

Etiopathogenesis of Rhinosinusitis in Relation to Ethmoid Anatomy

¹RG Aiyer, ²VK Pandya, ³GB Soni, ⁴PJ Dhameja, ⁵Rahul Gupta, ⁶Mayank Patel

¹Professor and Head, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Gujarat, India

²Associate Professor, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Gujarat, India

^{3,4}Assistant Professor, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Gujarat, India

⁵Senior Resident, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Gujarat, India

⁶Junior Resident, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Gujarat, India

Correspondence: RG Aiyer, Professor and Head, Department of ENT and Head and Neck Surgery, SSG Hospital and Medical College Baroda, Jesal Apartment, Abhishek Colony, Race Course, Vadodara-390007, Gujarat, India
e-mail: drrgaiyer@hotmail.com

Abstract

Introduction: Rhinosinusitis is one of the most common ENT disorders in the developed and developing world.

The quest and identification of factors predisposing to chronic rhinosinusitis is the key for guiding appropriate management.

Objectives: The purpose of this study was to determine the prevalence of anatomical variations of the ethmoid sinus in patients with rhinosinusitis. This was done to assess and evaluate the significance of the anatomical variations of the ethmoid in the genesis of inflammatory sinus disease.

Material and methods: We reviewed 50 patients with rhinosinusitis, of which 38(76%) had anatomical variations of ethmoid and the extent of mucosal disease.

Results: Concha bullosa was found to be the most common anatomic variation and was seen in 25(50%) patients closely followed by variations in the uncinat process, paradoxically bend middle turbinate. The most commonly affected paranasal sinus was maxillary sinus (84%) followed by anterior ethmoidal sinus, posterior ethmoidal sinus, frontal sinus and sphenoid sinus in descending order.

Conclusion: Anatomical variations of the ethmoid sinuses are important etiological factors in the genesis of inflammatory sinus disease.

Keywords: Rhinosinusitis, concha bullosa, anatomical variations, FESS.

INTRODUCTION

Rhinosinusitis is an inflammatory process involving one or more of the paranasal sinuses that usually follows an allergic reaction or viral/bacterial upper respiratory infections. Rhinosinusitis, with its classical symptoms of nasal obstruction, nasal discharge, headache and allergic symptoms is the most common disease for which otorhinolaryngological consultation is sought.

The obstruction of the osteomeatal complex—the region of middle meatus in which all maxillary, anterior ethmoidal and frontal sinuses drainage orifices are located has been considered the most important in the pathophysiology of rhinosinusitis.^{1,2}

Anything which interferes with the normal functions of the mucus membrane predisposes to rhinosinusitis.

Anyone can get acute rhinosinusitis but some are more prone to it.

The approach to the evaluation of rhinosinusitis changed after Messerklinger and Stammberger³ published the first comprehensive account of technique of nasal endoscopy and its application to the diagnosis of sinonasal disease. The same authors earlier gave the concept of mucociliary clearance of paranasal sinuses. Disruption of the mucociliary clearance due to anatomic variations is considered to be the prime factor for the continuation of symptoms and rhinosinusitis.

Computed tomography (CT scan) has proved to be an indispensable method for the diagnosis of paranasal sinuses afflictions, especially the coronal sections, in which we can clearly identify the important anatomical variations.^{4,5}

Environmental factors such as allergens, viruses or air pollutants have been considered to predispose to development of rhinosinusitis.

In this study we evaluated the role of anatomical variations of ethmoid in the causation of rhinosinusitis.

MATERIAL AND METHODS

The study was conducted at the Department of Otorhinolaryngology, Medical college and Sir Sayaji General Hospital, Baroda during the period between May 2007 and Nov 2009 which comprised 50 cases who underwent medical and surgical management for chronic rhinosinusitis and nasal polyposis.

The selection of the patients was done on the following basis:

- History of nasal obstruction nasal discharge, headache or allergic symptoms.
- All patients with clinical diagnosis of chronic sinusitis were included in the study. A detailed history and a thorough clinical examination was done. Routine hematological and serum investigations were performed. Nasal endoscopy and CT scan were performed in all cases.
- We excluded cases with Nose/PNS tumors, acute infective conditions and pediatric patients below 10 years of age.
- Endoscopic sinus surgery was performed on a majority of the patients.
- Septoplasty was performed in patients with severely deviated nasal septums beforehand to facilitate access during endoscopic sinus surgery. Patients were followed-up for symptomatic resolution by clinical assessment and routine endoscopic examinations.

RESULTS

Fifty patients who were diagnosed as having chronic sinusitis and underwent medical or surgical treatment, were studied in this series. Mean age of the patient was 36 years with the distribution ranging from 13 to 64 years. Males (76%) were found to be more commonly affected in this study (Table 1).

Table 1: Age wise distribution of patients

Age groups in years	No. of cases	Percentage (%) of total
11-20	06	12%
21-30	12	24%
31-40	15	30%
41-50	11	22%
51-60	04	08%
61-70	02	04%

Most of the patients had history of nasal obstruction and nasal discharge.

In majority of patients, nasal obstruction was unilateral, intermittent and was relieved on medication but it was persistent and severe in patients who had nasal polypi. Nasal discharge was intermittent, mucoid or mucopurulent; more common in patients who had associated nasal polypi.

Headache was intermittent, associated with nasal obstruction. Anosmia/Parosmia were more commonly associated with nasal polypi. Sneezing was usually associated with allergic conditions (Fig. 1).

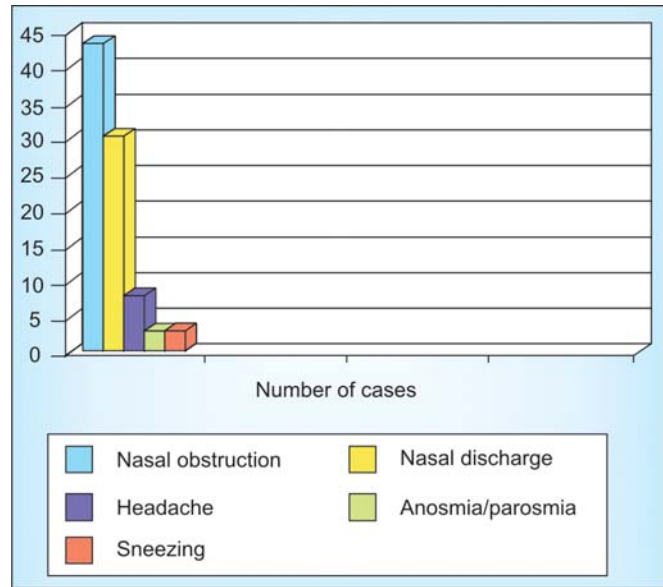


Figure 1: Symptomatology

Endoscopic examination revealed anatomical variations in a good proportion of patients.³

Findings on computed tomographic scan were categorized on the basis of severity of disease into five stages.

We used tomographic classification by Metson and Gliklich based on international protocol of AA-HNS⁶ (Table 2).

Table 2: Metson and Gliklich CT based classification

Stage (CT scan)	Staging criteria	No of patients
Stage 0	Less than 2 mm thickness of mucosa on the wall of any sinus	01
Stage 1	Unilateral anatomical disease or abnormality	13
Stage 2	Bilateral disease limited to ethmoid or maxillary sinuses	21
Stage 3	Bilateral disease involving at least one sphenoid or frontal sinus	09
Stage 4	Pansinusoidal disease	12

Analyzing the results of endoscopy and CT scans, 48 patients had some positive radiological finding and 2 patients had normal scan. Forty patients had positive results on both endoscopic analysis and CT scan. One of them had positive results on endoscopy but no finding on CT scan. Forty-one patients had positive endoscopic findings and 9 had no

documentable abnormality. Another 8 patients had CT scan positive results and negative endoscopic ones. One patient presented with negative results for both CT scan and endoscopic examination.

More than 70% of the patients had bilateral disease.

The maxillary sinus was the most common site of infection/inflammation followed by the anterior and posterior ethmoid, frontal sinus and sphenoid sinus (Fig. 2).

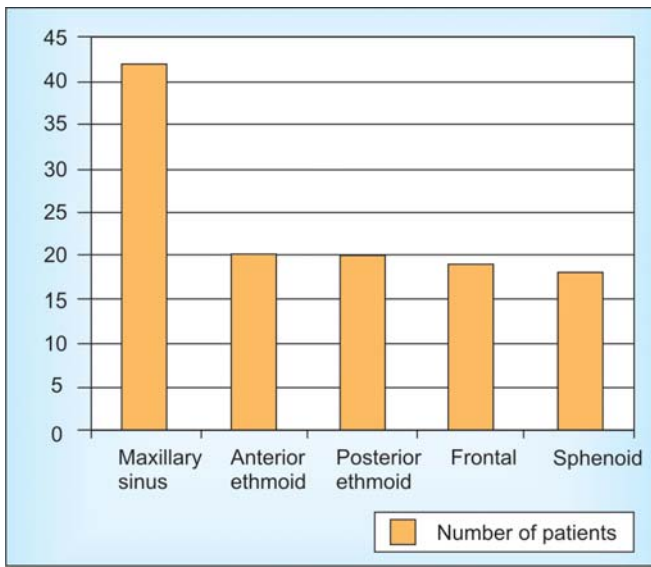


Figure 2: Sites of paranasal sinus involvement

Anatomical variations were seen in 38(76%) of patients. Concha bullosa was the most common abnormality followed closely by variations of the uncinate process and paradoxical bend of middle turbinate (Figs 3A to 7C).

Functional endoscopic sinus surgery was performed in 39 (78%) of patients in this study. Septoplasty was usually performed as an adjunct to functional endoscopic sinus surgery to provide space for instrumentation.

DISCUSSION

The quest and identification of factors predisposing to chronic rhinosinusitis is the key for guiding appropriate management.

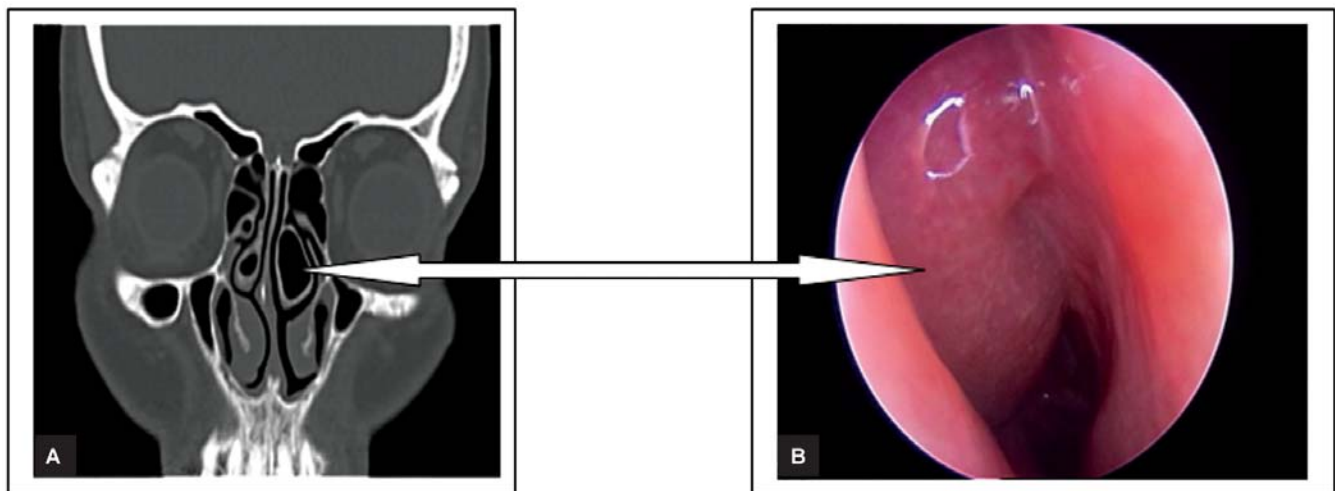
Sinusitis is one of the most common health care challenges in the developed and developing world.

Association between presence of concha bullosa and development of chronic rhinosinusitis was quite strong.⁷⁻¹¹ It is due to its negative influence on paranasal sinus ventilation and mucociliary clearance in the middle meatus region as quoted by Tonai¹² (Figs 3A and B). The incidence of concha bullosa was 50% which is less as compared to the reported incidence of 53.6% by Bolger et al,⁷ 42.6% by Maru et al,¹³ 28% by Asruddin et al,¹⁴ 24% by Llyod.¹⁵

Lloyd even suggested a possibility of complete blockage of the entrance to the middle meatus, if the concha bullosa were to grow to such a degree that the turbinate heads completely filled the space between the septum and lateral nasal wall^{8,9} (Table 3).

The middle turbinate may be paradoxically curved, i.e. bent in the reverse direction. This may lead to impingement of the middle meatus and thus to sinusitis. It was found in 11(22%) patients (Figs 4A and B). The incidence is higher to that of 12% by Asruddin et al¹⁴ and 15% by Llyod.¹⁵ It is less than that reported by Bolger et al⁷ (27%).

Zinreich first observed that the uncinate process may be curved or bent. It can impair sinus ventilation especially in the anterior ethmoid, frontal recess and infundibulum



Figures 3A and B: CT and endoscopic picture of concha bullosa

Table 3: Association between concha bullosa and rhinosinusitis

Concha bullosa	Rhinosinusitis/ nasal polypi	Nonrhinosinusitis/ nonnasal polypi	Total
Presence	24(48%)	1(2%)	25(50%)
Absence	21(42%)	4(8%)	25(50%)
Total	45(90%)	5(10%)	50(100%)

regions.⁸ The incidence of variation in uncinete process was found in 30% which is higher than higher than that of 2.5% reported by Bolger⁷ and 2% by Asruddin¹⁴ and less than that of 9.8% by Maru et al¹³ (Figs 7A to C).

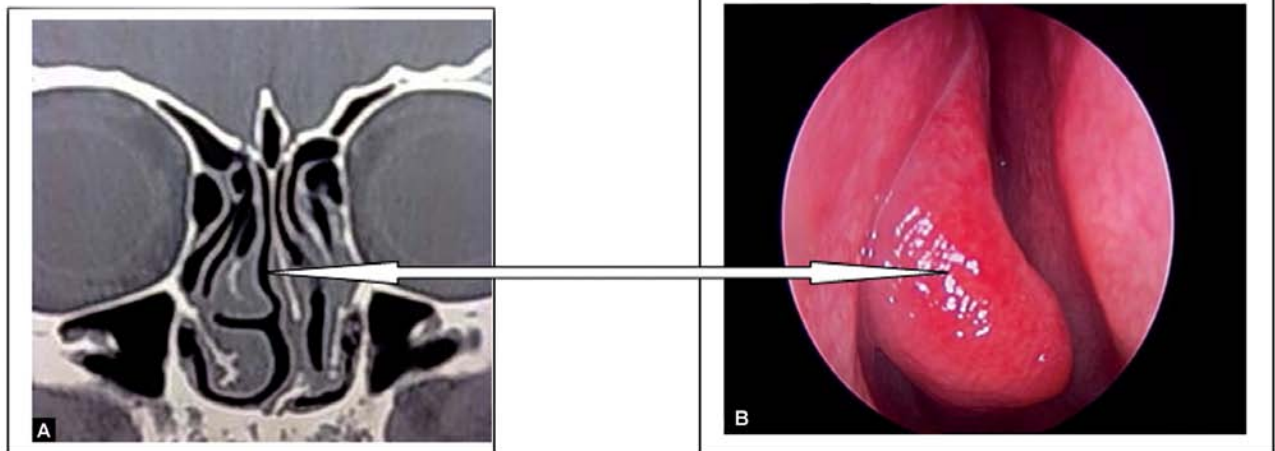
Unfortunately, the accuracy of reported rhinosinusitis cases is difficult to ascertain. The diagnosis on the basis of symptoms is common but can be very unreliable.

Endoscopic examination is a mandatory investigation in all patients of Rhinosinusitis and Sinonasal polyposis. It helps to know the site of origin of the polypi and the extent of disease.

CT scan of paranasal sinuses is indispensable in identifying disease that may not be appreciated during routine clinical and endoscopic examination. In addition, CT examination of the paranasal sinuses will provide an anatomic road map of paranasal sinuses and identify the presence of significant anatomic abnormalities, the location and severity of disease. Coronal scans are preferred because anatomy and pathology are examined in a plane most identical to that approached by the endoscopic surgeon.

The osteomeatal complex is a region of key importance for the development of sinusitis.¹⁶ This is an area through which the maxillary, anterior ethmoid and frontal sinuses drain into the nasal cavity. Anatomic variations of the ethmoid which are extremely common sometimes block drainage from these three sinuses and lead to stagnation of secretions, creating a culture medium for infection to develop.

Successful management of rhinosinusitis by medical or surgical treatment is achieved in the majority of patients. Surgery is usually required in those patients having some anatomical abnormality obstructing the sinus drainage or



Figures 4A and B: CT and endoscopic picture of paradoxically bend middle turbinate

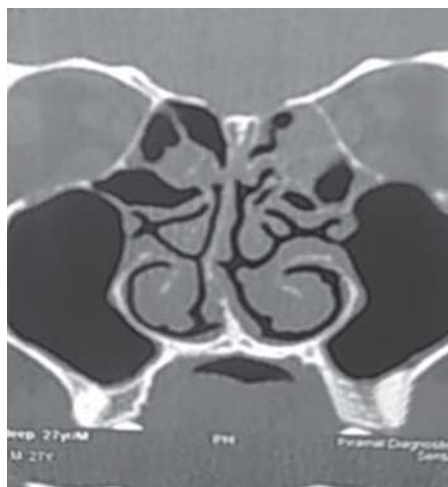
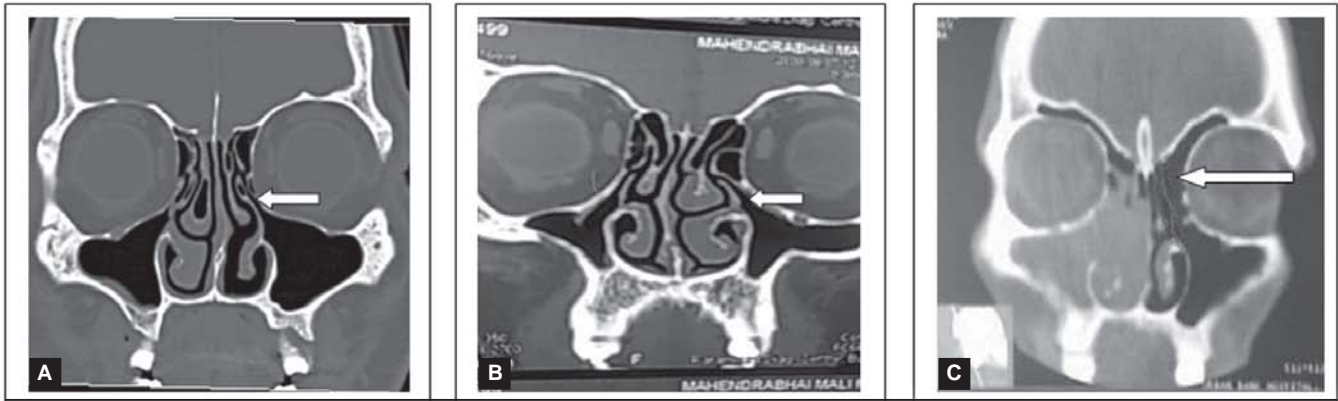


Figure 5: Duplication of middle turbinate



Figure 6: Agger nasi cell



Figures 7A to C: Variations in uncinate process (A) Pneumatize uncinate process, (B) Free lying uncinate process, (C) Uncinate attached to cribriform

those not responding to medical management. In some cases symptoms resolve spontaneously. Treatment of chronic rhinosinusitis is intended to reduce symptoms and signs, improve quality of life and prevent disease progression or recurrence.

CONCLUSION

Anatomical variations of the ethmoid sinuses are important etiological factors leading to the genesis of nasal pathology. Concha bullosa, variation in uncinate process and paradoxical middle turbinate which contribute to the narrowing of the osteomeatal complex are associated with mucosal disease.

REFERENCES

1. Draf W (Ed). Endoscopy of the Paranasal Sinuses. New York: Springer-Verlag 1983.
2. Schlosser RJ, London SD, Gwaltney JM, Gross CW. Microbiology of chronic sinusitis. *Laryngoscope* 2001; 111:1330-32.
3. Stammberger H. Functional endoscopic sinus surgery. The Messerklinger technique. Toronto, Philadelphia: BC Decker; 1991.
4. Lusk RE, Alister BM, Fouley A. Anatomic Variations in Pediatric Chronic Sinusitis. *Otolaryngol. Clin. North Am* 1996; 29:75-91.
5. Willner A, Choi SS, Vezina G, Lazar RH. Intranasal Anatomic Variations in Pediatric Sinusitis. *Am. J Rhinol* 1997;11: 355-60.
6. Metson R, Gliklich RE, Stankiewicz JA, Kennedy DW, Duncavage JA, Hoffman SR, Ohnishi T, Tenn White PS. Comparison of sinus computed tomography staging system-*Otolaryngol Head-Neck Surg* 117:372-79.
7. Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. *Laryngoscope* 1991;101(1 Pt 1): 56-64.
8. Zinreich SJ, Kennedy DW, Rosenbaum AE, et al. Paranasal sinuses: CT imaging requirements for endoscopic surgery. *Radiology* 1987;163:769-75.
9. Zinreich SJ, Mattox DE, Kennedy DW, et al. Concha bullosa: CT evaluation. *J Comput Assist Tomogr* 1988;12:778-84.
10. Lloyd GAS. CT of the paranasal sinuses: Study of a control series in relation to endoscopic sinus surgery. *J Laryngol Otol* 1990;104:477-81.
11. Lloyd GA. Diagnostic imaging of the nose and paranasal sinuses. *J Laryngol Otol* 1989;103:453-60.
12. Tonai A, Bala S. Anatomic variations of the bone in sinonasal CT. *Acta Otolaryngol. (Stockh) Supplement* 1996;525:9-13.
13. Maru YK, Gupta V. Anatomic variations of the bone in sinonasal CT. *Indian Journal of Otolaryngol and Head-Neck Surgery* 2001; 53:123-28.
14. Asruddin, Yadav SPS, Yadav RK, Singh J. Low dose CT in chronic sinusitis. *Indian Journal of Otolaryngology and Head Neck Surgery* 2000;52:17-21.
15. Lloyd GAS, Lund VJ, Scadding GK. Computerised tomography in the preoperative evaluation of functional endoscopic sinus surgery. *Journal of Laryngology and Otology*.
16. Yousem DM, Kennedy DW, Rosenberg S. Ostiomeatal Complex Risk Factors for Sinusitis: CT Evaluation. *J Otolaryngol* 1991;20: 419-24.