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Original research article

Diagnostic Assessment of Osteomeatal Complex Abnormalities by CT Scan and Endoscopy and their Management

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Abstract

Background: There are considerable anatomical variations the nasal cavity that may interfere with normal nasal function and predispose to recurrent or chronic sinusitis. Functional endoscopic sinus surgery restores normalcy by working on the key regions rather than on the larger sinuses. The aim of the current study is to study the various anatomical variations which are present in patients undergoing endoscopic sinus surgery.

Methods: A prospective study of sinus diseases using diagnostic endoscopy and computed tomography was conducted in the Department of ENT, Govt. ENT Hospital, Koti, Hyderabad. All the patients attending the ENT outpatient department, who had chronic sinusitis, not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery. Sample Size: 50 Sampling: Prospective Study.

Results: Keros Type I: 6 (10%), Keros Type II: 32 (68%), Keros Type III: 12 (22%). Septal deviations were seen in 29 (58%). Of these n=10 (34.03%), were to right and n=19 (65.5%), were to the left. Septal spurs were seen in n=18(36%) cases. Of these n=8(16%), were to right and n=10(20%) cases were to the left. Pneumatization of the septum was found in n=3(6%). *Agger Nasi*: Pneumatization of agger nasi was seen in n=29(58%) cases.

Conclusion: Inferior turbinate enlargement in association with ipsilateral maxillary sinusitis was commonly noted. Most of the cases were Keros Type II category based on the Depth of Olfactory fossa. Therefore, through CT scan along with diagnostic nasal endoscopy must be done in whom anatomical variations are the cause of chronic sinus mucosal diseases.

Keywords: *Osteomeatal Complex, Variations, Chronic Sinusitis, Computed Tomography, Functional Endoscopic Sinus Surgery*

Introduction

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 opposed 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 two 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. The safe and effective performance of any surgery is dependent on a sound knowledge of anatomy. 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. The difficulty is compounded by the occurrence of variations in sino-nasal anatomy. The incidence with which these variations are seen in a normal population is less frequent than in those individuals with chronic sinusitis. The incidence of the sino-nasal anatomical variation reported in literature shows considerable variation between populations. This study aims to study the various sino-nasal anatomical variations in our population.

Materials and Methods:

This prospective study of sinus diseases using diagnostic endoscopy and computed tomography was conducted in the Department of ENT, Govt. ENT Hospital, Koti, Hyderabad. All the patients attending the E.N.T. outpatient department, who had chronic sinusitis, not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery. Sample Size: n=50. Ethical approval for the study was obtained from institutional Ethical committee. Written consent was obtained from all the participants of the study.

Inclusion Criteria

1. All patients who are clinically proven to have chronic rhinosinusitis with typical symptoms persisting for 12 weeks or more who have previously failed to medical management.
2. Age group – 20 to 60 yrs.

Exclusion Criteria:

1. Patients with acute attack of sinusitis.
2. Patients with coexisting sinus malignancies.
3. Patients not willing to undergo FESS.
4. Patients responding to medical management.
5. Patients who are previously operated.

Collection of Data: According to proforma detailed history was taken, thorough examination was done in all the patients to arrive at a provisional diagnosis. 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. Each patient underwent a systematic diagnostic nasal endoscopy and computed tomography of nose and para nasal sinuses. Patients not responding to medical treatment are treated by septoplasty and functional endoscopic sinus surgery.

Results:

The age of the patients varied from 20 years to 60 years. Out of the n=50 cases n=26 were male cases and n=24 were female patients. The majority of the patients n=19(38%), were in the third

decade of life followed by 21 – 30 years age group with n=15(30%) cases the details are depicted in table 1.

Table 1: Age wise grouping of the cases included in the study

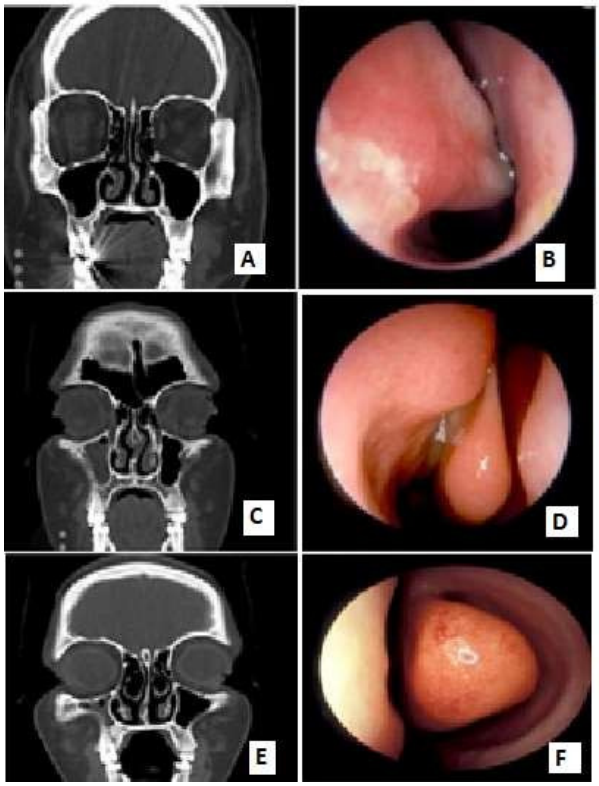
Age group	*No. of Cases*	*Percentage*
21 – 30	15	30
31 – 40	19	38
41 – 50	11	22
51 – 60	5	10
Total	50	100

Skull Base Types: The following were the incidence of various skull base types: Keros Type I: 6 (10%), Keros Type II: 32 (68%), Keros Type III: 12 (22%). Septal deviations were seen in 29 (58%). Of these n=10 (34.03%), were to right and n=19 (65.5%), were to the left. Septal spurs were seen in n=18(36%) cases. Of these n=8(16%), were to right and n=10(20%) cases were to the left. Pneumatization of the septum was found in n=3(6%). *Agger Nasi*: Pneumatization of agger nasi was seen in n=29(58%) cases. When present, the agger cells were always bilateral. *Frontal Sinus*: The frontal sinus was present in all n=48 cases (96%), and absent in n=2(4%) cases Hyperpneumatized in n=8(16%). The sinus was larger on the right in 24 subjects and on the left in n=26 subjects. *Frontal Recess*: The frontal recess was found to be obstructed in 12 of 75 (16%). Of these n=6 cases were on the right and n=6 cases were on the left. The obstruction was caused by agger nasi cells in n=6 ethmoidal bulla or accessory cells in n=4 and polyps in n=2.

Table 2: Middle turbinate variations in the cases

Middle turbinate variations	*No of cases*	*Percentage*
Typical	24	48
Paradoxically curved	5	10
Pneumatized	20	40
Large Non-pneumatized	1	2

Middle Turbinate: The middle turbinate was typical in n=24 (48%). Of these n=14 (28%) cases were on the right and n=10 (20%) cases were on the left. It was paradoxically curved in n=5(12%). Of these n=4 (8%) cases were on the right and n=2(4%) was on left. It was paradoxically curved in n=5(12%). Of these n=4 (8%) cases were on the right and 2(4%) cases were on the left. Hyperplastic non-pneumatized middle turbinate was seen in n=2 (4%). Of these none were on the right and n=2 (4%) was on the left. Pneumatized middle turbinate was seen in n=20 (40%). Of these n=5 cases were on both sides n=8 on right side and n=7 cases were on the left.



A: CT Scan of left deviated Nasal spetum

B: Endoscopic view of left deviated Nasal septum

C: CT scan of Agger Nasi

D: Endoscopic view of Agger Nasi

E: CT Scan of Chocha bullosa

F: Endoscopic view of Concha bullosa

Pneumatized turbinates, n=23(46%) cases showed lamellar pattern, n=2 (4 %) showed bulbous pattern and n=25(50%) cases were true concha bullosa. Onodi Cell: Onodi cells were seen in n=11 (22%). Of these n=6 (12%) cases were on the right and n=5 (10%) cases were on the left. Large Inferior Turbinate: A large inferior turbinate was found in n=29(58%). Of these n=14 (28 %) cases were on the right and n=15 (30%) cases were on the left in n=8 (16%) of patients, it was bilateral in n=22 (44%), the large inferior turbinate was associated with pathology in ipsilateral maxillary sinus and in n=7 (14 %) there was no ipsilateral maxillary sinus pathology. Uncinate variations are shown in table 3.

Table 3: Uncinate variations in the cases of study

Variation	*No of cases*	*Percentage*
Typical	29	58
Medialized/deviated	22	44
Anteriorly turned	1	2
Hypertrophied	6	12
pneumatized	2	4
Total	50	100

The superior attachment of the uncinate process was as follows: middle turbinate in n=20 (40%), lamina papyracea in n=22(44%) and skull base in n=8 (16 %). *Ethmoidal Bulla*: The bulla was typical in n=28 (56 %), large in n=12 (24%) and hypoplastic in n=10(20 %). *Supra-Orbital Cells*: Supra-orbital ethmoid pneumatization was seen in n=11 (22%). Of these n=6 (12%) cases were on the right and n=5 (10%) cases were on the left. OSTIA: Accessory

maxillary sinus ostia were seen in n=12 (24%). Of these, n=8 (16%) nasal cavities showed accessory ostia in anterior fontanelle and n=4 (8%) in the posterior fontanelle. In n=2 (4%) of patients, there were multiple accessory ostia. *Maxillary Sinus Septations*: Septations were found in n=4 (5%) maxillary sinuses. Of these n=1 (25%) was on the right and n=3 (75%) cases were on the left. In n=1 (2.5%), it was bilateral. *Haller Cell*: Haller cell was seen in n=3 (6%)

Pneumatized Superior Turbinate: Superior turbinate pneumatization was seen in n=5(6.25%). Of these n=3 (60%) cases were on the right and n=2 (40%) cases were on the left. In n=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 n=12 (24 %), oval in n=28 (56%) and slit in n=10 (20 %). The various patterns of pneumatization seen were: conchal in n=1 (3%), pre-sellar in n= 5(11%) and sellar in n=30(59%) mixed in n=14 (27%). The various intrasphenoidal projections seen were: Optic nerve in n=19 (38%). Maxillary nerve in n=14 (28 %). Vidian nerve in n=17(34%). Unable to see internal carotid artery projections due to most of the CT PNS taken by coronal cuts in our centre.

Correlation of diagnostic Endoscopy findings With Computed Tomography Findings: The parameters correlated in our study include middle turbinate, middle meatus, bulla ethmoidalis, hiatus semilunaris, frontal recess and shenoethmoid recess. The false positive, false negative, sensitivity and specificity were calculated for diagnostic endoscopy as compared to CT findings given in table 4.

Table 4: Correlation of Diagnostic nasal endoscopy findings with computed tomography findings.

Parameter	*Middle turbinate*	*Middle meatus*	*Bulla ethoidmalis*	*Hiatus semilunaris*	*Frontal recess*	*Sphenoethmoid recess*
Normal DE (N) + CT (N)	38	27	32	25	51	32
Abnormal DE (A) + CT (A)	35	46	13	30	27	3
False positive DE (A) + CT (N)	12	8	8	2	3	0
False negative DE (N) + CT (A)	7	13	10	22	5	8
Sensitivity	83.33	77.97	56.52	57.69	84.38	27.27
Specificity	76.0	77.14	80.0	92.59	94.44	100
PPV	74.47	85.19	61.9	93.75	90.0	100
NPV	8444	67.50	76.19	53.19	91.07	80

Discussion

In this study we found most patients ,38% were in third decade. The sex distribution showed a slight male preponderance with 52% males and 48% females. Septal variations: We found septal deviations in 58% of cases. In our study, there was slight preponderance of deviation to the left 65.5% compared to deviation to the right 34.4%. I. Baumann et al., [4] has described septal deviations by including the anatomic location and severity of deviation such as mild, moderate, and severe deviation. Sawheny et al., [5] integrated the level of severity of deviation with cartilage and bony deflection, dislocation of septal cartilage and level of deviation. The prevalence of septal spurs in our study was 36%. Nasal septal deviation is quite common and may not be symptomatic and its corrections requires a focused anatomically based treatment. However, a marked deviation can force the middle turbinate laterally, thus narrowing the

entrance to the middle meatus. Also, ridges and spurs coming to contact with turbinates or other areas of the lateral wall can predispose to recurrent sinusitis. We found septal pneumatization in 6% of cases. The prevalence of septal spurs was reported in 33% of cases by Danse M et al., [6] and in 25.3% of cases by Jareoncharisri P et al., [7] In the current study we found n=25(50%) cases were true concha bullosa. In a similar study Bolger et al., [8] found concha bullosa in 53% of cases. Lloyd G et al., [9] found concha bullosa in 24% of cases and Jones et al., [10] found it in 20% of cases. Agger nasi cells: We found pneumatization of the agger nasi cells in 58%. In all patients, the pneumatization when present was bilateral. The reports of incidence of agger nasi cells varies widely from 10 to 10% by different studies. Lower incidence was reported by Messerklinger et al., [11] and higher levels of 90% were reported by Davis et al., [12] and 100% was reported by Kennedy et al., [13] 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. Frontal sinus: We found the prevalence of non-pneumatization of frontal sinus in 4%. In a similar study by P Rajeshwara Rao et al., [14] found the presence of non-pneumatization of frontal sinus in 6.25% and Nastis K et al., [15] reported the same in 5% of cases in close agreement with the observations of the current study. Frontal recess: As the axis of the frontal recess is tilted approximately 50 degrees to the canthomeatal line, this drainage pathway cannot be included entirely within a single coronal section. Therefore, coronal oblique views are required for complete information. In our study, we found that the frontal recess was obstructed in 16%. Clearing the frontal recess is mostly done to achieve patency of frontal sinus ostium in many cases. [16, 17] In this study the pneumatized middle turbinate was in 40% of cases. Of these, 46% showed lamellar pattern, 4% showed bulbous pattern and 50% showed true concha bullosae. The reported incidence of middle turbinate pneumatization is from 15% to 42% by several authors. [17 - 19] We found paradoxical curvature of middle turbinate in 10% of cases Calhoun et al., KH et al., [20] (7.9%) and Liu X et al., [16] (8.5%) respectively. We found large ethmoidal bulla in 24% of cases during the 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 40%, lamina papyracea in 44% and skull base in 16% in a similar study Lloyd et al., [9] similar ethmoidal bullae was found in 17% of cases. In our study, we found medially turned uncinate process in 40% and anteriorly turned uncinate process in 2% along with pneumatized uncinate process in 4% cases. Liu X et al., **[16]** have reported the rate of deflection of uncinate process in 31% of cases and similarly Danse et al., [6] reported deviated uncinate process in 31% of cases. In our study, Haller cells were present in 6%. We found the following prevalence of intrasphenoid projections as Optic nerve in 38%, Maxillary Nerve in 28 % and Vidian Nerve in 34%. The true prevalence of internal carotid artery projections or dehiscence could not be ascertained as axial CT sections were not obtained in our patients. J Lang et al., [19] have found intrasphenoid projections in optic nerve 19% cases, Maxillary Nerve in 28.6% and Vidian nerve in 14.3% cases. In the current study we found Keros type I (1 to 3 mm deep) olfactory fossa in 10%, type II (4 to 7 mm) in 68% and type III (8 to 16 mm) in 22%. Arslan et al., [21] in their study have reported the average depth of 8 mm on right side and 9.5 mm on the left side

Conclusion

Anatomical variations which predispose to several sinus diseases must be evaluated correctly to successfully treat the cases. Deviated nasal septum is very common and in fact is considered norm and un-deviated septum is now considered as exception. The penumatized middle turbinate and medialised uncinate process is also commonly noted in this study. Inferior turbinate enlargement in association with ipsilateral maxillary sinusitis was commonly noted. Most of the cases were Keros Type II category based on the depth of olfactory fossa. Therefore,

through CT scan along with diagnostic nasal endoscopy must be done in whom anatomical variations are the cause of chronic sinus mucosal diseases.

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