

# Variations in Sinonasal Anatomy in Chronic Rhinosinusitis- A Cross Sectional Study

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## ABSTRACT

**Introduction:** The anatomy of nose is one of the most variable in the whole human anatomy. Knowledge about the possible variations is never complete, since there is always a scope to understand better and know more. Numerous studies have been undertaken in the past to better the already existing know-how about the various anatomical deviations in the nose and paranasal sinuses causing chronic rhinosinusitis. The present study was carried to know the prevalence of variations in sinonasal anatomy causing chronic sinusitis.

**Material and Methods:** A Cross sectional study conducted over a period of one year, in patients presenting to ENT OPD with any nose and paranasal related complaint, in a setting of tertiary hospital, with the requisite investigative protocols. Patients meeting the inclusion criteria were included in the study and subjected to the prescribed interventions.

**Results:** Observations gathered from this study are- of the 65 patients included, 86.1% had septal deformities, 58.4% had Concha bullosa, 52.3% had Agger Nasi, 15.3% had Haller Cell, 13% had Paradoxical Middle Turbinate, 4.6% had Everted Uncinate Process, 3% had Enlarged Bulla.

**Conclusion:** Sinonasal anatomy is very much variable, with various concomitant variations also. A detailed knowledge makes the life of a clinician much easier.

**Keywords:** Anatomical Variations; Nose and Paranasal Sinuses Anatomy; Septal Deviation; Concha Bullosa; Agger Nasi; Haller Cell; Paradoxical Middle Turbinate; Everted Uncinate Process; Concomitant Variations

## INTRODUCTION

The anatomy of the nasal cavity and its adnexae has a very wide spectrum of variations. No two lateral walls of nose are the same- as the age old adage goes. Since the anatomical variations have a heavy impact on various pathologies caused, it is imperative to know the incidence and percentage of various variants in anatomy. This can lead the clinician to a suspicion regarding the pathological basis of the symptoms with which a patient presents and arrive at the accurate diagnosis. Sinonasal diseases are common health problems those are frequently seen in rhinologic practice. Though a clinician can arrive at the accurate diagnosis by clinical examination and adequate endoscopic examination, imaging studies definitely have a role. Anatomical disparities of nose have been reported to predispose to sinusitis<sup>1</sup> Chronic rhinosinusitis is one of the most common illnesses, and it has been known to negatively impact health-related quality of life.<sup>2</sup> Currently, computed tomography (CT) in both coronal and axial planes is the investigation of choice. Of these, more onuses is on the coronal plane is the most common

method used by surgeons because of its similarity with the surgical orientation. One of the biggest advantages of CT is that it gives us an accurate idea about the bony landmarks and orientation of various sinuses around the nasal cavity.<sup>3</sup> The different variations in anatomy may form various contact points, thereby, stimulating “trigger points” and determining facial pain crisis, as older literature suggests. The newer literature has termed the similar clinical scenario as “anterior ethmoidal syndrome”. Three-dimensional (3D) imaging of paranasal sinuses is mandatory for diagnosis and treatment of the underlying anatomical variations, as these variations could be a cause for sinonasal symptoms, facial pain symptoms, and headache.<sup>4-5</sup>

The present study was carried to know the prevalence of variations in sinonasal anatomy causing chronic sinusitis.

## MATERIAL AND METHODS

The present study was a cross sectional study, done in Tertiary hospital, Nellimarla, Vizianagaram, conducted over a period of 1 year from September 2016 to August 2017. At the time of inclusion of the patient into the study, detailed and informed consent was taken. Every patient was subjected to the requisite investigations and followed up. Institutional ethical committee clearance was taken before the study.

Study Subjects were patients presenting to ENT OPD, suffering from any complaint regarding nose and paranasal sinuses were included in the study

### Inclusion Criteria

1. Patients presenting with nasal symptoms
2. Patients willing to be included in the study
3. Patients willing for the necessary investigations

### Exclusion criteria

1. Patients presenting with Allergic Rhinosinusitis
2. Patients aged <15yrs and >60yrs
3. Pregnant individuals for risk of radiation exposure
4. Patients with any other contraindication for radiologic

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investigations

**Intervention:** All the patients included for this study were subjected to CT Paranasal sinuses, and evaluated for any anatomical variation and categorized accordingly. Microsoft Excel was used to tabulate and categorize.

## RESULTS

In this study 65 patients were included, out of which, there were 47 (72.3 %) males and 18(27.6 %) females with ages ranging from 15 to 60 years.

Age wise distribution showed that out of 65 patients, 12(18.46%) belonged to 15-25yrs; 26(40%) to 25-35 yrs; 16 (4.6%) to 35-45 yrs; 11 (16.9%). Each group were further categorized as males and females, viz. out of the 47 male patients included in the study, 9(19%) belonged to 15-25 yrs, 18(38.2%) to 25-35yrs, 11(23.4%) to 35-45yrs; 9(19.1%) to 45-60yrs.

Every patient underwent CT PNS and searched for any

Males	Females	Total
47 (72.3%)	18(27.6%)	65

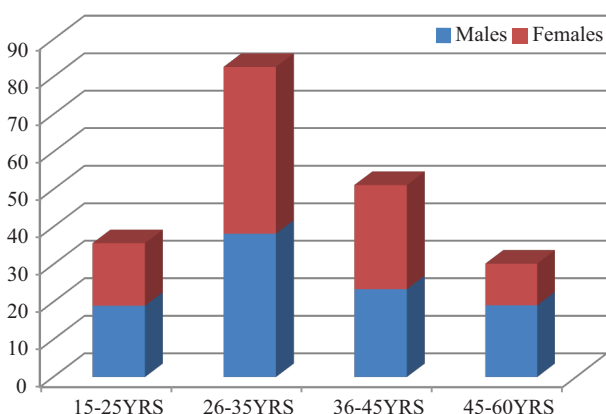
**Table-1:** Showing sex wise distribution

Age	Males	Females	Total
15-25yrs	9 (19%)	3 (16.66%)	12 (18.46%)
25-35yrs	18 (38.2%)	8 (44.44%)	26 (40%)
35-45yrs	11 (23.4%)	5 (27.77%)	16 (24.6%)
45-60yrs	9 (19.1%)	2 (11.11%)	11 (16.9%)
Total	47	18	65

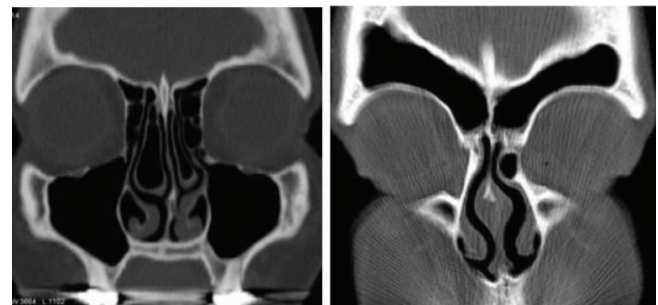
**Table-2:** Showing Age wise distribution:

Anatomical Variation	Number	Percentage
Septal deviation (SD)	56	86.1%
Concha bullosa (CB)	38	58.4%
Enlarged Bulla (EB)	2	3%
Everted Uncinate (EU)	3	4.6%
Agger Nasi (AN)	34	52.30%
Paradoxical MT (PMT)	9	13%
Haller cell (HC)	10	15.3%

**Table-3:** Showing anatomical variations



**Figure-1:** A bar diagram showing the percentages of the patients belonging to various age groups, considering the sex of the patient



**Figure-2:** A clinical photograph showing the Deviated Nasal Septum in Anterior Rhinoscopy; **Figure-3:** CT scan of Paranasal sinuses showing bilateral Concha Bullosa; **Figure-4:** CT scan of PNS showing left Agger Nasi.

underlying anatomical abnormalities.

As quoted earlier, various anatomical variations considered for this study were septal deviation, concha bullosa, enlarged ethmoid bulla, everted uncinate, agger nasi, paradoxical middle turbinates and Haller cell.

Some patients had the concomitant presence of more than one variation, making many different combinations of the existing variations possible.

Septal deviation was seen in 56 (86.1%) patients, Concha bullosa in 38(58.4%) patients, Enlarged bulla in 2(3%) patients, Everted Uncinate in 3(4.6%) patients, Agger Nasi in 34(52.3%) patients, Paradoxical Middle Turbinate in 9(13%) patients, and Haller Cell in 10 (15.3%) patients.

## DISCUSSION

Nasal cavity and paranasal sinuses belong to the same anatomical unit, having common structure and the same covering epithelium.<sup>7</sup> Complete and thorough knowledge of the sinonasal anatomy is a must for accurate diagnosis and management of a patient presenting to rhinological OPD. For the clinician to have sound anatomical background knowledge, the prevalence of various anatomical variations goes a long way. Awareness about the prevalence gives a predetermined mindset regarding the most probable variant on an individual patient basis.

In this study, out of the total 65 patients included, 47 were males and 18 were females. Maximum age group were of 25-35 yrs age group, followed by the age group of 35-45yrs. These were similar to the findings of Perez et al.<sup>8</sup>

The most common anatomical variation found in this study was a Deviated Nasal septum. Whatever the shape and type of the deviation was found to be occurring, it was consistent with the symptoms presented by the patients. This study showed a prevalence of 86.1%. This is similar to various literatures in the past. Narendra kumar and Subramaniam<sup>9</sup>

presented it as 76% whereas Turnaet al<sup>10</sup> found it as 59.1%. H Mamatha<sup>11</sup> et al found it to be 65% and K Dua<sup>12</sup> et al 44%. Adeel M<sup>13</sup> et al of Pakistan found it to be prevalent in 26 out of 77 patients, Shpilberg KA<sup>14</sup> et al of USA found it to be in 98 patients out of 192.

The term Concha bullosa was coined by Zuckerkandl in 1862. It is defined as the pneumatized middle turbinate. It is one of the most common variants in sinonasal anatomy.<sup>15</sup> This study showed a prevalence of 58.4%, correlating with the studies of Bolger<sup>16</sup> et al and Khojastepour<sup>17</sup> et al.

Agger Nasi cells are defined as the anterior-most Anterior Ethmoidal cell, Located anterior to the nasolacrimal duct. The plane of maxillary sinus infundibulum lies posterior to it.<sup>18</sup> Pneumatisation of the agger nasi may extend up to frontal recess, narrowing the recess. It has got much clinical implications, as defined by Bruner et al<sup>19</sup> which include persistent and considerable fronto ethmoid pain and chronic frontal sinusitis. This study showed a prevalence of 52.3%. These findings were almost consistent with those of Talaiepouret al.<sup>21</sup> Kaygusuz<sup>22</sup> et al of turkey found out 61 patients had agger nasi out of their sample size of 99 patients A Middle turbinate that is oriented in such a way as to a bend into the middle meatus is not pathology in itself unless it blocks the osteomeatal complex. Calhoun<sup>23</sup> reported the prevalence as 7.9% and Lusk<sup>24</sup> et al As 8.5%. This study showed a prevalence of 13%.

Haller or infraorbital ethmoid air cells are the pneumatisation of the ethmoid bone below the orbit. They project along the medial roof of the maxillary sinus and into the lamina papyracea, below the ethmoid bulla, lateral to the uncinat process. It was described by Albert Haller<sup>25</sup> in 1765. Jaiger<sup>26</sup> et al showed 8% prevalence whereas Tiwari<sup>27</sup> et al's study had a prevalence of 3.5%. This study showed a prevalence of 15.3%

An Everted Uncinate Process may cause an obstruction to the osteomeatal complex leading to chronic sinusitis and persistent headaches. Pradeep Kumar<sup>28</sup> et al of India showed a prevalence of 82% whereas Aramani<sup>29</sup> et al of India had a prevalence of 16%. In this study 4.6% patients had a uncinat variant.

An Enlarged Bulla ethmoidalis creates difficulty in the ventilation of the middle meatus as well as during surgery, preoperatively. A Study by Gouripur<sup>30</sup> et al had a prevalence of enlarged bulla as 15%, whereas this study showed a prevalence of 3%.

The strengths of the study are along with a study of incidence of various individual anatomical variants, detailed knowledge was gained about concomitant existence of two or more variations in the same patient

Limitations being, since it included only those people who presented to the ENT OPD with complaints regarding nose and paranasal sinuses, there might be a bias in extending the results to the general population. A degree of human error is always possible.

## CONCLUSIONS

Knowledge about the variations in Sinonasal Anatomy is

very important for thorough follow up and diagnosis, and to avoid surprises during functional endoscopic sinus surgeries. Sinonasal variations are more seen in patients suffering from chronic rhinosinusitis, and vice versa, these anatomical variations lead to chronic Rhinosinusitis.

This study shows a prevalence of the different anatomical variations as follows:-

- a) 86.1% of Septal deformities
- b) 58.4% of Concha bullosa
- c) 52.3% of Agger Nasi
- d) 15.3% of Haller Cell
- e) 13% of Paradoxical Middle Turbinate
- f) 4.6% of Everted Uncinate Process
- g) 3% of Enlarged Bulla

Some of the variations are seen concomitantly occurring in various combinations, making it extremely important for us to identify and document them, to let us correct it and do the needful to the patient.

## REFERENCES

1. Maru YK, Gupta V. Anatomical variations of the bone in sinonasal C.T. Indian J Otolaryngol Head Neck Surg 2001;53:124-128.
2. Abri RA, Bhargava D, Sawhney S. Clinically significant anatomical variants of the Paranasal sinuses. OnamMed J 2014;29:110-113.
3. Ayukt M, Gumusbrum E, Muderris S, Adiguzel E. The secondary nasal middle concha. Surgical and Radiologic Anatomy. 1994;16:307-9.
4. Elsherif A-AMH, Elsherif AMH. Some anatomical variations of the paranasal sinuses in patient with chronic sinusitis: a correlative CT study to age and sex. Al-AzharAssiut Med J 2006;4:1-15.
5. Murthy DD, Roa BRC, Roa SSP. Analytical study of anatomical variations of nose and PNS in CT scan and chronic sinusitis. IOSR J Dent Med Sci 2016;7:30-35.
6. Pg 1334, Vol 2, 7<sup>th</sup> edition Scott-Brown's Otorhinolaryngology, Head and Neck surgery, Ed:- Michael Gleeson; 2008
7. Lingaiah RKN, Putturaj NC, Chikkaswamy HA, Nagarajaiah PKC, Purushottama S. Prakash V, Booma P, Ismail M. Anatomical Variations of paranasal sinuses on coronal CT-scan in subjects with complaints pertaining to PNS. IJARS DOL:10.7860/IJARS/2016/21554:2192
8. Perez P, Sabate J, Carmona A. Anatomical variations in the human paranasal sinus region studied by CT. Journal of Anatomy. 2000; 197:221-227.
9. Narendrakumar V, Subramaniam V. Anatomical variations in osteomeatal complex among patients undergoing functional endoscopic sinus surgery. ClinRhinolInt J 2016;9:28-32.
10. Turna O, Aybar MD, Karagoz Y, Tuzcu G. Anatomical variations of the paranasal sinus region: Evaluation with multidetectorCT. Istanbul Med J 2014;1:104-109.
11. Mamatha H, Shamasundar NM, Bharathi MB, Prasanna LC. Variation of osteomeatal complex and its applied anatomy: a CT scan study. Indian J OF Science and technology. 2010; 3:904-7.
12. Dua K, Chopra H, Khurana A, Munjal M. CT scan variations in chronic sinusitis. Indian J Radiol imaging.

- 2005;15:315-20.
13. Adeel M, Rajput MS, Akhter S, Ikram M, Arian A, Khattak YJ. Anatomical variations of nose and paranasal sinuses; cccCT scan review. *J pak Med Assic.*2013;63:317-9.
  14. Shpilberg KA, Daniel SC, Doshi AH, Lawson W, Som PM. CT of anatomic variants of the paranasal sinuses and Nasal cavity- poor correlation with Radiologically significant Rhinosinusitis but Importance in Surgical Planning. *Neuroradiology/Head and neck Imaging AJR.* 2015;2014:1255-60.
  15. Miranda CMNR, Maranhao CPM, Arraes FMNR, Padilha IG, Farias LPG, Jatoba MSA, Andrade ACM, Padilha BG. Anatomical variations of paranasal sinuses at multislice computed tomography: what to look for. *Radiol Bras* 2011;44:256-262.
  16. Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomical variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. *laryngoscope* 1991;101:56-64.
  17. Khojastepour L, Mirhadi S, Mesbahi SA. Anatomical variations of osteomeatal complex in CBCT of patient seeking rhinoplasty. *J Dent (shiraz)* 2015;16:4248.
  18. Earwalker J. Anatomic variants in sinonasalCT. *Radiographics* 1993;13:381-415.
  19. Brunner E, Jacobs JB, Shpinzer BA, Lebowitz RA, Holliday RA. Role of the agger nasi cell in chronic frontal sinusitis. *Ann Otol Rhinol Laryngol.* 1996;105:694-670.
  20. Wani AA, Kanotra S, Lateef M, Ahmad R, Qazi SM, Ahmad S. CT scan evaluation of the ostiomeatal complex. *Indian J Otolaryngol Head Neck Surg* 2009;61:163-168.
  21. Talaiepour AR, Sazgar AA, Bagheri A. Anatomic variations of the paranasal sinuses on CT scan images. *J Dent(Tehran)* 2005;2:142-146.
  22. Kaygusuz A, Haksever M, Akduman D, Aslan S, Sayar Z. Sinonasal Anatomical Variations: Their Relationship with Chronic Rhinosinusitis and effect on the severity of the disease- A Computerized Tomography Assisted Anatomical and Clinical Study. *Indian J of Otolaryngol Head and Neck Surg.* 2014;6:260-6.
  23. Calhoun KH, Waggenspack GA, Simpson CB, Hokanson JA, Bailey BJ. CT evaluation of the paranasal sinuses in symptomatic and asymptomatic populations. *Otolaryngol Head and neck Surg.*1991;104:480-83.
  24. Lusk RP, McAlister B, Fouley A. Anatomic Variation in pediatric Chronic Rhinosinusitis: A CT study. *Otolaryngology Clin North Am.*1996;29:75-91.
  25. Eweiss AZ, Kjalil HS. Prevalence of frontal cells and their relationship to frontal sinus:a radiological study of frontal sinus area. *ISRN Otolaryngology* 2013; Article ID 687582:1-4.
  26. Jaiger. CT Evaluation of paranasal sinus, their anatomical variation and their clinical importance (2010)
  27. Tiwari R, Goyal R. Study of anatomical variations on CT in chronic sinusitis. *Indian J of Otolaryngol Head and Neck surgery.* 2015;67:18-20.
  28. Kumar P, Rakesh BS, Prasad R. Anatomical variations of sinonasal region, a coronal Ct scan study. *Int J Contemporary Med Res.*2016;3:2601-4.
  29. Aramani A, Karadi RN, Kumar S.A Study of Anatomical Variations of Osteomeatal Complex in Chronic Rhinosinusitis patients-CT findings. *JClinDiag Res.* 2014;8:1-4.
  30. Gouripur K, Udayakumar M, Janagond AB, Elangovan S, Srinivasa V. Incidence of sinonasal anatomical variations associated with chronic rhinosinusitis by CT scan in Karaikal, South India. *Int J Otorhinolaryngol Head and Neck Surg* 2017;3:576-80.

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