasi was found in 80% by Leunig et al;[12] 88.5% by Maru and Gupta;[7] 68.8% by Gupta et al[6] and 40% by Dua et al.[8] In our study it is found in 41.09%.

**Concha Bullosa**

A concha bullosa by itself does not represent a disease state per se, but it predisposes the patient to develop rhinosinusitis more readily and more frequently.[9] Concha bullosa may block area of middle meatus by mucosal contact.[13] It is a possible factor in recurrent sinusitis due to negative influence on sinus ventilation. The incidence of concha bullosa in our study is 39.7% which was comparable to reported incidence of 42.6% by Maru and Gupta[7] and less as compared to 53.6% by Bolger et al.[11]

**Paradoxical Middle Turbinate**

Stammberger and Wolf[13] accepted paradoxical curvature of the middle turbinate as an etiological factor for CRS because it may cause obliteration or alteration in nasal air flow dynamics. It was found in 19.17% of our study population. It was noted to be 12% by Asruddin et al[10] and 15% by Llyod;[14] 27% as found by Bolger Et Al[11] and 29% by Tonai and Baba.[15]

**Bent Uncinate Process**

The uncinate process, being one of the first structures encountered intra-operatively, is now given immense surgical importance. Zinereich et al[9] first observed that the uncinate process may be curved or bent, impairing sinus ventilation especially in the anterior ethmoid, frontal recess and infundibulum. Bent uncinate process is found only in 2.73% of our population and is comparable to 2.5% by Bolger Et Al[11] but lesser compared to 22.8 % by Fadda et al[16] and 9.8% by Maru and Gupta.[7]

**Haller Cell**

According to Kennedy and Zinreich,[17] Haller cells are ethmoidal air cells that project inferiorly to the ethmoidal bulla into the floor of the orbit in the region of the maxillary sinus ostium, are encountered in 10% of the population. However, Bolger et al[11] defined Haller cells as any air cells located beneath the ethmoidal bulla, lamina papyracea, or orbital floor. Using this criterion, they reported a prevalence of 45%. Although they found no significant difference in the prevalence of Haller cells between patients scanned for chronic sinus disease and patients scanned for non-sinus reasons. Stammberger and Wolf[13] consider the presence of these cells as another predisposing factor for recurrent maxillary sinusitis. Haller cell was noted in 3.62% by Gupta Et Al[6] and 36% by Maru and Gupta.[7] Our study showed 9.58%.

**Onodi Cell**

Onodi cell is the most posterior ethmoid air cell that extends laterally. This extension is near the carotid canal and close to the optic nerve, which emphasizes the clinical importance of considering this anatomic variation prior to any attempt for invasive intervention. Incidence of Onodi cell varied in different studies and in all it was less than 10%.[5-10]

Regarding involvement of sinuses in CT; as in other studies maxillary sinus was the commonest sinus to be involved followed by frontal sinus; ethmoid sinus and least commonly sphenoid sinus.

**CONCLUSION**

Diagnostic nasal endoscopy together with CT PNS has been most helpful in diagnosing chronic rhinosinusitis as well as its management. An isolated finding of anatomical variation in patients without any disease is not problematic; however, its presence in patients with CRS has been found to have correlation in several studies. With these diagnostic methods the key factor which compromises osteomeatal complex can be found and treatment process can be aimed at removing the same.

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