Original Research Paper

Volume-8 | Issue-9 | September-2018 | PRINT ISSN No 2249-555X

Otorhinolayrngology

STUDY OF VARIOUS OSTIOMEATAL COMPLEX ABNORMALITIES BY ENDOSCOPY AND CT SCAN AND ITS MANAGEMENT IN RURAL MEDICAL COLLEGE MY EXPERIENCE

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ABSTRACT This study was conducted in the department of ENT, GREAT ESTREN MEDICAL SCHOOL AND HOSPITAL ,SRIKAKULAM. The study was conducted from July 2017 to DEC 2017. The objective of the study was to study the various sinonasal anatomical variations in patients with chronic sinusitis and to determine their frequency of occurrence. The study included 50 patients undergoing endoscopic sinus surgery. The various sinonasal anatomical variations were noted during diagnostic nasal endoscopy, CT scanning of paranasal sinuses and during surgery.

The various anatomical variations encountered with their clinical significance is described. The prevalence of the various anatomical variations as detemined by our study correlated well with that of other authors studying similar patient groups.

KEYWORDS : deviated nasal septum, hypertrophied inferior turbinate, sphenoid, hazyness, spheniod sinusitis, concha bullosa, uncinate process, sphenoid ostium, paradoxical middle turbinate, pneumatised middle turbinate, bulla ethmoidalis middle meatal antrostomy

INTRODUCTION

"If the ethmoids were placed in any other part of the body, it would be an insignificant and harmless collection of bone cells. In the place where nature has put it, it has major relationships so that diseases and surgery of the labyrinth often leads to tragedy. Any surgery in this region should be simple but it has proven one of the easiest ways to kill the patient" -Mosher in 1929.

The two cardinal factors in the maintenance of normal physiology of the paranasal sinuses and their mucous membranes are drainage and ventilation. Normal drainage of the paranasal sinuses depends on effective mucociliary clearance; this is dependant, among other things, on the condition of the sinus ostia.1 Mucus transport from the sinuses into the nose is greatly enhanced by unimpeded nasal airflow creating negative pressure within the nasal cavity during inspiration.1 The secretions of the various sinuses do not reach their respective ostia randomly but by definite pathways which seem genetically determined.2 The two of the largest sinuses, the frontal and maxillary, communicate with the middle meatus via narrow and delicate prechambers. In each of these prechambers, the mucosal surfaces are closely apposed such that mucus can be more readily cleared by an effective ciliary action on two or more sides. However, when surfaces become more closely apposed due to mucosal swelling, the ciliary action is immobilized. This impairs the ventilation and drainage of larger sinuses, result in mucus stasis, predispose to further infection and establish a vicious cycle causing chronic sinusitis.2 The key region for these changes is that part of the lateral nasal wall that encloses the sinus ostia and their adjacent mucosa and prechambers. There is considerable anatomical variation in this area that may interfere with normal nasal function and predispose to recurrent or chronic sinusitis.3

Functional endoscopic sinus surgery restores normalcy by working on the key regions rather than on the larger sinuses(4,5). The safe and effective performance of any surgery is dependent on a sound knowledge of anatomy(6). This is most true during endoscopic sinus surgery because of the intimate association with such vital structures as the orbit, optic nerve, anterior and posterior ethmoidal vessels, skull base and internal carotid artery(7-10).The difficulty is compounded by the occurrence of variations in sinonasal anatomy(11). The incidence with which these variations are seen in a normal population is less frequent than in those individuals with chronic sinusitis(12). The incidence of the sinonasal anatomical variation reported in literature shows considerable variation between populations(13-15). This study aims to study the various sinonasal anatomical variations in our population.

AIMS AND OBJECTIVES:

1. To study the various anatomical variations those are present in patients undergoing endoscopic sinus surgery.
2. To determine the frequency of occurrence of these variations.
3. To compare the radiological appearance (CT scan) and endoscopic findings in patients with various anatomical variations.

The various anatomical variations can be summarized as follows:
Ethmoid roof and depth of cribriform plate: Keros types I to III, Septal variations: Deviations, spurs, thick septum and pneumatization.

Turbinates:Middle: Paradoxical, pneumatized, hyperplastic, lateralized. Superior: Pneumatized. Inferior: Hypertrophied and pneumatized. Supreme: Presence or absence. Uncinate: Medialized, lateralized, anteriorly curved, hyperplastic and pneumatized.

Infundibulum: Shallow or deep, Narrow or wide Ethmoidal bulla: Absent, hypoplastic, typical and enlarged, Extramural ethmoidal cells: Agger nasi cells (lacrimal bone), Supraorbital cells, Middle turbinal cells (concha bullosa), Uncinate process cells, Superior turbinal cells, Haller cell (orbital plate of maxilla). Sphenoid sinus: Septations, Patterns of pneumatization: Conchal, presellar and sellar. Lateral

extensions: Lesser wing, greater wing and pterygoid. Midline

extensions: Rostral, septal, inferior clival and superior clival, Dehiscences of optic nerve and internal carotid artery. Frontal sinus: Aplastic, hypoplastic and hyperplastic, Presence of more than two chambers, Extensions into Orbital plate, Crista galli, Anterior ethmoid, Maxillary sinus, Sinus septa, Accessory ostia, Extensions, Infraorbital recess, Alveolar recess, Zygomatic recess.

7 COMPUTED TOMOGRAPHY PARANASAL SINUSES VARIATIONS

The patients had CT Scan PNS , 5 mm coronal and axial sections done. They were analysed for anatomical variations which were as follows : The men outnumbered the women in the ratio of 1.27: 1 (28 men, 22 women). (Table 1). CT Scan detection of anatomic variations : Deviated nasal septum was the most common variation in 22 (44%) followed by agger nasi in 20 (40%) patients. Other variations found were concha bullosa, paradoxical middle turbinate, over pneumatized ethmoidal bulla or giant bulla, haller cells, onodi cells, lamina papyracea pushed laterally, maxillary sinus septae and pneumatization of vomerine bone in 1 (2%) patient

Table CT Scan detection of anatomic variations

Anatomic variation	u/l	b/l	total
Concha bullosa	5	3	8
Paradoxical middle turbinate	3	2	5
Curved uncinate process	2	1	3
Overpneumatised ethmoidal bulla	4	3	7
Haller cells	4	4	8
Agger nasi cells	-	20	20
Onodi cells	2	1	3
Lamina papyracea pushed laterally	-	2	2
Maxillary sinus Sepatae	1	2	3
Pneumatization of Vomer	-	-	1
SeptalDeviation/spur	-	-	22

Surgical Management

FESS (Functional Endoscopic Sinus Surgery)

Endoscopic sinus surgery & technique: Two approaches to endoscopic sinuses

1. Messerklinger approach:anterior to posterior dissection
2. Wigand approach: posterior to anterior dissection.

In our hospital, we follow Messerklinger anterior to posterior dissection.

MATERIAL AND METHODS

This present study was prospective study of sinus diseases using diagnostic endoscopy and computed tomography was conducted in the department of ENT, GREAT ESTREN MEDICAL SCHOOL AND HOSPITAL. from JULY 2017toDEC 2017.

SOURCE OF DATA:

All the patients attending the E.N.T. outpatient department, who had chronic sinusitis for more three months duration not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery.

Sample Size: 50

INCLUSION CRETERIA:

All the patients with clinically proven chronic sinusitis not responding to routine medical line of treatment.

EXCLUSION CRITERIA: Patients with acute attack of sinusitis, Patient with sinus malignancies, Patient who were not willing to undergo FESS.

Methods of Collection of Data:

1) The cases selected for the study were subjected to detailed history taking and examination.
2) A routine haemogram (HB, BT, CT, TC, DC) and urine examination (albumin, sugar, microscopy), swab from middle meatus for culture sensitivity along with X-ray para nasal sinuses were done for the patients.
3) All the patients in active stage of the disease were treated with course of suitable antibiotic, systemic antihistamines and local decongestants. They were also treated for medical conditions like diabetes mellitus, hypertension, nasal allergy. No patient received steroid therapy or immunotherapy.
4) Each patient underwent a systematic diagnostic nasal endoscopy and computed tomography of nose and para nasal sinusus.

OBSERVATION AND RESULTS

Age distribution:

The age of the patients varied from 11 years to 60 years. The majority of the patients i.e. 16 (22.5%) were in the third decade of life.

Table 1. Age distribution

Age group	No. cases
11-20	8
21-30	12
31-40	16
41-50	9
51-60	5

The age of the patient in our study CT findings Varied from 21yrs to 60yrs. Maximum number of patients were in 31 to 40 years of age group, therefore 54% of patients were in early 3rd decade of age.

Table 2: Age percentage

Age	No.of patients	%
21-30	13	26
31-40	27	54
41-50	8	16
51-60	2	4
Total	50	100

Sex distribution:

The sex distribution showed a slight male preponderance with 28 (56%) males and 22 (44%) females by endoscopic study. Thus male to female ratio 1.27:1. My CT scan study showed male preponderance i.e 32(64%) male and 36%18(36%) female patients. Thus male to female ratio was 1.8:1.

Variations:

Skull base types: The following was the incidence of various skull base types-Keros Type I: 6 (12%), Keros Type II: 32 (64%), Keros Type III: 12 (24%) Keros type Number Percentage

Septum:

Septal deviations were seen in 27 (54%). Of these 10 (37.03%) were to right and 17 (62.9%) were to the left. Septal spurs were seen in 16 (32%). Of these 7 were to right and 9 were to the left. Thick septum was found in 5 (10%). Pneumatization of the septum was found in 2(4%).

Agger nasi: Pneumatization of agger nasi was seen in 58 (72.5%) nasal cavities. When present, the agger cells were always bilateral.

Frontal sinus: The frontal sinus was present in 95 (93.5%) sides, absent in 5 (6.25%) sides, and Hyperpneumatized in 14 (27.5%). The sinus was larger on the right in 24 subjects and on the left in 26 subjects. Interfrontal cells were seen in 8 (16%).

Frontal recess: The frontal recess was found to be obstructed in 14 of 75 (18%). Of these 8 (57%) were on the right and 6 (43%) were on the left. The obstruction was caused by agger nasi cells in 6 (43%), ethmoidal bulla or accessory cells in 4 (28.5%) and polyps in 4 (28.5%).

Middle turbinate:

The middle turbinate was typical in 25 (50%). Of these 14 (28%) were on the right and 11 (22%) were on the left. It was paradoxically curved in 6 (12%). Of these 4 (8%) were on the right and 2(4%) were on the left. Hyperplastic non-pneumatized middle turbinate was seen in 2 (4%). Of these 0(0%) were on the right and 2 (4%) was on the left. Pneumatized middle turbinate was seen in 17 (34%). Of these 7 (14%) were on the right and 10 (20%) were on the left. Pneumatized turbinates, 22 (44%) showed lamellar pattern, 2 (4 %) showed bulbous pattern and 26 (52%) were true concha bullosae.

Uncinate process: The uncinate was typical in 29 (58%), medialized in 22 (44%), anteriorly turned in 1 (2%), hypertrophied in 6 (12%) and pneumatized in 2 (4%). The superior attachment of the uncinate process was as follows: middle turbinate in 21 (42%), lamina papyracea in 18 (36%) and skull base in 11 (22 %).

Ethmoidal bulla: The bulla was typical in31 (62 %), large in 11 (22%) and hypoplastic in 8 (16 %).

Supra-orbital cells: Supra-orbital ethmoid pneumatization was seen in 18 (36%). Of these 10 (20%) were on the right and 8 (16%) were on the left. In 8 (16%) patients, it was bilateral.

Accessory ostia: Accessory maxillary sinus ostia were seen in 12 (24%). Of these, 8 (16%) nasal cavities showed accessory ostia in anterior fontanelle and 4 (8%) in the posterior fontanelle. In 2 (4%) of patients, there were multiple accessory ostia.

Maxillary sinus septations: Septations were found in 4 (5%) maxillary sinuses. Of these 1 (25%) was on the right and 3 (75%) were on the left. In 1 (2.5%), it was bilateral.

Haller cell: Haller cell was seen in 3 (6%).

Pneumatized superior turbinate: Superior turbinate pneumatization was seen in 5 (6.25%). Of these 3 (60%) were on the right and 2 (40%) were on the left. In 1 (2.5%) patient, it was bilateral.

Supreme turbinate: The presence of supreme turbinate could not be discerned in any of the subject examined.

Sphenoid sinus: The ostium was circular in 15 (30 %), oval in 23 (46%) and slit in 12 (24 %). The various patterns of pneumatization seen were: absent in 1 (2 %), conchal in 1(2 %), presellar in 12 (24%) and sellar in 36 (72 %). The various intrasphenoidal projections seen were: Optic nerve in 19 (38%), Maxillary nerve in 14 (28 %), Vidian nerve in 17(34%).

Onodi cell: Onodi cells were seen in 18 (36%). Of these 10 (20%) were on the right and 8 (16%) were on the left. In 7 (14%) of patients, it was bilateral.

Large inferior turbinate:A large inferior turbinate was found in 29 (58%). Of these 14 (28 %) were on the right and 15 (30%) were on the left. In 8 (16%) of patients, it was bilateral. In 22 (44%), the large inferior turbinate was associated with pathology in ipsilateral

maxillary sinus and in 7 (14 %) there was no ipsilateral maxillary sinus pathology.

CORRELATION OF DIAGNOSTIC ENDOSCOPY FINDINGS WITH COMPUTED TOMOGRAPHY FINDINGS:

The parameters correlated in our study include middle turbinate, middle meatus, bulla ethmoidalis, hiatus semilunaris, forntal recess and shenoethmoid recess. The false positive, false negative, sensitivity and specificity were calculated for diagnostic endoscopy as compared to CT findings. Diagnostic endoscopy was found to have sensitivities for frontal recess, hiatus semilunaris and shenoethmoidal recess as 90%, 94% and 100% respectively. While sensitivity for middle turbinate, bulla ethmoidalis and middle meatus was 74%, 62% and 85% respectively. The sensitivity of diagnoistic endoscopy for frontal recess, middle turbinate and bulla ethmoidalis was found as 91%, 84% and 76% respectively and for shenoethmoidal recess, hiatus semilunaris and middle turbinate as 80%, 53% and 67% respectively. So diagnostic endoscopy was found to be more sensitive for frontal recess, shenoethmoidal recess and hiatus semilunaris and more specific for middle turbinate, bulla ethmoidalis.

DISCUSSION

The present study was conducted from July 2017 to dec 2017 in the department of ENT, GREAT ESRTEN MEDICAL SCHOOL AND HOSPITAL ,SRIKAKULAM. The study included 50 patients of endoscopic and CT examination who were undergoing endoscopic sinus surgery. CT scan was used in addition to endoscopic assessment to increase the accuracy of recording of the findings. The various anatomical variations of each patient were noted and their frequency of occurrence determined.

The discussion is presented along the following headings:

Age and sex distribution,Septal variations, Agger nasi cells, Frontal sinus, Frontal recess, Middle turbinate, Bulla ethmoidalis, Uncinate process, Maxillary intrasinus septa, Accessory ostia, Inferior turbinate hypertrophy, Pneumatized superior turbinate, Supreme turbinate, Onodi cell, Haller cell, Supraorbital ethmoidal cells, Intrasphenoidal projections, Sphenoid sinus pneumatization, Skull base configuration, Rathke's pouch remnant.

AGE AND SEX DISTRIBUTION:

The age of the patients varied from 11 years to 60 years. The sex distribution showed a slight male preponderance with 56% males and 44% females.

Septal variations:

We found septal deviations in 54% of cases. In our study, there was slight preponderance of deviation to the left (61.6%) compared to deviation to the right (38.4%). The reported incidence of septal deviations in literature ranges from 40% (Calhoun et al29) to 96.9% (Takanishi et al35). The prevalence of septal spurs in our study was 32%. Among these, over half (57.8%) had contact area with the turbinates. The prevalence of deviations of nasal septum as reported by various workers is 21% (Zinreich31), 24% (Jones NS21), 38% (Yadav SPS26), 40% (Bolger34) and 72% (Jareoncharsri P18). Our results are comparable to the higher ranges reported. The prevalence of septal ridges or spurs is reported as 33% (Danese M et al17) and 25.3% (Jareoncharsri P et al18). The results in our study are slightly higher than this. Prevalence of septal deviations. The mere presence of a septal deviation does not suggest pathology. However, a marked deviation can force the middle turbinate laterally, thus narrowing the entrance to the middle meatus. Also, ridges and spurs coming into contact with turbinates or other areas of the lateral wall can predispose to recurrent sinusitis. We found septal pneumatization in 4%.

Agger nasi cells:

We found pneumatization of the agger nasi cells in 72.5%. In all patients, the pneumatization when present was bilateral. The prevalence of agger nasi cells varies widely as reported by various workers: 10-15% (Messerklinger36); 14% (Lloyd et al37); 65% (Davis38); 89% (Van Alyea25) and 100% (Kennedy and Zinreich39). Depending on the degree of pneumatization, agger nasi cells may reach laterally to the lacrimal fossa and superiorly to cause narrowing of frontal recess.

On coronal CT, these cells appear inferior to frontal recess and lateral to the middle turbinate. Because of this intimate relationship these cells form excellent surgical landmarks. Opening the agger nasi cells usually provides a good view of the frontal recess. Therefore, identification of this variation is important in diagnosis and treatment of recurrent or chronic frontal sinusitis.

Prevalence of agger nasi cells

Author	Prevalence%
Messerklinger	10 to 15%
Lloyd	14%
Davis	65%
Van Alyea	89%
Kennedy and Zinreich	100%
Our study	72.5%

Frontal sinus:

We found the prevalence of nonpneumatization of frontal sinus in 6.25%. This correlates with the study by Natsis K40 who reported a prevalence of 5%.

In all our patients, frontal sinuses on either side were always asymmetrical with right being large in 47.5% and the left sinus being large in 52.5%.

Frontal recess:

In our study, we found that the frontal recess was obstructed in 18%. Of these, in 43% the obstruction was by agger nasi cells, in 28.5% by ethmoid bulla or accessory cells and in 28.5% by polyps. As the natural ostium of the frontal sinus is very wide with average anteroposterior diameter of 7.22 mm and transverse diameter of 8.92 mm, the obstruction to the frontal sinus drainage and ventilation most often lies in the frontal recess rather than the ostium as is evident from our results. Therefore merely clearing the recess is sufficient to achieve patency of frontal sinus ostium in most cases.20,21

Pneumatized middle turbinate: We found pneumatized middle turbinate in 50%. Of these, 44% showed lamellar pattern, 4 % showed bulbous pattern and 52% showed true concha bullosae. The origin of the pneumatization can sometimes be seen as depressions on the lateral surface. Literature reports a wide variation in the incidence of middle turbinate pneumatization and is a follows: Joe JK23 et al -15%; Liu X22 et al – 34.85%, Basic N30 et al -42%, Lothrop61 -9%, Davis58 - 8%, Shaeffer62 -11%. Our results are close to that reported by Lie X et al22. Presence of a concha bullosa does not suggest a pathological finding. However, in the setting of chronic sinus disease, resection of the concha bullosa should be considered to improve paranasal sinus access. Further, the concha bullosa interior may be affected by disease in other sinuses.

Paradoxically bent middle turbinate:

A middle turbinate which is distorted such that the convex surface faces towards the meatus is in itself not pathologic but can contribute to severe narrowing of the middle meatus if other mucosal derangements are present. We found paradoxical curvature of middle turbinate in 12%. This correlates well with that reported by Calhoun29 (7.9%) and LiuX22 (8.5%).

Bulla ethmoidalis:

We defined a hypoplastic bulla as one in which the distance between the lateral surface of middle turbinate and summit of bulla was more than 4 to 5 millimeters. An enlarged bulla ethmoidalis was defined as one that contacts or extends beyond the free margin of the uncinate and middle turbinate. This can result in a narrow hiatus semilunaris. We found large ethmoidal bulla in 22%. This correlates with the reported frequency by Lloyd37 (17%)

Uncinate process:

The superior attachment:

During surgery, this attachment needs to be cleared before gaining access to frontal recess. In our study, we found that the superior attachment was to middle turbinate in 42%, lamina papyracea in 36% and skull base in 22%.

Deviated uncinate process:

In our study, we found medially turned uncinate process in 44% and anteriorly turned uncinate process in 2 %. This correlates well with 45.27% deviations reported by Liu X et al 22and 31% deflection reported by Danese17. An anteriorly bent uncinate process gives the impression of double middle turbinate on endoscopy.

Pneumatized uncinate process:

We found this variation in 4%. This correlates with the prevalence

reported by Kennedy(39)(0 to 4%) and Bolger et al (34)(2.5%). The pneumatized uncinate is called uncinate bulla and can narrow the infundibulum, frontal recess and middle meatus.

Maxillary intrasinus septa:
An intrasinus maxillary septum can convert the maxillary sinus into two chambers.

According to Arslan, 16 this was present is 1% to 6% of the population. n our study, accessory ostia were present in 15% of nasal cavities.

Accessory ostia:
Table 17. Differences between natural and accessory ostia

Natural	Accessory
Always present	Present in 10% to 40%
Difficult to see clinically	Easily seen on endoscopy
Lies deep in infundibulum	Lies in the sagittal plane in fontanelle
Oval shaped	Round or punched out appearance
Always single	Could be multiple
Small in diameter	Could be large (upto 1 cm)

Inferior turbinate hypertrophy:
We found inferior turbinate enlargement in 36.2%. Of these, in 75.8%, the large inferior turbinate was associated with ipsilateral maxillary sinus pathology. While the incidence of inferior turbinate enlargement in patients with nasal obstruction and with septal deviations is reported widely in literature, we did not find any studies reporting its prevalence in patients with chronic sinusitis. However, Stammberger2 stated that in a vast majority of their cases of inferior turbinate enlargement, there was inflammatory disease in other parts of the nose. In almost all their cases, inferior turbinate enlargement resolved after sinusitis was treated. Stackpole SA et al28 found significant increase in inflammatory cells in inferior turbinates in patients with chronic sinusitis. The high incidence of ipsilateral maxillary sinus pathology associated with inferior turbinate enlargement in our study could be related to the above phenomenon.

Pneumatized superior turbinate:
Pneumatization of superior turbinate can occur from posterior ethmoid cells. Of the 48% incidence reported by Ariyurek OM et al(32) in their study, 40% of cases showed pneumatization in the form a small air cell minimally expanding the superior concha-he called this as grade I pneumatization. In the remaining 8%, there was marked pneumatization which he called as grade II pneumatization. In our study, we found a prevalence of superior turbinate pneumatization of 6.25% which correlates to the prevalence of marked pneumatization reported by Ariyurek OM et al(32). Markedly pneumatized superior turbinates can narrow the nasal cavity predisposing the patient to chronic sinusitis. A pneumatized superior turbinate may also contain polyps, cysts, mucoceles and pyoceles.

Supreme turbinate:
We could not discern the presence of supreme turbinate in any of our cases. However, a study by Kim SS(33) which was based on cadaver dissections found evidence of basal lamella of supreme turbinate in 15%.

Onodi cell:
This is a posterolateral pneumatization of posterior ethmoidal cell coming into intimate relationship with optic nerve. On coronal CT, an Onodi cell is seen above the sphenoid sinus.

Table 18. Prevalence of Onodi cell

Author	Prevalence
Aibara	7%
Basic	10%
Earwaker	24%
Our study	22.5%

Haller cells:
These are anterior ethmoidal cells pneumatizing the floor of the orbit or the roof of the maxillary sinus. above the region of the maxillary sinus ostium and infundibulum, they can cause narrowing of maxillary sinus ostium or infundibulum, thus predisposing to recurrent maxillary sinusitis. In my study, Haller cells were present in 3.75%. The wide discrepancy noted in literature in the prevalence of these cells may be related to the differences in the interpretation of these cells:-Ethmoidal labyrinth cells which outwardly excavate the os planum and os maxillae.

Supraorbital ethmoidal cells:
The ethmoid air cells can extend supraorbitally and is said to be present in 15% to 21% according to Bhatt NJ.27 In our study, we found a prevalence of 22.5% which corresponds to that reported by Bhatt NJ.

Intrasphenoidal projections:
According to Lang,30 they are as follows: Optic nerve in 19%, maxillary nerve in 28.6%, vidian nerve in 14.3%. Our results are closer to that reported by Lang. The high incidence of these projections means that in addition to optic nerve and carotid artery, even maxillary nerve and vidian nerve are at risk during sphenoid surgery.

Sphenoid sinus pneumatization:
The pneumatization of the sphenoid sinus can vary from total nonpneumatization to hyperpneumatization including clinoid processes, sphenoid wings and pterygoid plates. In our study, we found absent pneumatization 2.5%, conchal type in 2.5%, presellar type in 22.5% and sellar in 72.5%. These findings compare well with that reported by Lang30 (conchal 0%, presellar 23.8%, sellar 76.2%) and by Congdon (conchal 5%, presellar 28%, sellar 67%).

Skull base configuration:
In our study, we found Keros type I (1 to 3 mm deep) olfactory fossa in 12 %, type II (4 to 7 mm) in 64% and type III (8 to 16 mm) in 24%. Though several authors draw attention to the importance of deep skull base conformation, we did not find any studies reporting the incidence of various types of conformations. Arslan et al16 reported that average depth was 8 mm on right side and 9.5 mm on the left side.

CONCLUSION
All the variations of sinonasal anatomy described in literature except the presence of supreme turbinate were encountered in our study. The medialised uncinate process was most common uncinate process variation and pneumatized middle turbinate was the most common middle turbinate variation. Extramural pneumatization like septal, supraorbital, sphenoid wing and pterygoid plates was quite common. Inferior turbinate enlargement in association with ipsilateral maxillary sinusitis was common. The depth of olfactory fossa was of Keros Type II in majority of patients. There was also a high prevalence of optic nerve, maxillary nerve and vidian nerve lying bare in the sphenoid sinus.

In view of the presence of these significant variations, we reemphasize the need for proper preoperative assessment in every patient in order to accomplish a safe and effective endoscopic sinus surgery.

ACKNOWLEDGEMENTS
It is my privilege and indebtedness to express my gratitude to my teachers **Dr.B.TATARAO,** M.S., professor and Head of the Department, Department of Otorhinolaryngology, great estren Medical school, srikakulam for their constant supervision, guidance and encouragement at every step in carrying out this study.Also I thank my colleagues for their help in completing the study.Finally I would like to thank the superintendent and staff in the Medical record department of great estren medical school and Hospital, srikakulam. for allowing me to avail the records and also my patients for their cooperation

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