Correlation between Pre-Operative CT Scan and Intra Operative Endoscopic Findings in Functional Endoscopic Sinus Surgery

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Introduction

Paranasal sinuses are the air containing spaces in skull that include maxillary, ethmoid, frontal and sphenoid sinuses. The nasal passage and paranasal sinuses diseases and conditions range from sinusitis, polyps other inflammations to neoplasms.

Material and Method

Record based retrospective study done in 68 patients diagnosed as per European Position paper on Rhino sinusitis and Nasal Polyps. Messerklinger Technique of Fess was used for FESS Surgery. Rhino sinusitis Symptom Inventory Scoring for pre and postoperative clinical symptoms were used. Nasal Endoscopic Score Lund Mackay Endoscopic staging system for pre and postoperative endoscopic appearance was also used. CT PNS score Lund Mackay Radiological grading of CT PNS was correlated to Endoscopic findings.

Results

In our study there were 69.12% males and 30.88% were females. 33.82 % patients were in 21-30 years of age. Mean age was 28.2 ± 9.3 years. Mucosal abnormality on CT scan had 97.05% of maxillary and 67.64% were common in anterior ethmoid. Polypoidal change was commonly found in posterior ethmoid in 92.64% patients with chronic sinusitis. OMC-TO was present in 61.76% of patients intraoperatively as compared to 32.35% on CT scans. Good correlation (0.75) was found for polypoid change in anterior ethmoid. There was very good agreement (1.0) between preoperative CT scan and operative findings in cases with normal osteomeatal complex.

Conclusion

The management of chronic sinusitis (with or without polyps) demands CT scan findings before management by FESS surgery. Endoscopic findings along with CT findings has shown good correlation in our study, this will help in dealing with the disease and help complete clearance of the same.

Key words: CT Scan, Sinuses, FESS, Polyp, Endoscopy.

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INTRODUCTION

Computed tomography (CT) is used in medical field since 1970's and has proved to be an efficient tool for diagnosis. Paranasal sinuses (PNS) are maxillary, ethmoid, frontal and sphenoid sinuses, these are air containing spaces that lighten the skull, humidify air and provide voice resonance. The nasal passage and paranasal sinuses are house for wide spectrum of diseases and conditions ranging from inflammation to neoplasms. [1,2]

The precise knowledge of the anatomy of paranasal sinuses is essential for Surgeon. Various imaging modalities are available for evaluation of paranasal sinuses and with the advances in CT imaging and Functional Endoscopic Sinus Surgery (FESS) thus a lot of useful information in the diseases of maxillary and frontal sinuses is available but however there is limited role in evaluation of nasal cavity, ethmoid and sphenoid sinuses.[2] If the diagnosis is clinically confirmed and maximal medical therapy has not improved symptoms, a CT scan is then indicated. CT findings not only enable assessment of the presence of residual disease that could be addressed by surgery but also provide the surgeon with the ability to recognize the presence of anatomical risk factors for the development of CRS and to facilitate surgical planning. The radiological evaluation of sino-nasal diseases is very essential as the clinical findings in these cases may be non-specific.[1,3] CT shows the bony anatomy very well ; this provides a map for endoscopic sinus surgery. That is why it is important to understand the correlation of the pre-operative CT scan and the endoscopic findings intra operatively. The aim of the study was to correlate the pre-operative CT scan findings and intra-operative endoscopic finding in FESS surgeries.

MATERIALS AND METHODS

Study was approved from the Institutional Review Board and Institutional Clinical Ethics Committee (ICEC Number 272/07) for Human research of our institute. The study was record based retrospective done in 68 patients from 01.08.2018 TO 30.06.2022 in department of Ear, Nose, Throat, (ENT) Head & Neck Surgery, Rajiv Gandhi Medical College & Chhatrapati Shivaji Maharaj Hospital, Kalwa, Thane, Maharashtra. The study included 68 of the total patients diagnosed as per European Position paper on Rhinosinusitis and Nasal Polyps. Messerklinger Technique of Fess was used for FESS Surgery.[4,5] Only those records having preoperative CT scan and details of RSI Scoring for pre and postoperative clinical symptoms were included.[6] It is routine procedure to use Nasal Endoscopic Score Lund Mackay Endoscopic staging system for pre and postoperative endoscopic appearance and also to use Lund Mackay Radiological grading of CT PNS.[6,7,8] The records and case sheet sought from Operation theatre record and Medical Record Section. The demographic data, diagnosis, dates of surgery and pre- operative CT scan details & intra operative findings were retrieved from the case sheets.

Inclusion criteria were non neoplastic sino-nasal pathologies i,e patients with diagnosis of Chronic rhinosinusitis ,sinonasal polyposis ,Allergic Fungal Rhinosinusitis in both gender with age of 18 to 65 years with Bilateral or unilateral disease. Exclusion criteria were Mucormycosis, Acute Rhinosinusitis, Nasal masses (suspected malignancy), previously operated or revision surgery cases. Facial trauma. [1]

The European Position Paper on Rhinosinusitis And Nasal Polyps (EPOS) has now defined rhinosinusitis as a diagnosis made on clinical grounds based on the presence of characteristic symptoms, combined with objective evidence of mucosal inflammation.[4] Additional symptoms (may also be present and at least one is needed if only one of the primary symptoms is present). As per duration, 10 days to 3 months was acute and > 3 months as chronic. The defining symptoms and signs listed in the EPOS document apply to both

adults and children and was further qualified in terms of severity by use of a Visual Analogue Score (VAS) for rhinosinusitis symptoms.[4,9,10]

The parameters for study included Osteomeatal complex (OMC) normal (N), total occlusion (TO), partial occlusion (PO), Mucosal thickening (MT) in nasal cavity(N) and sinuses (S), Polypoidal changes (PC) in nasal cavity (N) and sinuses (S), Polypoidal changes in individual sinuses like maxillary(M), frontal(F), anterior ethmoid (AE),Posterior ethmoid (PE). RSI Scoring was used for clinical symptoms pre and postoperative. For Nasal Endoscopic Score Lund Mackay Endoscopic staging system for pre and postoperative endoscopic appearance and CT PNS score Lund Mackay Radiological grading of CT PNS.[6,11]

The data collected was entered in microsoft excel worksheet and descriptive statistics such as mean, standard deviation and percentage was used to present the data.. A p-value less than 0.05 were considered as significant.

Statistical Package for Social Sciences (SPSS) for windows (version 20.0) was used for statistical analysis. Correlation between CT scan and Endoscopic sinus surgery was done on the basis of Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Kappa's measure of agreement. Sensitivity of >90 was excellent correlation,>80 was good correlation,>70 was acceptable correlation,>60 was poor correlation. 0.81-1.0 was very good agreement between CT scan and operative findings. 0.61-0.80 was good agreement, 0.41-0.60 was moderate agreement, 0.21-0.40 was fair agreement, 0.2 was poor agreement, <0.01 was no agreement.

RESULTS

In this study 47 (69.12%) were males and 21 (30.88%) were females. (23) 33.82 % of the patients were in 21-30 years age group of presentation. Mean age was 28.2 ± 9.3 years. The age and distribution is given in table 1 and table 2 shows distribution of duration of disease.

Table 1 Age and Gender Distribution in our study

Age (years)	Total Male and (%)	Total Female Female and (%)	Total	Total (%)
11-20	5 (7.35)	3 (4.41)	8	11.76
21-30	15 (22.05)	8 (11.76)	23	33.82
31-40	11 (16.17)	6 (0.08)	17	25
41-50	7 (10.29)	2 (2.94)	9	13.23
51-60	9 (13.23)	2 (2.94)	11	16.17
Total	47 (69.11)	21 (30.88)	68	(100)

Table 2 Distribution of Duration Of Disease

Duration In years	No of cases	Percentage (%)
Less than 1	7	10.29%
1 – 5	35	51.47
More than 5	26	38.23

Duration of disease in our study

Duration In years	No of cases	Percentage (%)
Less than 1	7	10.29%
1 – 5	35	51.47
More than 5	26	38.23
Total	68	(100)

Among the clinical symptoms, nasal discharge was the commonest symptom noted in 88.23%, followed by nasal obstruction 80.88%. Table 3 shows Clinical Symptoms In Patients With Chronic Sinusitis, Deviated nasal septum, concha bullosa, onodi cells and haller cells were the common anatomical variants noted in 47.05%, 30.87%, 26.46% and 24.99% respectively.

Table 3 Clinical Symptoms In 68 Patients With Chronic Sinusitis

Symptom	Total No of cases	Percentage (%)
Nasal discharge	60	88.23
Nasal obstructions	55	80.88
Headache	45	66.17
Post nasal drip	13	19.11
Anosmia	13	19.11
Facial pain/pressure	7	10.29
Facial congestion	10	14.70
Fever	0	0
Halitosis(bad breath)	4	5.88
Fatigue/tiredness	5	7.35
Dental pain	7	10.29
Cough	13	19.11
Ear pain/fullness	10	14.70

Table 4 shows anatomical Variations on CT Scan in Patients of Chronic Sinusitis. Less common anatomical variant noted was paradoxical middle turbinate.

Table 4Anatomical Variations On Ct Scan In Patients Of Chronic Sinusitis

Anatomical variants	Male n (%)	Total	Female	Total Female (%)	Total	Total (%)
Deviated nasal septum	18	26.47	14	20.58	32	47.05
Concha bullosa	14	20.58	7	10.29	21	30.87
Paradoxical middle turbinate	3	4.41	4	5.88	7	10.29
Haller cells	8	11.76	9	13.23	17	24.99
Onodi cells	13	19.11	5	7.35	18	26.46

Table 5 shows assessment Of Mucosal Thickening In Individual Sinuses on CT Scan. Overall 97.05% of maxillary,67.64% of anterior ethmoid,45.58% of posterior ethmoid,19.11% of frontal and14.70% of sphenoid sinuses were found to have mucosal abnormality on CT scan.

Table 5 Assessment of Mucosal Thickening In Individual Sinuses On Ct Scan

Involved sinuses	Number of cases			Total Cases (%) 68	Total (%)
	Left	Right	Bilateral		
Maxillary	15	11	40	66	97.05
Anterior Ethmoid	15	8	23	46	67.64
Posterior Ethmoid	12	13	6	31	45.58
Frontal	3	6	4	13	19.11
Sphenoid	3	2	5	10	14.70

Table 6 shows assessment Of Polypoidal Changes in Individual Sinuses on CT scan. Polypoidal change was commonly found in posterior ethmoid in 63 patients with chronic sinusitis (92.64%), followed by the anterior ethmoid in 58(8529%), maxillary sinus in 49(72.05%) and frontal sinus in 13(19.11%).

Table 6 Assessment of Polypoidal Changes In Individual Sinuses On Ct Scan

Involved sinuses	No of cases			Total Cases 68	Total (%)
	Left	**Right**	**Bilateral**		
Maxillary	13	10	26	49	72.05
Anterior ethmoid	12	11	35	58	85.29
Posterior ethmoid	19	7	37	63	92.64
Frontal	4	3	6	13	19.11

Table 7 shows correlation of Preoperative CT Scan and Intraoperative Endoscopic Findings in Chronic Sinusitis.51.47% of patients with chronic rhinosinusitis had clinical symptoms for 1 to 5 years (yrs) and 38.23% had symptoms for more than 5 years whereas 10.29% had symptoms for less than 1 yr. In this study total occlusion in osteomeatal complex (OMC-TO) was present in 61.76% of patients intraoperatively as compared to 32.35% in CT scans. Similarly partial occlusion (OMC–PO) was found in about 29.41% intraoperatively and 22.05% in CT scan. Mucosal thickening in sinuses was found in 69.11% of patients intraoperatively and in 58.82% patients in CT scan. polypoidal change in the sinuses showed discrepancy between ct scan 55.88% and intraoperatively (75%).

Table 7 Correlation Of Preoperative Ct Scan And Intraoperative Endoscopic Findings In 68 Patients of Chronic Sinusitis

Parameters	CT scan		FESS	
	No	**Percentage (%)**	**No**	**Percentage (%)**
OMC- N	6	8.82	6	8.82
OMC – TO	22	32.35	42	61.76
OMC – PO	15	22.05	20	29.41
MT – S	47	69.11	40	58.82
PC-S	38	55.88	51	75

Table 8 shows Sensitivity, Specificity, PPV and NPV with correlation
Table 9 Kappa's Measure of Agreement and 'P' Value. The correlation was excellent in patients with normal osteomeatal complex, mucosal thickening in sinuses and polypoidal change in anterior ethmoid. Good correlation (0.795) was found for polypoid change in anterior ethmoid.

Acceptable correlation (0.661) for polypoid changes in sinuses and poor correlation for osteomeatal complex total occlusion (0.591), partial occlusion (OMC- PO) (0.661) ,polypoid change for maxillary and frontal sinuses. Very good agreement (1.0) was found between preoperative CT scan and operative findings in cases with normal osteomeatal complex. p value <0.05 is statistically significant.

Table 8: Sensitivity, Specificity, PPV and NPV correlation to Parameters

Parameters	Sensitivity	Specificity	PPV	NPV	Correlation
OMC – N	100	100	100	100	Excellent
OMC-TO	64.3	93.7	90	75	Poor
OMC-PO	100	95.2	85.7	86.5	Poor
MT-S	100	75	85.7	100	Excellent
PC-S	73.9	85.7	94.4	50	Acceptable
M	60	86.7	81.8	68.5	Poor
F	66.7	96.3	66.7	93.3	Poor
AE	91.6	88.9	84.6	94.1	Excellent
PE	86.7	86.7	86.7	86.7	Good

PPV: Positive Predictive value, NPV: Negative Predictive Value

Table 9: Kappa's Measure of Agreement

Parameters	Kappa's Value	Agreement
OMC – N	1.0	Very good
OMC-TO	0.591	Moderate
OMC-PO	0.661	Good
MT-S	0.783	Good
PC-S	0.478	Moderate
M	0.467	Moderate
F	0.630	Good
AE	0.795	Good
PE	0.733	Good

DISCUSSION

Rhinosinusitis has been defined as inflammation of mucosa of nose and paranasal sinuses. Evaluation of a patient with chronic sinusitis relies on the patient reporting a series of highly subjective symptoms. Diagnosis depends upon meticulous history taking, ruling out systemic relevant pathology by valid investigations, Diagnostic Nasal Endoscopy, CT scan Plain multidimensional. In the last three decades, the incidence and prevalence of CRS has been gradually increasing, causing a serious health problem worldwide. [2,4]

CT has become a standard diagnostic tool in the evaluation of PNSs. Modern surgical techniques aim at preservation of anatomy and restoration of normal physiology. [2] PNSs are subject to inter subject and intra-subject variations. Various vital structures lie in close relationship to PNS, these are of great importance from both clinical and surgical point of view. FESS has revolutionized the treatment of chronic sinusitis. It is based on the concept of facilitation of mucociliary clearance of nose and PNS. Obstruction of draining pathways is the most important cause of sinusitis. Clearance of this obstruction is the main aim of endoscopic surgery. [3,5]

In our study, the common age group involved was 21-30 years for both sexes (38.82%) ,followed by 31-40 years (25%). In a study by Sancheti found out that 31-40 years were commonly involved followed by 31-35 years.[12] While study Babu also found that the commonest age group involved was 20-40 years.[15] In our study symptoms of minor criteria were facial pain(n=7,10.29%),facial congestion (n=10,14.70%) and halitosis(n=4,5.88%) dental pain (n=10.29%) fatigue (n=5,7.35%). Study by Sancheti documented the commonest symptoms was nasal obstruction 78.33% followed by nasal obstruction in 66.6% and postnasal discharge in 43.33%. [11] Study by Patel revealed that maxillary and ethmoid were involved in 6.63% cases, followed by frontal and sphenoid sinus. Similar observations were also made by Handanakere and Ravibabu.[13,14]

In our study, we observed that DNS, concha bullosa, haller cells, onodi cells and paradoxical middle turbinate were common anatomical variants in 46.66% ,33.33% ,25.33% ,28.66% and 8.66%. respectively. Recurrent sinusitis can be attributed to anatomical variation. Our results are comparable with Kumari, Sancheti, Patel and Deepthi who observed that the CT PNS is the most sensitive and specific radiographic modality.[1,11,13,14]

Preoperative CT scan, after maximum medical management is an important mandatory step in now a days practice of management of CRS (including both with and without polyposis). CT scan gives a road map for the surgeon by reflecting the anatomy , anatomical variation, mucosal pathology in the nasal cavity as well as sinuses ; making it the most sensitive and specific investigation for FESS surgery. Although CT scan is very specific and sensitive, it cannot reveal exact pathology in case of polyposis; in which case the surgeon relies mostly on intra operative endoscopic findings. However our study shows strong correlation between pre-operative CT scan and intra operative endoscopic findings. A successful FESS surgery and complete disease clearance demands a surgeon to be very well versed with thorough reading of pre-operative CT scans and keep a check on all minor radiological findings while proceeding for surgery endoscopically.

Important role in the pre-operative evaluation of patients considered for FESS. CT scan provides a Road Map to guide the otolaryngologist during surgery and serves to direct the surgical approach.[1] However, the mucosal changes that it can show rarely tell us about the pathology in the sinuses. That is why it is important to understand the correlation of the pre-operative CT scan and the endoscopic findings intra operatively

The management of CRS (with or without polyps) demands maximum medical therapy, the failure of which prompts an ENT surgeon to proceed with the only effective management viz FESS surgery. Endoscopic findings along with CT findings make a surgeon way very smooth in dealing with the disease and help complete clearance of the same. At the same time, it is to be borne in mind that the timing of advising the scan has to be only after maximal medical therapy. Also the time lapse between the CT scan and surgery must not be too long, or else the mucosal changes seen endoscopically will not correlate with CT scan. Both of these investigation have excellent correlation and if studied extensively keeping an eye on even minor mucosal or anatomical landmarks can result in effective surgery. Therefore first objective should be to optimize patient medically In patients with chronic sinusitis indicated for FESS surgery a preoperative CT scan for anatomical variations and extent of the disease is a prerequisite to complete treatment and to minimize the complications.

This study proves that CT-PNS gives us the detailed accurate picture of the disease with its extent as well as of existing anatomical variations in non-neoplastic sinonasal diseases

except in FRS cases where in anatomical variations are difficult to see. Comparison of intra-op findings with CT findings suggest that it is almost 100% accurate baring few exceptions. CT gives almost a virtual picture to the endo-nasal surgeon about what he/she will encounter intra-operatively while doing the actual surgery. This helps in making the surgery more meticulous and chances of complications and residual diseases are minimal. Thus, CT-PNS is almost like a Virtual tour of nasal passages and PNS before doing the actual ESS.

Computed Tomography of the paranasal sinuses has improved the visualization of paranasal sinus anatomy and has allowed greater accuracy in evaluating paranasal sinus disease. In our study DNS is the most common anatomical variation. Among the special cells, Agger nasi cell is the most common type. Septations in paranasal sinuses is most common in frontal sinus. Type I variety is the commonest type of uncinate insertion. Type II variety of the cribriform plate is the most common type.[13] Our results are comparable with Mallikarjun, Kumari, Sancheti and Patel.[1,2,11,14]

Mere presence of anatomical variants does not establish the causality of disease but these variations are factors that predispose patients to intro-op complications. The role of radiologist is important here to expose the variants and provide guidemap to surgeons and help avoid complications related to variations.[2] The nasal fossae together with paranasal sinuses constitute a functional unit. The

paranasal sinuses communicate with nasal cavities via small openings and narrow ducts that are covered by same mucosa, this allows aeration as well as sinus drainage. This is the area that are subjected to large variety of lesions including congenital anomalies, this pathological consequence may be the source of difficulty/complication during surgery. Because of structural superimposition, conventional radiology does not give precise exploration of the region. Also surgeon must have a precise knowledge of nasal sinus anatomy and of the large number of anatomical variants in the region, this can be known only by the use of CT.[2,14] CT gives almost a virtual picture to the endo-nasal surgeon about what he/she will encounter intra-operatively while doing the actual surgery.

LIMITATIONS
Study was single center. This was a retrospective study.

CONCLUSION
In our study there was good correlation between CT scan and endoscopic findings. Thus CT scan is the preferred study for the surgeon performing FESS because the coronal images give an endoscope appearance of the sinonasal cavity. Because of the proximity of the sinuses to vital structures like orbit and brain needs an accurate preoperative evaluation to know the extent of involvement of the sinuses as well as to rule out any anatomical aberrations. Thus Preoperative CT will ensure effective treatment of the disease without any inadvertant complications. A prospective study with more patients will throw light on CT scan and Endoscopic findings.

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