

# Anatomical Variations of Paranasal Sinuses on Multidetector Computed Tomography

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## Abstract

**Background:** Multi-detector computed tomography (MDCT) imaging of paranasal sinuses prior to functional endoscopic sinus surgery (FESS) has become mandatory.

**Material and methods:** Comparative study of 20 patients underwent FESS to detect anatomical variations by MDCT and endo-nasal rhinoscopy examination, pre and postoperative.

**Results:** The study was done on 20 patients, 14 females and 6 males, their age ranged from 6 years to 45 years with a mean of age (23.45). The most common anatomic variation found is the deviated septum in (45%) of the patients. The second anatomic variation is Onodi cell which appears in (35%) of patients, while the least found were congenital bony and mucosal atresia, Agger nasi cell and obstruction of maxillary ostium by bony septum which appear only in (5%).

**Conclusion:** Multiplanar imaging, particularly coronal reformations, offers precise information regarding the anatomy of the sinuses and its variations, which is an essential requisite before surgery.

**Keywords:** Anatomical variations; MDCT; FESS

## Introduction

Multi detector computed tomography (MDCT) scan of paranasal sinuses has become mandatory for all patients undergoing functional endoscopic sinus surgery. It depicts the anatomical variations in much simpler way and acts as a roadmap for endoscopic sinus surgery [1]. Some anatomical variations may predispose to nasal and paranasal diseases, constituting areas of high risk for injuries and complications during surgical procedures. Therefore, the recognition of such variations is critical in the preoperative evaluation for endoscopic surgery [1].

### The osteomeatal complex

The OMU is the key factor in the pathogenesis of chronic sinusitis. The ethmoid sinus is the key sinus in the drainage of the

anterior sinuses. It is vulnerable to trauma during surgery due to its close relationship with the orbit and the anterior skull base [2]. The ethmoid roof is of critical importance for two reasons. First, it is most vulnerable to iatrogenic cerebrospinal fluid leaks. Second, the anterior ethmoid artery is vulnerable to injury, which can cause devastating bleeding into the orbit. During FESS, intracranial injury can occur on the side where the position of the roof is relatively low [3].

### Onodi cells

These are posterior ethmoidal cells extending into the sphenoid bone, either adjacent to or impinging upon the optic nerve. When these Onodi cells abut or surround the optic nerve, the nerve is at

risk when surgical excision of these cells is performed. It is also a potential cause of incomplete sphenoidectomy [4].

The Middle Turbinate Variations:

- 1) Paradoxical curvature: When the convexity is directed laterally, it is termed a paradoxical middle turbinate. Most authors agree that the paradoxical middle turbinate can be a contributing factor to sinusitis.
- 2) Concha bullosa: This is an aerated turbinate, most often the middle turbinate. When pneumatization involves the bulbous portion of the middle turbinate, it is termed concha bullosa. If only the attachment portion of the middle turbinate is pneumatized, it is termed lamellar concha. A concha bullosa may obstruct the ethmoid infundibulum [5].

## Haller cells

These cells contribute to the narrowing of the infundibulum and may compromise the ostium of the maxillary sinus, thus contributing to recurrent maxillary sinusitis [6,7]. The revolutionary changes in the surgical treatment of sinusitis in recent years, particularly in endonasal endoscopic surgery, require the clinician to have a precise knowledge of nasal sinus anatomy and of the large number of anatomical variants in the region many of which are detectable only by the use of CT [5].

## Material and Methods

Twenty patients, with the clinical diagnosis of rhinosinusitis from February to August 2019 and who had been considered for FESS underwent modified CT Scanning before and after the surgery. All CT scans were performed on MDCT scanners.

## Results

**Table 1:** Shows CT incidence of anatomic variations of nasal and Para nasal sinuses in 20 patients.

Anatomic Variation	No. of Patients	Percentage
Deviated septum	9	45%
Post aerated septum	4	20%
Concha bullosa	Unilateral: 4	Unilateral: 20%
	Bilateral: 5	Bilateral: 25%
Hypoplastic frontal sinus	6	30%
Hyperpneumatized frontal sinus	5	25%
Septated frontal sinus	5	25%
Onodi cell	7	35%
Haller cell	3	15%
Congenital bony+mucosal choanal atresia	1	5%
Compromised osteomeatal complex	6	30%
Septal spur	3	15%
Agger nasi cell	1	5%
Septated maxillary sinus	2	10%
Obstruction of maxillary antrum by bony septum	1	5%

**Table 2:** Shows Incidence of anatomic variations of nose and Para nasal sinuses by Endoscopic examination (intra operative).

Anatomical Variation	No. of Patients	Percentage
Deviated septum	9	45%
Septal spur	3	15%
Posterior aerated septum	0	0%
Concha bullosa	Unilateral: 4	Unilateral: 20%
	Bilateral: 5	Bilateral: 25%
Hypoplastic frontal sinus	0	0%
Hyperpneumatized frontal sinus	0	0%
Septated frontal sinus	0	0%
Agger nasi cell	1	5%
Onodi cell	7	35%
Haller cell	3	15%
Congenital bony+mucosal choanal atresia	1	5%
Compromised osteomeatal complex	6	30%

Septated maxillary sinus	2	10%
Obstruction of maxillary antrum by bony septum	1	5%

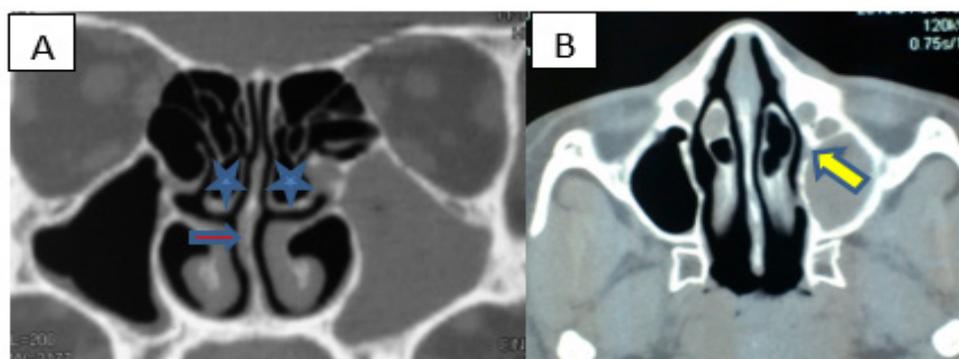
The study was conducted on 20 patients, 14 females and 6 males, their age ranged from 6 years to 45 years with a mean of age (23.45) (Table 1).

Regarding the incidence of anatomic variations by CT examination, it was found that the most common anatomic variation is the deviated septum which appears in 9 patients with percentage 45%. The second anatomic variation is Onodi cell which appears in 7 patients with percentage 35%, other variations as concha bullosa appear unilateral in 4 patients (20%) and bilateral in 5 patients (25%), posterior aerated septum in 4 patients (20%), hypo plastic frontal sinus in 6 patients (30%), hyper-Pneumatized frontal sinus in 5 patients (25%), septated frontal sinus in 5 patients (25%), Haller cell in 3 patients (15%), compromised osteomeatal complex in 6 patients (30%), septal spur in 3 patients (15%), septated maxillary sinus in 2 patients (10%), the least incidence of anatomical variations were congenital bony and mucosal atresia, agger nasi cell and obstruction of maxillary ostium by bony septum which appear only in one patient with percentage (5%) (Table 2).

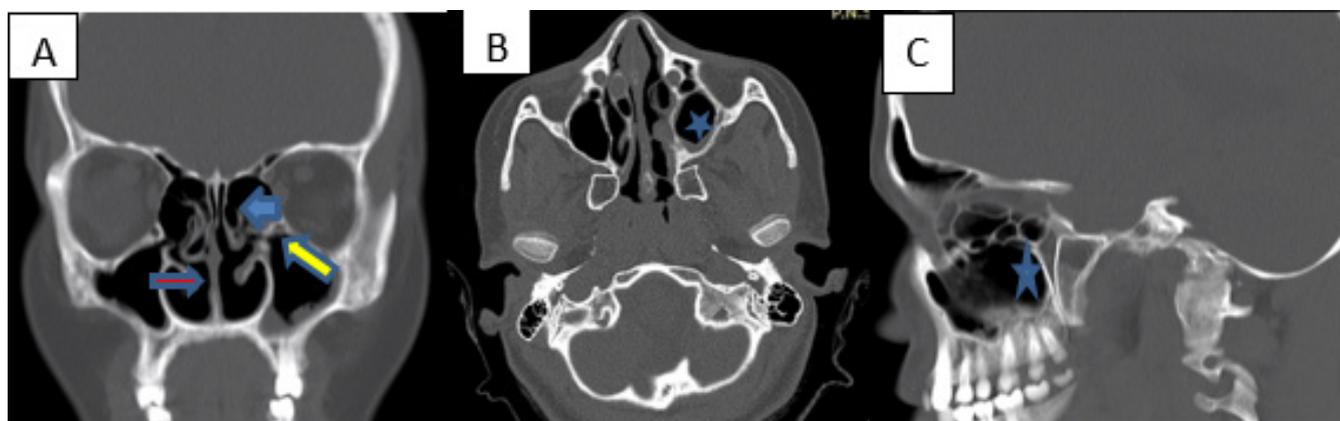
Regarding the incidence of anatomic variations by endoscopic examination (intra operative), it was found that the most common anatomic variation is the deviated septum which appeared in 9 patients with percentage 45%. The second anatomic variation is the Onodi cell which appears in 7 patients with percentage 35%, followed by concha bullosa which was detected (intraoperative) unilateral in 4 patients (20%) and bilateral in 5 patients (25%), Haller's cell in 3 patients (15%), compromised osteomeatal complex in 6 patients (30%), septal spur in 3 patients (15%) and septated maxillary sinus in 2 patients (10%). The least incidence of anatomical variations was congenital bony and mucosal atresia, agger nasi cell and obstruction of maxillary ostium by bony septum which appear only in one patient with percentage (5%). Other variations as posterior aerated septum, hypo-plastic frontal sinus, hyper-pneumatized frontal sinus and septated frontal sinus, couldn't be detected intraoperative by the endoscope.

Case 1: Figure (1,2).

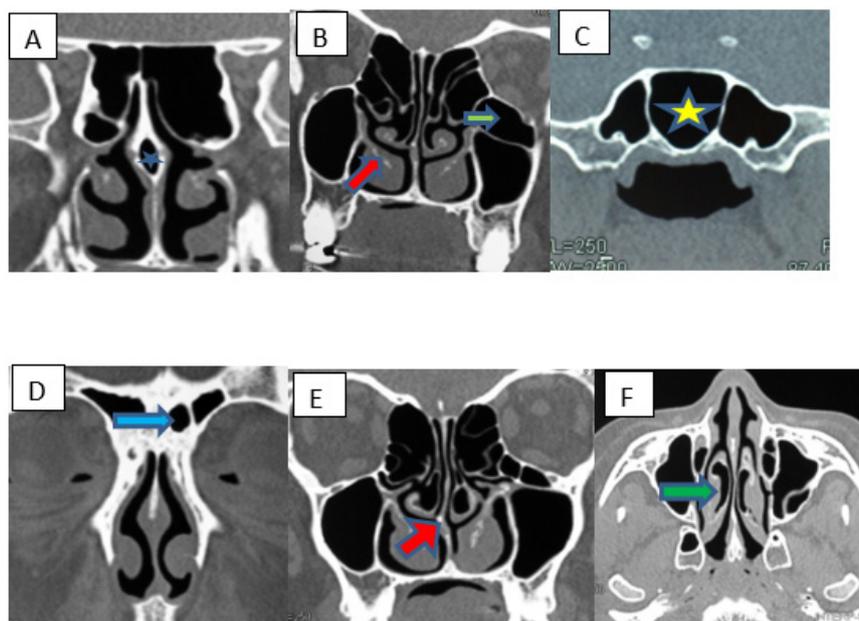
Case 2: Figure (3).



**Figure 1:** showing (A) pre-operative coronal cut showing bilateral aerated middle turbinates (blue stars), deviated septum to the right (red arrow). (B) Pre-operative obstructed maxillary sinus by bony septum (yellow arrow) and opacified left maxillary sinus.



**Figure 2:** Showing (A) post-operative coronal cut showing opened left maxillary ostium (yellow arrow), centralized septum (red arrow) and left resolved surgical concha (blue arrow). (B) Post-operative axial cut and (C) post-operative sagittal cut showing significant resolution in the left maxillary (blue star).



**Figure 3:** Showing pre-operative cuts (A) coronal cut shows aerated posterior septum (blue star) (B) Coronal cut shows left Haller cell (green arrow) and hypertrophied inferior turbinate (red arrow) (C) Coronal cut shows onodi cell (yellow star) (D) Coronal cut shows septated frontal sinus (blue arrow) (E) Coronal cut shows deviated septum to the right with septal spur (red arrow) (F) Axial cut shows bilateral aerated middle turbinate (green arrow).

## Conclusion

MDCT of the paranasal sinuses has improved the visualization of paranasal sinus anatomy and has allowed greater accuracy in evaluating paranasal sinus disease.

## Acknowledgement

None.

## Conflict of Interest

No conflict of interest.

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