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Computed Tomographic Evaluation Of Nose And Paranasal Sinus Pathology To Correlate Pre And Intraoperative Findings Of Functional Endoscopic Sinus Surgery.

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Abstract
Objective- The present study was undertaken in order to study the correlation between the CT and endoscopic sinus surgery in evaluating sinonasal area, their anatomical variations and their pathology and extent of disease.
Introduction-The complex anatomy of paranasal sinus makes the sinus vulnerable to different pathologic condition,which needs multiple procedures to evaluate the exact nature and extent of the pathology of which CTscan and nasal endoscopy provide the ability to accuratelyassess and access these areas.
Materials and methods-An institution based prospective correlation study was performed on 50 patients having symptoms of chronic sinusitis who were referred from ENT department to the department of Radiodiagnosis for CT nose and paranasal sinus and endoscopic sinus surgery was performed in those patients with positive CT findings.
Results- A good correlation was found between CT nose and paranasal sinus with endoscopic sinus surgery except a few cases of maxillary and frontal sinus pathology.
Conclusion- Multidetector CT scan can be used as a reliable pre-operative tool to guide endoscopic sinus surgery.
Keywords: *Multidetector CT scan (MDCT), Functional endoscopic sinus surgery(FESS), Paranasal sinus(PNS),Chronic rhinosinusitis*

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I. Introduction

The paranasal sinuses originate as invagination of nasal mucosa into the lateral nasal all,frontal,ethmoid,maxilla and sphenoid bones during fetal development. Drainage and ventilation are the two most important factors in the maintenance of normal physiology of the paranasal sinuses and their mucous membranes. Infection of these sinuses is one of the common causes that compel patients to attend to the otorhinolaryngology clinic .

With the advent of the concept of Functional Endoscopic Sinus Surgery(FESS) and Computerised Tomographic scan of nose and paranasal sinuses, a surgeon nowadays readily gets a precise knowledge regarding the anatomy of different sinuses and the adjoining meatii (like ostiomeatal complex,ethmoidal labyrinth,sphenoethmoidal recess, ethmoidal fovea, onodi cells,concha bullosa,pneumatised different frontal cells etc) to which they drain as also their relation to various skull base structures and orbit. [(1-3).] Thus it has revolutionized regarding planning before surgery as also easy followup on each and individual case according to nature and extent of the pathology. It has also minimised peroperative and postoperative complications on individual case basis.

The ostiomeatal complex is the key area for the pathogenesis of chronic rhinosinusitis.Ciliary activity in the sinuses directs the flow of mucous towards these ostia. Every episode of rhinosinusitis hampers the ciliary movement and results in stasis of mucous inside the sinuses causing engorgement of sinonasal mucosa and thus closing the ostia as also inviting infection[(4)]. This process is usually reversible and once the ostiomeatal complex is reopened, the disease usually resolves spontaneously. If, however there is an anatomical variant that narrows this key area, then a minimal amount of mucosal oedema may predispose the patient to recurrent infection and may result in chronic inflammatory changes in the mucosa[(5)]. As anatomical variations have been implicated in etiology of chronic recurrent rhinosinusitis, CT Scan of paranasal sinuses is being routinely used in the

evaluation of patients with sinus diseases, because even minor anatomical variation of OMC and key areas as mentioned above can be evaluated in detail by using different plane of CT Scan i.e. axial, coronal and sagittal.

CTscan and nasal endoscopy provide the ability to accuratelyassess and access these areas for evidence of localized disease or anyanatomic variation/ defect that may compromise ventilation andmucociliary clearance. This correlation of diagnostic nasal endoscopy and CT findings also make surgeon aware of the difficulties he might face during surgery and also indicatepatients susceptibility regarding injury of vital structures during surgery of patients that might be avoided. The keystone ofFESS is the ability to accurately treat even relatively minor changesin ostiomeatal complex that interfere with mucociliaryclearance of the frontal, ethmoid and maxillary sinuses.

The understanding of mucociliary drainage pattern and pathophysiology of paranasal sinus disease are the keys to functional endoscopic sinus surgery [FESS]. Diagnostic nasal endoscopy and CT are performed to determine the extent of the disease prior to planning the surgery.

Computer assisted tomography [CT] provides an essential pre-operative assessment of patients undergoing FESS. Thus the aim of CT of the sinuses is to delineate the extent of disease, define any anatomical variants and relationship of the sinuses with the surrounding important structures. To avoid complications during endoscopic sinus surgery, CT scan should be studied thoroughly before surgery.

The present study was undertaken in order to study thecorrelation between the CT and endoscopic sinus surgery in evaluating sinonasal area,their anatomical variations and their pathology and extent of disease.

RHINOSINUSITIS

Rhinosinusitis is widely believed to comprise of a spectrum of inflammatory and infectious diseases concurrently affecting the mucous membrane of nose andparanasal sinuses.

Chronic rhinosinusitis is defined as the group of disorders characterized byinflammation of the mucosa of the nose and paranasal sinuses for atleast 12 consecutive weeks duration. The ultimate end stage of chronic rhinosinusitis is inflammatory mucosal thickening or polypoid changes.Although its histologic hallmark is persistent underlying eosinophilic inflammation,the exact cause and pathophysiology have been a source of extensive controversy.

Chronic rhinosinusitis is affecting nearly 10-15% of the Indian population and a significant cause of morbidity to the patients.[(31)].

The pathophysiology of sinus disease is mainly related to patency of ostia, function of cilia and quality of the nasal secretions. The ostiomeatal complex is the key area involved in the pathogenesis of chronic rhinosinusitis.[(32)].Based on this concept, Functional Endoscopic Sinus Surgery (FESS) aims to eliminate disease in the primary site, i.e. the ostiomeatal complex and allow resolution of the secondary infection in the larger sinuses.[(33)]

Babbel et al. reviewed 500 patients with screening sinus CT scans and defined five recurring patterns of inflammatory sinonasal disease. The five anatomic patterns were-
1) infundibular,
2)OMU,
3) sphenoethmoidal recess,
4)sinonasal polyposis and
5)sporadic or unclassifiable.

CAUSES OF OSTIOMEATAL OBSTRUCTION:

I) Pathological variations:
1. Mucosal thickening due to oedema or hyperplasia of mucosa secondary to infection or allergy.
2. Polyposis.
3. Synechiae in middle meatus.
4. Pathologic mucous which is thick viscid blocking the OMC.
5. Immotile cilia syndrome

II)Anatomical variations:

It is very important to understand the various anatomic variants, as most of these are useful in warning the surgeon of the impending risk of the procedure. The importance of anatomic variations as a predisposing cause of sinus disease.

The various anatomic variations are classified as:
A) Primary bony abnormalities
1. Septal abnormalities-

a. Septal deviation
b. Septal spur
2. Middle turbinate-
a. Paradoxical curve
b. Hypoplastic
3. Uncinate process, ethmoid bulla and ostiomeatal complex
a. Uncinate process - Vertical or horizontal
b. Ethmoid bulla – Enlarged or normal
- Absent / Hypoplastic
4. Unilateral Choanal atresia.

B. Extension of sinus air cells.
1) Ethmoid complex: Intra mural cells
Extra mural cells
a. Extra mural Aggernasi cells
b. Extra mural supra orbital cells
c. Extramural Middle turbinate cells (Concha bullosa).
d. Extramural uncinate process cells
e. Extra mural superior turbinate cells
f. Cells of orbital plate of the maxilla (Haller cells)
g. Extramural sphenoidal cells – posterior ethmoidal cells
migrating into anterior sphenoid bone surrounding the optic nerve(Onodi cell) or reach anterior wall of sella turcica.
2) Sphenoid sinus extensions
a. Absence of Sphenoid sinus
b. Lateral recess
i. Lesser wing
ii. Greater wing
iii. Pterygoid.
c. Midline recess
i. Rostral
ii. Septal vomeral
iii. Inferior clival
iv. Superior clival
d. Dehiscence of optic nerve and internal carotid artery
3) Frontal sinus extensions
a. Aplastic
b. Hypoplastic
c. Extensions into orbital plate
d. Extensions into crista galli
e. Extensions into anterior ethmoids
4) Maxillary sinus extensions
a. Infraorbital recesses
b. Alveolar recesses
c. Zygomatic recesses
Other anatomic variations include:
a) Maxillary sinus septa
b) Accessory ostia
c)Septations of sphenoid

AIMSANDOBJECTIVES

1.To correlate pre- and intra-operative findings of nose and paranasalsinus pathology on the basis of Computerised Tomographic scan and nasal endoscopy.
2.To evaluate the mucosal abnormalities of nose and paranasal sinuses by Computerised Tomographic scan.
3.To study the anatomical variations of ostiomeatal complex,ethmoidal fovea and other important defined areas in patients with sinusitis or symptoms alike.
4.To assess the clinical significance of the different anatomical variations of these defined areas.
5.To assess the association between chronic sinusitis (clinically and radiologically proven) with abnormalities and anatomic variants of ostiomeatal complex.

II. Materials And methods

Type of study: Prospective correlation study
Sample Size:50 patients having clinical symptoms of chronic sinusitis or sinusitis like symptoms not responding to medicaltreatment referred from ENT Outpatient department(OPD) and ward for CT scan of nose and paranasal sinus(PNS).
Place of Study: Dept of ENT,IPGMER&SSKM hospital and Dept of Radiodiagnosis,Bangur institute of neuroscience(BIN)
CT scanner:16 slice scanner
Study Period: Dec2016 to Dec2017
Inclusion Criteria:
All the patients >7 years having chronic sinusitis or sinusitis like symptoms not responding to medical treatment.

Exclusion Criteria:
1. Patients responding to medical treatment
2. Facial trauma
3. Recurrent cases with history of previous sinonasal surgery
4. CNS involvement with intracranial extension
5. Age <7 years.
6. Co-morbidities like CKD,ILD,CLD,uncontrolled diabetes etc.

The parameters used for correlation were- Deviated Nasal Septum, Inferior Turbinate Hypertrophy, Middle Turbinate abnormalities like concha bullosa, paradoxical turbinate,ostiomeatal complex including Hiatus semilunaris, ,Infundibulum, Uncinate process attachment, Haller cell,intrasinus mucosal disease of Maxillary, Ethmoids, Frontal and Sphenoid, Frontal recess.

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) alongwith X-ray paranasal sinuses were done for thepatients.
3. All the patients in active stage of the disease were treated with course of Antibiotic, systemic antihistamines and or systemic steroids, local decongestants and local intranasal steroid and or saline spray.
4.Each patient underwent acomputed tomography of nose and paranasal sinuses and functional endoscopic sinus surgery(FESS).

III. Results And Analysis

The present study was conducted on 50 patients who attended ENT OPD with clinical signs and symptoms of chronic rhinosinusitis and were referred for CT nose and paranasal sinus to department of radiology,BIN and who had positive findings on CT.Our study included fifty patients; out of which 30 patients had bilateral disease and needed bilateral surgery and rest 20 patients had unilateral disease and needed unilateral surgery. Thus a total of 80 procedures werecarried out.

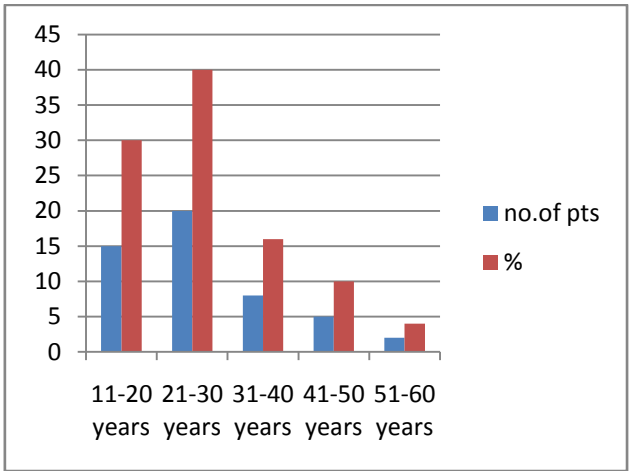
AGEWISEDISTRIBUTION OF THE STUDY SAMPLE:

TABLE 1: AGE WISE DISTRIBUTION OF PATIENTS

AGE(YEARS)	NO. OF PATIENTS	PERCENTAGE
11-20	15	30
21-30	20	40
31-40	8	16
41-50	5	10
51-60	2	4
TOTAL	50	100

In my study we included patients above 7 yrs of age. Majority of the study samplei.e. (20 out of 50 i.e.40%) were found to be in the age group of 21 to 30 years (3rd decade) .

CHART NO.1: AGE WISE DISTRIBUTION OF PATIENTS



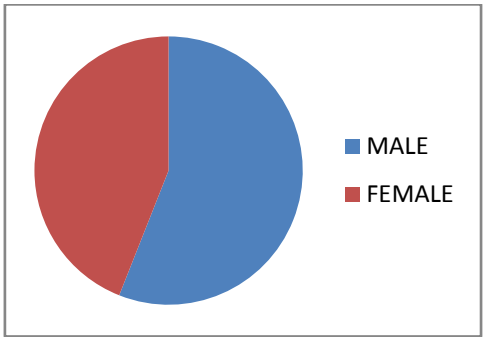
GENDER WISE DISTRIBUTION OF PATIENTS

TABLE 2: GENDER WISE DISTRIBUTION OF PATIENTS

GENDER	NUMBER	PERCENTAGE
MALE	28	56
FEMALE	22	44

Total number of cases were 50, out of which 28 patients (56%) were male and 22 patients (44%) were female in my study.

CHART NO.2: GENDER WISE DISTRIBUTION OF PATIENTS



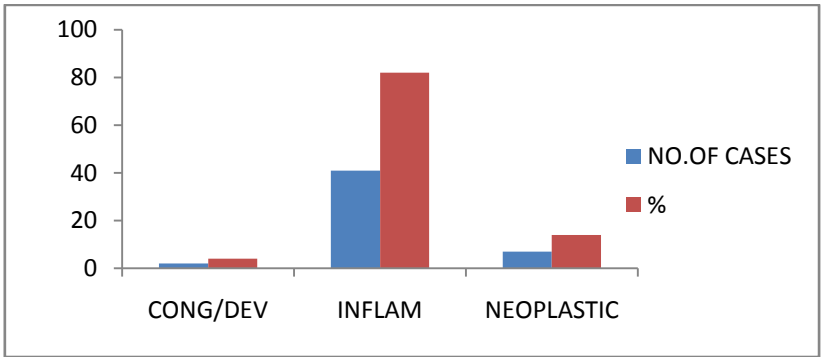
VARIOUS TYPES OF SINONASAL LESIONS

TABLE 3: CHARACTERIZATION OF VARIOUS SINONASAL LESIONS ON BASIS OF CT PARAMETERS

AETIOLOGY	NO.OF CASES	PERCENTAGE
CONG/DEV	2	4
INFLAM/ INFECTIVE	41	82
NEOPLASTIC	7	14
TOTAL	50	100

All the patients were categorised according to aetiology of sinus disease into congenital/developmental, inflammatory and neoplastic, based on CT findings. Most of the patients had inflammatory aetiology, comprising of 82%. Seven patients (14%) had neoplastic lesions and two patients in my study (4%) had congenital/developmental cause.

CHART3: CHARACTERIZATION OF VARIOUS SINONASAL LESIONS



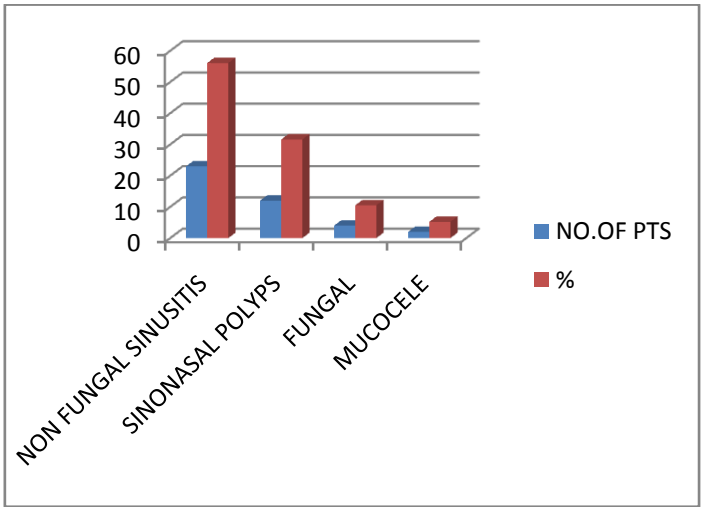
DIFFERENT TYPES OF INFECTIVE/INFLAMMATORY SINONASAL DISEASE

TABLE 4: DISTRIBUTION OF CASES WITH INFLAMMATORY AETIOLOGY

INF/INFLAM	NUMBER	%
SINUSITIS(NON-FUNGAL)	**23**	**56.1**
SINONASAL POLYPS	**12**	**31.6**
FUNGAL	**4**	**10.5**
MUCOCELE	**2**	**5.2**

Out of 41 patients of infective/inflammatory sinonasal disease included in my study, 23 patients (56.1%) showed non fungal sinusitis, 12 patients(31.6%) presented with sinonasal polyps ,4 patients (10.5%) were that of fungal origin that demonstrated fungal hyphae on mucin study collected during operation and 2 patient (5.2%) presented with mucocele

CHART 4: DISTRIBUTION OF CASES WITH INFLAMMATORY DISEASE



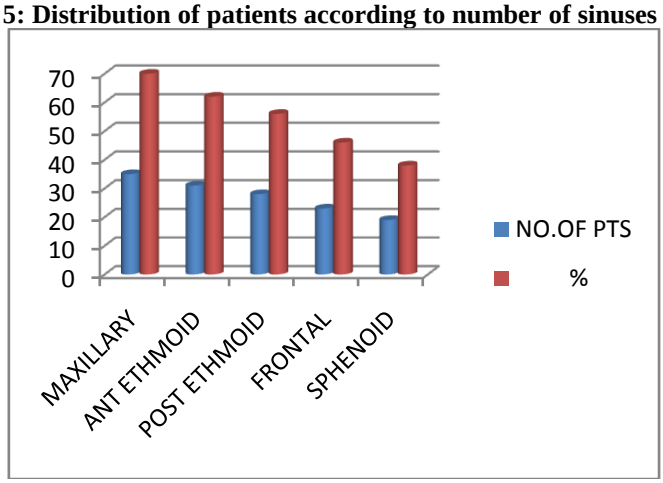
SINUSITIS-DISTRIBUTION OF STUDY SAMPLE ACCORDING TO SINUS INVOLVED

TABLE 5: Distribution of patients according to number of sinuses involved.

SINUSITIS	NO.OF PATIENTS	PERCENTAGE
MAXILLARY	**35**	**70**
ANTERIOR ETHMOID	**31**	**62**
POSTERIOR ETHMOID	**28**	**56**
FRONTAL	**23**	**46**
SPHENOID	**19**	**38**

Study sample were categorised according to the number of sinuses involved. Most of the patients were found to have maxillary sinusitis(70%) and least involved sinus was found to be sphenoid sinus (38%).

CHART 5: Distribution of patients according to number of sinuses involved.



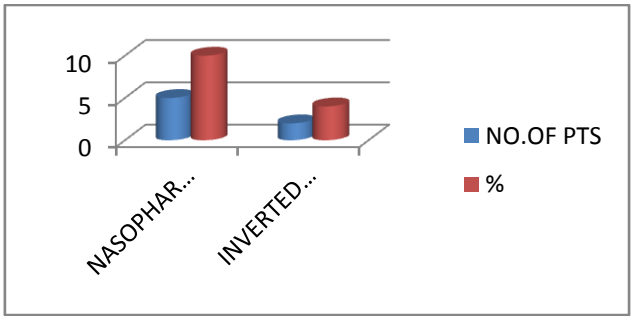
NEOPLASTIC DISEASES

TABLE 6: DISTRIBUTION OF CASES OF NEOPLASMS

TYPE OF LESION	NO.OF CASES	%
NASOPHARYNGEAL ANGIOFIBROMA	5	10
INVERTED PAPILLOMA	2	4

Out of 7 cases of neoplastic disease, 5 cases were reported as nasopharyngeal angiofibroma and 2 cases were reported as inverted papilloma.

CHART 6: DISTRIBUTION OF NEOPLASTIC DISEASE



CORRELATION OF CT FINDINGS WITH OPERATIVE FINDINGS:

The various parameters correlated in our study were maxillary sinus, inferior turbinate, middle turbinate, infundibulum,uncinate process,hiatus semilunaris, concha bullosa, anterior ethmoids, posterior ethmoid, sphenoethmoid recess, haller cells and frontal recess.

The sensitivity, specificity,positive predictive,negative predictive value and Cohen Kappa's coefficient (k-value) were calculated for each parameter.

TABLE 7: CT CORRELATION WITH FESS(Operation) FINDINGS

SL NO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
PARAMETER	MS	AE	PE	FR	SER	IT	MT	CB	UP	HS	INF	HC
CT[N]+ OT[N]	18	37	46	40	37	8	26	31	29	34	37	79
CT[N]+ OT[A]	16	6	2	3	7	4	4	4	6	18	13	0
CT[A]+ OT[N]	19	4	2	7	6	7	3	2	4	7	12	0
CT[A]+ OT[A]	27	33	30	30	30	61	47	43	41	21	18	1
Sensitivity	62.8	84.6	93.7	90.9	81.1	93.8	92.1	91.4	87.2	53.8	58	100
Specificity	48.6	90.2	95.8	85.1	86	53.3	89.6	93.9	87.8	82.9	75.5	100
Predictive +ve	58.7	89.2	93.7	81.2	83	89.7	94	95.5	91.1	75	60	100
Predictive -ve	52.9	86	95.8	93	84.1	66.7	86.6	88.6	82.8	65.4	74	100

(CT-Computed tomography, OT-intra-operative,MS- maxillary sinus, AE- anterior ethmoid, PE-posterior ethmoid,FR- frontal recess, SER-sphenoethmoidalrecess, IT-inferior turbinate, MT-middle turbinate, CB-concha bullosa, UP- uncinate process,HS-hiatus semilunaris, INF-infundibulum, HC-haller cells)

CT showed highest sensitivity for posterior ethmoids,haller cells, uncinate process,inferior turbinate,middle turbinate and concha bullosa. The specificity of CT was found to be best for haller cells, anterior ethmoids, posterior ethmoids,concha bullosa and middle turbinate.

CHART 7: CT CORRELATION WITH OT FINDINGS

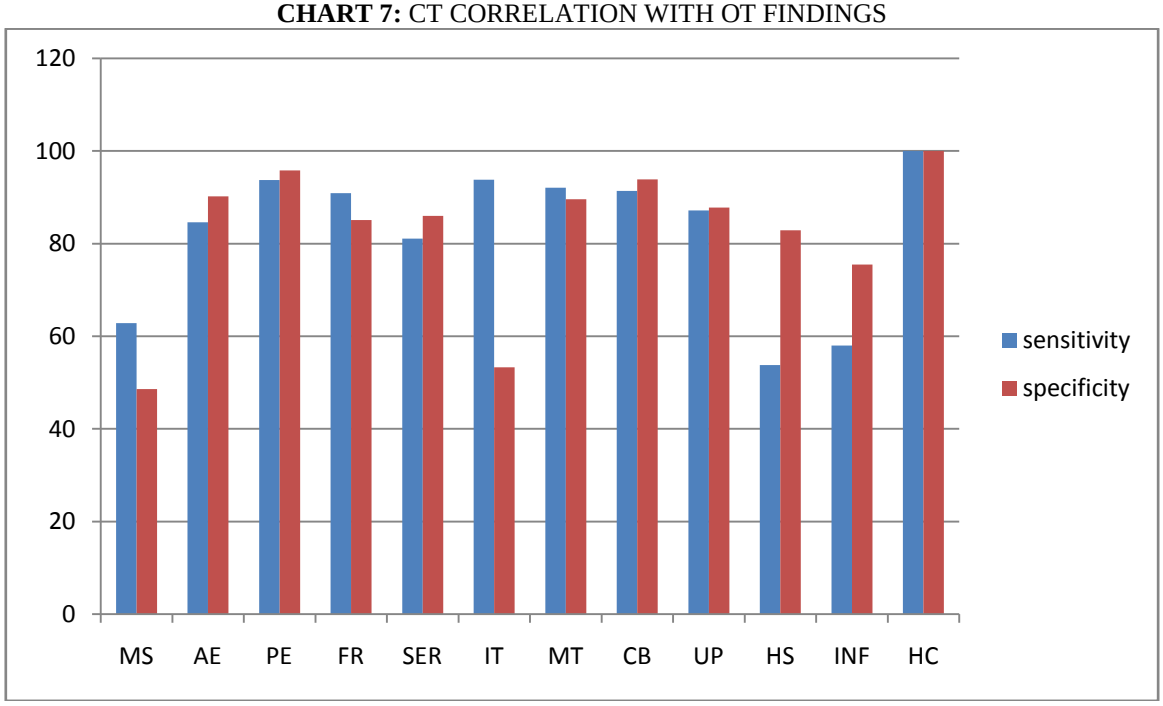


Table 8: Correlation between Endoscopic operative findings of intrasinus mucosal disease and CT scan using Cohen Kappa's agreement.

Descriptive category	Cohen Kappa's agreement	Comment
Maxillary sinus	0.11	Poor agreement
Anterior ethmoid	0.75	Good agreement
Posterior ethmoid	0.89	Very good agreement
Frontal sinus	0.13	Poor agreement
Sphenoid sinus	0.74	Good agreement

Table 9: Correlation between CT scan and Endoscopic operative findings of various anatomical variations using Cohen Kappa's agreement.

Descriptive category	Cohen kappa's agreement	Comment
DNS	0.27	Fair agreement
Inferior turbinate	0.51	Moderate agreement
Middle turbinate	0.81	Very good agreement
Concha bullosa	0.84	Very good agreement
Uncinate process	0.74	Good agreement
Hiatus semilunaris	0.37	Fair agreement
Infundibulum	0.35	Fair agreement
Haller cells	1	Very good agreement
Frontal recess	0.74	Good agreement
Sphenoethmoidal recess	0.67	Good agreement

1. Middle turbinate, Concha Bullosa, Haller cells and Posterior ethmoids showed very good agreement.
2. Anterior ethmoids, Sphenoid sinus,Uncinate process, Frontal recess and sphenoethmoidal recess showed good agreement.
3. Hypertrophied inferior turbinate showed moderate agreement.
4. Deviated septum, Hiatus semilunaris and Infundibulum showed fair agreement.
5. Maxillary sinus and Frontal sinus showed poor agreement.

Table 10: Agreement of Cohen Kappa's statistics

Cohen Kappa's statistics	Agreement
<0.20	Poor
0.20-0.40	Fair
0.40-0.60	Moderate
0.60-0.80	Good
0.80-1.0	Very good

IV. Discussion

The present study entitled "Computed Tomographic evaluation of nose and paranasal sinus pathology to correlate pre and intra-operative findings of functional endoscopic sinus surgery" was conducted inthe Department ofRadiodiagnosis,BIN and Department of ENT,IPGME&R and SSKM Hospital , Kolkata from Dec 2016 to Dec 2017. The study included 50patients of chronic sinusitis and symptoms related to nose and PNSwho did not respond to medical line of treatmentand are willing to undergo Functional Endoscopic Sinus Surgery.

Of the 50 patients, 30 underwent bilateral and 20 unilateral endoscopic surgeries, hence a total of 80 procedures were carried out. All the cases hadundergone computed tomography before theoperation.

In our study, age of patients varied between 10 and 60 years with the maximumnumber of patients in 21 to 30 year category. Thus in our study the majority of the patients (20cases i.e. 40%) were in the third decade.In our study, most of the patients belonged to male population; out of 50 study sample,28 (56%) were male and 22 (44%)were females.

Various sinonasal pathologies diagnosed on CT are classifiedbased on their imaging features. Most common sinonasal pathology foundin present study was that of inflammatory origin i.e. found in 41 (82%) patients.This is followed by that of neoplastic lesions(7 cases i.e.14%) and congenital/developmental lesions(2 cases i.e. 4%).

In the study conducted by Rashmi et al.(2016)[(42)], the most common sinonasal pathology was that of inflammatory cause(77.14%) followed by neoplastic lesions(12%) .

Similar findings were also observed in the studies done byKhan N et al.(2006), Vijay Prabhu et al.(2015) andVikasDhillon et al(2016)[(39,40,41)]

Now the most common inflammatory pathology found in our study was that of non-fungal sinusitis without polyposis(56.1%)followed by sinusitis with polyposis (31.6%), which was also found in the study conducted by Rashmi et al.(2016) [(42)]wherethey found sinusitis without polyp in 40.5% cases and polyp in 23.4% cases. Similar finding was also reported in the study done by Azzam MA, Salami et al.(2009)[(43)]accounting to 33.3% and 20% of sinusitis without polyposis and sinusitis with polyposis respectively.Sinusitis was also reported to be the most common pathology accounting to 56% as evident in the study conducted by Vijay Prabhu et al.(2015).[39]

Among the intrasinus mucosal disease involvement, maxillary, anterior ethmoid, posterior ethmoid, frontal,and sphenoid were found to be involved in 70%, 62%, 56%, 46% and 38% respectively in the present study. So, the most common sinus involvement as per our study was that of maxillary sinus followed by anterior ethmoid, posterior ethmoid, frontal and sphenoid sinuses in that order. In this context,it is also to be mentioned that there are samples in our study which showed more than one sinus involvement but while calculating the percentage of sinus involvement, I have considered the sinus lesions only separately ignoring the individual persons number of involvement of sinus lesions.

According to Bolger et al.(1991), maxillary sinus disease was reported in 77.7% cases followed by posterior ethmoids involvement in 38.6%, frontal 36.6% and sphenoid sinus lesions in 25.4%.

Maru et al.(2001) reported maxillary sinus disease in 70.4% cases, posterior ethmoidlesions in 52.4%, frontal disease in 48.3% and sphenoid sinus disease in 40.8% cases.

Thus the present study correlates well with studies done by Bolger et al.(1991) and Maru et al.(2001).

Suthar et al.(2015)[(44)]., Chaitanya CS et al.(2015) %[(45)] and Kushwah APS et al.(2015) also conducted similar studies and all these three studies also showed the maxillary sinus to be the most commonly involved ones[(46)].

In all the five studies mentioned above, the sphenoid sinus was conspicuously found to be the least one to get involved in sinus pathology(inflammatory- non polypoidal or polypoidal); this is also evident in our present study.

Concha Bullosa is a ballooned out middle turbinate due to pneumatisation. The pneumatisation can grow to such an extent that the bulging end of the turbinate completely fills the space between the septum and the lateral wall of nose resulting in the blockade of the sinus draining into the middle meatus. The incidence of concha bullosa in this study was 53.7%. Two other similar studies done by Bolger et al%(1991)[(47)]and Maru et al. (2001)[(48)]have reportedregarding the presence of concha bullosa to be 53.6% and 42.6% respectively, which

is almost similar to our present study. The incidence of concha bullosa in our study was found to be almost similar as compared to the reported incidence of 49.3 % by Fadda et al.(2012)[49]

The incidence of concha bullosa was reported to be 23.6% as per study done by Perez Pinas et al.(2000)[52] ; these findings are less than that found in our present study.

In our study the, incidence of Haller cell was found to be present in only 1 study sample (1. 2%) which is quite corroborating to the result of the study conducted by Baradaranfar MH et al.(2007) [50] who have reported the presence of 4.17% Haller cells among their study sample.

Bolger et al.(1991) [47] also carried a similar study where they reported the presence of 45.9% of Haller cells among their study population.

CT is effective in demonstrating predisposing causes of chronic sinusitis and provides precise guidance for therapeutic endoscopic instrumentation. CT with its excellent capability for displaying precisely both in bone and soft tissues window, it is the current diagnostic modality of choice for evaluating the ostiomeatal complex(Zinreich et al.)[53.54].

Among the various parameters that were correlated, the sensitivity was found to be statistically significant enough for almost all the parameters [incase of frontal recess(90.9%), posterior ethmoids (93.7%),anterior ethmoid(84.6%), inferior turbinate(93.8%),concha bullosa(91.4%) and haller cells(100%)].

Similarobservation was also reported by Kaluskar and Patil (1992) when they compared the sinus disease radiologically with that of surgery.

The specificity among the other parameters in our study was found to be statistically significant also for the anterior ethmoids(90.2%),posterior ethmoid(95.8%), middle turbinate(89.6%) , concha bullosa(93.9%) and haller cells(100%) .

Thus it can be said that CT isa very sensitive and specific investigation for the disease in all the sinuses except the maxillary sinus and its ostium.

The scan always serves as a "road map" for the surgeon as he negotiates the potentially hazardous clefts of the paranasal sinus unit converting the precise disease clearance with minimum residuals and least complications.

Among the intrasinus mucosal disease, Maxillary sinus(k=0.11) and Frontal sinus (k=0.13) disease showed pooragreement, as evident from the respective k-value, whereas in case of anterior ethmoid lesions (k=0.75) and Sphenoid sinus lesions (k=0.74) a good agreement is evident in my study. PosteriorEthmoids sinus diseaseshowed a very good agreement(k=0.89) in our study.The study conducted by Polisetti et al.(2016)[50] also showed very good agreement with posterior ethmoid disease(k=0.80), a good agreement with anterior ethmoid(k=0.76) and sphenoid sinus disease (k=0.76) and a poor agreement obtained with frontal (k=0.01) and maxillary sinus(k=0.08) disease in their study. So these findings of Polisetti et al.almost tallied with those obtained in our present study.

Paradoxical middle turbinate refers to the concavity of the turbinate medially, contrary to the normal convexity medially. This causes obstruction of the ostiomeatal complex leading to sinusitis. In our study middle turbinate abnormality showed a very good agreement(i.e.k=0.81) between CT and endoscopic sinussurgery which corroborated with the findings obtained in thePolisettiet al(2016)study (k=1).

Assessment of hiatus semilunaris and infundibulum also showed a fair agreement in our study (i.e.k=0.37 and 0.35, respectively) between CT and FESS findings.This is quite in line with the similar results obtained in the study of Polisetti et al(2016) which also showed a fair agreement as regards detecting the hiatus semilunaris (k=0.39) and infundibular(k=0.37) lesions.

On the contrary, the study conducted by Sheetal D et al.(2011) [36]showed a poor correlation between CT and FESS findingsso far as Hiatus semilunaris and infundibular lesions are concerned.

In our study, uncinate process attachment showed a good agreement (k=0.74). However in studies conducted by Polisetti et al and Sheetal D et al., an excellent correlation was found.

The present study showed a very good agreement of concha bullosa statistically (k=0.84) between the observations in CT and FESS (operation). Similarly, the study done by Polisetti et al.(2016) also showed a very good statistical agreement (k=0.97) as regards CT and FESS findings .

Haller cells (Infraorbital cells) are an extension of ethmoid air cells present in theinferomedial wall of the orbit or roof of the maxilla and obstruct the infundibulum leading to sinusitis. Haller cells showed a very good agreement in the present study (k= 1.000).

Very good agreement was also found in a similar study done by Polisetti et al.(2016) (k=1.00) [51]. However, in the study done bySheetal D et al.(2011) a poor correlation was observed in the respect of Haller cell detection between the CT and FESS findings.

In our study frontal recess showed good agreement(k=0.74) between CT scan and FESS which tallied with the result of study conducted by Polisetti et al. However, in study conducted by Sheetal D et al. study showed poor correlation.

The advantages and disadvantages of endoscopy can be statedas follows:
Advantages of endoscopy are:
- Optical brilliance and clear field of vision.
- Easy handling, office procedure, economic.
- Ability to "look around corners" with deflecting angles.

Limitations of nasal endoscopy are:-
1. Gross septal deviation can make endoscopy difficult and unrewarding.
2. Localized disease within the infundibulum, frontal recess and maxillary sinusostium is difficult to diagnose.
3. Optical illusory effect – due to this, a beginner may find it difficult to orient the anatomy especially when using different optical views.
4. Depth perception is not there because of absence of binocular vision.

Overall, the advantages and disadvantages of CT scans can be stated follows:

Advantages of CT scan are:
1. It shows progressively deeper structures as the surgeon encounters them during operation (eg: uncinate process, bulla ethmoidalis, ground lamella, sphenoid sinus).
2. It shows the relationships of the above structures to important areas such as the lamina papyracea and skull bone, reducing the morbidity.
3. Dehiscence of the lamina papyracea are better visualized.
4. Comparative study of two sides of the ethmoids labyrinth is possible.To sum up, the CT scan serves as a "road map" for the surgeon as he negotiates the potentially hazardous clefts of the PNS unit. It is a non-invasive, rapid, convenient investigation, which helps in documentationand education. As already mentioned CT scan delineates the extent ofdisease, anatomical and pathological variations far better than othermethods.

Disadvantages of CT scan: -
1. Radiation dose to the sensitive areas like cornea and lens is particularly high when axial cuts are taken – nearly 185 times more than that recorded for plain X – rays. Careful positioning of the patient in the scanner can reduce this.
2. Inability to differentiate between fibrous tissue (post-op) and inflammatory mucosal disease.
3. Relatively expensive investigation.

V. Conclusion

The computerised tomographic(CT) findings correlated very well with operative findings (FESS) for almost all the sinuses with eithera very good, or good or fair Cohen kappa correlation(as depicted by the respective k-values) except for maxillary and frontal sinus lesions and septal pathologies. The reasons behind these poor correlations for thelatter three parameters could be due to non-visualisation of the same during endoscopy for individual anatomical variationsor difficult endoscopic negotiation due to pathological changes.

CT scan is a must prior to any functional endoscopic sinus surgery. It helps in assessing the extent of sinus disease and to know the variations and vital relations of the paranasal sinuses. CT assists the surgeon as a "road-map" during FESS.

However, the present study is delimited by the inclusion of a small size study sample(50 patients) and duration of only one year. So to conclude finally in a better way,we have to perform a similar study with a larger size of study sample and a longer duration.

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