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Assessment of Ostiomeatal Complex Abnormalities by Endoscopy and CT Scan and their Management

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Abstract

***Background**: The advent of modern techniques of analysis of paranasal sinus anatomy by CT imaging and nasal endoscopy has helped greatly in the successful performance of sinus surgeries. The current study aimed to determine the ostiomeatal complex abnormalities by endoscopic and CT scans and their management. **Methods:** This cross-sectional study was conducted in the Department of ENT, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Surgical Management: was done by Antral Lavage and FESS (Functional Endoscopic Sinus Surgery) using the Messerklinger approach was done. Post-operative care: At the end of the surgery small loose fragments of bone and mucosa are removed as it causes foci of infection. Packing of the nose using gauze, merocele, gel foam soaked with antibiotic ointment. Antibiotic coverage for 7 to 10 days. **Results**: The various skull base types found in our study. Keros Type I: n=6 (12%), Keros Type II: n=32 (64%), Keros Type III: n=12 (24%). The frontal sinus was present in n=45 sides, absent in n=5 sides, and Hyperpneumatized in n=14. The sinus was larger on the right in n=24 subjects and on the left in n=26 subjects. Inter-frontal cells were seen in n=8 (16%). Pneumatized turbinates, n=22(44%) showed lamellar pattern, n=2(4%) showed bulbous pattern and n=26 (52%) cases were true concha bullosae. The uncinate was typical in n=29 (58%), medialized in n=22 (44%), anteriorly turned in n=1 (2%), hypertrophied in n=6 (12%) and pneumatized in n=2 (4%). **Conclusion**: The depth of the olfactory fossa was of Keros Type II in the majority of patients. Because of the presence of these significant variations, we reemphasize the need for proper preoperative assessment in every patient to accomplish a safe and effective endoscopic sinus surgery.*

***Keywords**: Ostiomeatal Complex, CT scan, Sinus Endoscopy, Functional Endoscopic sinus surgery.*

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Introduction

The incidence of chronic sinusitis is very common it has been estimated to occur at a rate of 16.3% of all ENT cases. [1] Sinusitis was thought to be a bacterial infection however, it has been found that sinus inflammation can arise from several causes. In chronic sinusitis the rate of infection in the etiology of sinus inflammation is unclear. [2, 3] The ethmoids would have been an insignificant collection of bones had they been in any other location in the human body. However, because of its anatomical location, it has major relationships so that diseases and surgery of the labyrinth often lead to tragedy. Mosher in 1929 stated that "Any surgery in this region should be simple but it has proven one of the easiest ways to kill the patient" [4] The two fundamental factors for the maintenance of normal physiology of paranasal sinuses and its mucous membrane are the drainage and ventilation. The Normal drainage of the paranasal sinuses confides in the conditions of the sinus Ostia. The mucus transport from the sinus into the nose is markedly enhanced by unblocked nasal airflow. This creates a negative pressure inside the nasal cavity at the time of inspiration. The secretions of the sinus reach their respective Ostia in a well-defined path that is genetically determined. [5] The two of the largest sinuses, the frontal and maxillary, communicate with the middle meatus via narrow and delicate pre chambers. In each of these pre chambers, the mucosal surfaces are closely opposed such that mucus can be more readily cleared by 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. [6] The key region for these changes is that part of the lateral nasal wall that encloses the sinus Ostia and their adjacent mucosa and pre chambers. There is considerable anatomical variation in this area 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 knowledge of anatomy for surgery is a prerequisite and 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. [6] The difficulty is compounded by the occurrence of variations in sinonasal 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 sinonasal anatomical variation reported in literature shows considerable variation between populations. This study aims to study the various sinonasal anatomical variations in our population.

Materials and Methods

This cross-sectional study was conducted in the Department of ENT, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical approval was obtained for this study. Written consent was obtained from all the participants who voluntarily wished to participate in the study.

Inclusion criteria

1. All the patients with clinically proven chronic sinusitis not responding to routine medical line of treatment.
2. Males and Females
3. Aged 21 years and above cases

Exclusion criteria

1. Patients with an acute attack of sinusitis.
2. Patients diagnosed with sinus malignancies
3. Patients not willing to undergo Functional Endoscopic Sinus Surgery

Based on the inclusion and exclusion criteria n=50 patients were enrolled for the study. A routine haemogram (HB, BT, CT, TC, DC) and urine examination (albumin, sugar, microscopy), a swab from the middle meatus for culture sensitivity along with X-ray paranasal sinuses were done for the patients. All CT scans were obtained with Siemens Somatom AR star, spiral scanner (Forchheim, Germany). After obtaining the scout projection, the area of scanning was defined to include the region from the roof of the frontal sinus up to the hard palate. Axial sections were performed with the patient in the supine position and the plane of data acquisition parallel to the hard palate. Extended cephalic/caudal sections were done in a few patients to see an extension of the disease process. All the patients in an active stage of the disease were treated with a course of suitable antibiotics, 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. Each patient underwent a systematic diagnostic nasal endoscopy and computed tomography of the nose and paranasal sinuses.

Medical Management:

Culture studies show that increased overall incidence of *H.influenzae, S.aures*, anaerobic organisms (*Klebsiella and proteus*), and gram-negative organisms (*Pseudomonas aeroginosa*), and polymicrobial infection. In general, *Pseudomonas aeruginosa* is commonly cultured from patients who have received multiple courses of antibiotics over a prolonged period. Antibiotic therapy: Amoxycillin – clavulanate and second-generation cephalosporin's, cefixime, for *Haemophilus influenza* and new macrolide, clindamycin for resistant *streptococcus pneumoniae*, is advised for 2-3 weeks. More common oral decongestants are Pseudoephedrine and Phenylpropanolamine. Best used for short (3 to 5 days) courses. Guaifenesin is the most used mucolytic agent used in combination with a decongestant, high doses (up to 2400 mg/day for adults) are required for it to act on mucous. A saturated solution of potassium iodide (SSKI) is another one used as a mucolytic. It increases mucociliary flow rates and has a brief vasoconstriction effect, and it rinses/removes the predisposing agents of nasal allergy such as pollen, mold, dust, and particularly air pollutants. *Surgical Management:* was done by Antral Lavage and FESS (Functional Endoscopic Sinus Surgery) using the Messerklinger approach was done. Post-operative care: At the end of the surgery small loose fragments of bone and mucosa are removed as it causes foci of infection. Packing of the nose using gauze, merocele, gel foam soaked with antibiotic ointment. Antibiotic coverage for 7 to 10 days. The patient is typically seen every week for debridement of crusts until mucosalization of the cavities is progressing well. If polypoidal changes present advise a course of steroid spray.

Results

Out of the total n=50 patients included in the study, the age of the patients varied from 11 years to 60 years. Most of the patients were in the third decade of life 54% cases followed by 21 – 30 years age group 26% cases. depicted in table 1. The mean age was 27.5 years. The sex distribution showed a slight male preponderance of male preponderance 64% male and 36% female patients. Thus, male to female ratio was 1.8:1.

Table 1. Age-wise distribution of cases in the study

Age group	*Frequency*	*Percentage*
21 – 30	13	26
31 – 40	27	54
41 – 50	8	16
51 – 60	2	4
Total	50	100

The following was the incidence of various skull base types found in our study. Keros Type I: n=6 (12%), Keros Type II: n=32 (64%), Keros Type III: n=12 (24%). Septal deviations were seen in 27 (54%). Of these n=10 (37.03%) was to the right and n=17 (62.9%) was to the left. Septal spurs were seen in n=16 (32). Of these n=7 was to right and n=9 was to the left. The thick septum was found in n=5 (10%). Pneumatization of the septum was found in 2(4%) given in table 2.

Table 2. Septal variations of the cases in the study

Variation	*Number*	*Prevalence*
Deviation	27	54%
Spur	16	32%
Thick	5	10%
Pneumatized	2	4%

Pneumatization of agger nasi was seen in n=38 nasal cavities. When present, the agger cells were always bilateral. The frontal sinus was present in n=45 sides, absent in n=5 sides, and Hyperpneumatized in n=14. The sinus was larger on the right in n=24 subjects and on the left in n=26 subjects. Interfrontal cells were seen in n=8 (16%). The frontal recess was found to be obstructed in n=14 of 75 (18%). Of these n=(57%) were on the right and n=6 (43%) cases were on the left. The obstruction was caused by agger nasi cells in n=6 (43%), ethmoidal bulla or accessory cells in n=4 (28.5%), and polyps in 4 (28.5%). 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 n=6 (12%). Of these n=4 (8%) cases were on the right and n=2 (4%) cases were on the left. Hyperplastic non-pneumatized middle turbinate was seen in n=2 (4%). Of these, No cases were on the right and n=2 (4%) were on the left. Pneumatized middle turbinate was seen in n=17 (34%). Of these n=7 (14%) cases were on the right and n=10 (20%) cases were on the left.

Table 3: Middle turbinate variations

Variation	*Frequency*	*Percentage*
Typical	25	50
Paradoxically curved	6	12
Pneumatized	17	34
Large non-pneumatized	2	4

Pneumatized turbinates, n=22(44%) showed lamellar pattern, n=2(4%) showed bulbous pattern and n=26 (52%) cases were true concha bullae. The uncinate was typical in n=29 (58%), medialized in n=22 (44%), anteriorly turned in n=1 (2%), hypertrophied in n=6 (12%) and pneumatized in n=2 (4%). The superior attachment of the uncinate process was as follows: middle turbinate in n=21 (42%), lamina papyracea in n=18 (36%), and skull base in n=11 (22 %). The bulla was typical in n=31 (62 %), large in n=11 (22%) and hypoplastic in n=8 (16 %). Supra-orbital ethmoid pneumatization was seen in n=18 (36%). Of these n=10 (20%) cases were on the right and n=8 (16%) cases were on the left. In n=8 (16%) patients, it was bilateral. 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 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%) were 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= (60%) 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 subjects examined. *Sphenoid sinus*: The ostium was circular in n=15 (30 %), oval in n=23 (46%) and slit in n=12 (24 %). 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 the ipsilateral maxillary sinus, and in n=7 (14 %) there was no ipsilateral maxillary sinus pathology.

Table 4: Correlation of Diagnostic Endoscopy Finding with Computed Tomography Findings

Parameter	*Middle turbinate*	*Middle meatus*	*Bulla ethmoidal*	*Hiatus semilunar*	*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	74.47	85.19	61.9	93.75	90	100
Specificity	84.44	67.50	76.19	53.19	91.07	80
PPV	83.33	77.97	56.52	57.69	84.38	27.27
NPV	76.00	77.14	80	92.59	94.44	100

Discussion

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. We found septal deviations in 54% of cases. The reported incidence of septal deviations in the literature ranges from 40% Calhoun Khet al., [7] to 96.9% Takanishi et al., [8] The prevalence of septal spurs in our study was 32%. Among these, over half had contact areas with the turbinates. The prevalence of deviations of nasal septum as reported by various workers is 21% by Zinreich SJ et al., [9] 24% Jones NS et al., [10] 38%, and Yadav SPS et al., [11] 40%. 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. Pneumatization of agger nasi was seen in 76% of nasal cavities. In all patients, the pneumatization when the present was bilateral. The prevalence of agger nasi cells varies widely as reported by various workers from 14-89%. [12-14] 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 the diagnosis and treatment of recurrent or chronic frontal sinusitis. We found the prevalence of non-pneumatization of frontal sinus in 6.25%. This correlates with the study by Natsis K et al., [15] who reported a prevalence of 5%. In all our patients, frontal sinuses on either side were always asymmetrical with the right being large in 48% and the left sinus being large in 52%. 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 an 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. [16] We found pneumatized middle turbinate in 50%. Of these, 44% showed a lamellar pattern, 4 % showed a bulbous pattern and 52% showed true concha bullae. The origin of the pneumatization can sometimes be depressions on the lateral surface. Literature reports a wide variation in the incidence of middle turbinate pneumatization from 11% to 42%. [17-19] We found paradoxical curvature of middle turbinate in 12%. This correlates well with that reported by Calhoun KH et al. [20] 7.9% and Lusk RP et al., [21] 8.5%. An enlarged bulla ethmoidal can result in a narrow hiatus semilunaris. We found large ethmoidal bulla in 22%. This correlates with the reported frequency by Lloyd GA et al., [13] 17% and Lund VJ et al., [22] 18%. 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., [17] and 31% deflection reported by Danese M et al., [23] intrasinus maxillary septum can convert the maxillary sinus into two chambers. Earwaker J et al., [24] reported a prevalence of 2.38% in his study. In our study, we found maxillary sinus septation in 5%. Pneumatization of superior turbinate can occur from posterior ethmoid cells. Of the 48% incidence reported by Ariyurek OM et al., [25] in their study, 40% of cases showed pneumatization in the form of 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 grade II pneumatization. In our study, we found a prevalence of superior turbinate pneumatization of 6%. In our study, we found ethmoid air cells can extend supraorbitally and prevalence of 22% cases. The surgical management of cases was done by antral lavage and FESS with the Messerklinger approach. There were only minor complications reported in 10% of cases which included periorbital ecchymosis, periorbital emphysema, headache, and dental pain which were managed adequately.

Conclusion

Most of the variations of sinonasal anatomy described in literature except the presence of supreme turbinate were encountered in our study. The medialized uncinate process was the most common uncinate process variation and pneumatized middle turbinate was the most common middle turbinate variation. Extramural pneumatization like the septal, supraorbital, sphenoid wing and pterygoid plates was also commonly detected. The depth of the olfactory fossa was of Keros Type II in the majority of patients. Because of the presence of these significant variations, we reemphasize the need for proper preoperative assessment in every patient to accomplish a safe and effective endoscopic sinus surgery.

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***Source of support*: Nil**
***Ethical Permission*: Obtained**

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