

## Original Research Article

# Correlation and evaluation of computed tomographic scan findings with findings of functional endoscopic sinus surgery in cases of chronic rhinosinusitis

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**Received:** 07 January 2022

**Revised:** 13 February 2022

**Accepted:** 14 February 2022

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### ABSTRACT

**Background:** To correlate between computed tomography (CT) findings and the endoscopic findings in functional endoscopic sinus surgery (FESS) of chronic rhinosinusitis (CRS).

**Methods:** Clinically diagnosed 50 cases of chronic rhinosinusitis, who underwent CT-PNS scan and FESS during the period from July 2019 to September 2021 at department of ENT, government ENT hospital, Peddawaltair, Visakhapatnam, were selected by random sampling method. The findings of CT scan and FESS evaluated and the correlation was assessed using Chi-square test and kappa statistics.

**Results:** Hypertrophy of the inferior turbinate was the most obvious finding in CT (71%) and during FESS (69%). The most common co-morbidity found among the patients with chronic sinusitis was allergy in 35% (18) patients. Most of the important findings like mucosal thickness, osteomeatal complex (OMC) patency, hypertrophy of turbinates, septal deviation, polyp, Concha bullosa were detected both in CT and FESS and show good correlation. No significant correlation was found between clinical symptoms and gender or duration of disease.

**Conclusions:** There are good to excellent correlations between the two procedures. In spite of a good agreement between CT and FESS findings in most patients, in some unusual cases, CT may miss some findings. The value of FESS is more because of its therapeutic value. From this study it is evident that CT can complement FESS to a great extent.

**Keywords:** CRS, CT PNS, Turbinate hypertrophy, Deviated nasal septum, FESS

### INTRODUCTION

Chronic rhinosinusitis (CRS) is one of the most common chronic diseases and affects nearly 50 million individuals every year world over. The diagnosis of chronic rhinosinusitis relies heavily on clinical judgement based on number of subjective symptoms and signs. CT has become the standard diagnostic tool in evaluation of paranasal sinuses.<sup>1</sup> CT scan evaluation of the patient, who have to undergo eventually FESS, is extremely useful in confirming the clinical diagnosis of chronic rhinosinusitis.<sup>2</sup> The aim of this study is to evaluate and

correlate between CT findings and endoscopic findings in FESS.

The OMC is the key area for the pathogenesis of chronic rhinosinusitis. Patency of ostia is the most important factor in the development of chronic rhinosinusitis.<sup>3</sup> FESS aims to eliminate the disease from the primary site. i.e., the OMC and allow the resolution of secondary infection from the larger sinus.<sup>4</sup>

Computerized tomography (CT) provides essential preoperative information for the assessment of patients

undergoing FESS. One of the aims of CT of the sinuses is to delineate the extent of the disease, define any anatomical variants and relationship of the sinuses with the surrounding important structures. At present, CT scanning is the most commonly used imaging technique for assessing Sino nasal pathologies and defining the anatomic abnormality.

During the FESS prior endoscopic examination proves the ability to accurately access these areas for evidence of localized disease, or for the anatomical defects that compromise ventilation and mucociliary clearance.

Hence CT and endoscopy have revolutionised the understanding and management of chronic sinusitis in recent times. Recently combination of systematic understanding of the lateral nasal wall with CT in the coronal plane and endoscopy has become the corner stone in the evaluation of the PNS disease. This is the basis for the concept of FESS.

**Aim of study**

Aim of the study was to correlate and evaluate the computed tomographic scan finding of FESS in chronic rhinosinusitis.

**METHOD**

**Collection data**

This cross-sectional study was conducted at department of ENT, government ENT hospital, Peddawalair, Visakhapatnam, from July 2019 to September 2021, for 26 months. 50 adult patients attending ENT outpatient department, who were clinically diagnosed as CRS posted for FESS were included in the study after taking informed valid consent.

**Exclusion criteria**

Patients pediatric age group, with immunocompromised conditions like, 1. Complicated sinusitis 2. Osteomyelitis, 3. Aggressive fungal infection, 4. Benign tumours and 5. Malignant tumours and those who declined to participate in the study were excluded.

Prior to FESS, nasal endoscopy was performed with a 0 degree and 30-degree rigid endoscope. First, the endoscope was passed without decongestion or anesthesia to look for the status of the mucosa. Later, under topical anesthesia, DNE was performed with a zero degree and thirty-degree rigid endoscopes. The presence or absence of mucosal edema, watery or purulent discharge and polypi was recorded. and the anatomical variations, if present, were noted. Each patient was then prepared for a CT scan.

During DNE, all the secretions were suctioned, decongestion was done, and then the patient was sent for

CT PNS within a week. Plain CT scan of paranasal sinuses, axial and coronal cut, with sagittal reconstruction, was done. All the anatomical variations were noted.

**Statistical analysis**

The level of agreement between CT and FESS findings were determined by calculating kappa statistics used for statistical analysis.

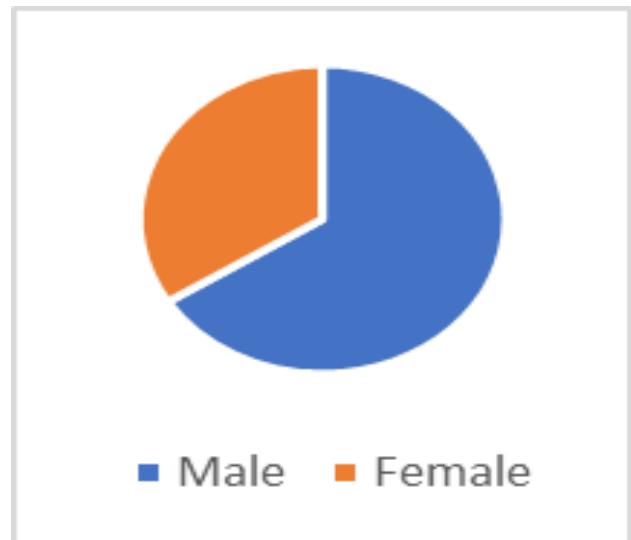
**RESULTS**

A total of 50 patients were studied.

**Table 1: Age distribution.**

Age (years)	No. of patients	Percentage (%)
0-20	13	26
21-40	23	46
41-60	12	24
61-80	2	4
<b>Total</b>	<b>50</b>	<b>100</b>

Maximum number of patients are in 21-40 years of age 46% of patients are in 3<sup>rd</sup> and 4<sup>th</sup> decades of age. The mean age of the patients is 34.4 years.



**Figure 1: Sex distribution.**

**Table 2: Sex distribution.**

Sex	No. of patients	Percentage (%)
<b>Male</b>	<b>33</b>	<b>66</b>
<b>Female</b>	<b>17</b>	<b>34</b>
<b>Total</b>	<b>50</b>	<b>100</b>

The present study shows male preponderance i.e., 66% male and 34% female patients. Thus, male to female ratio is 1.9:1

**Table 3: Symptoms.**

Symptoms	No. of patients	Percentage (%)
Headache	39	78
Nasal obstruction	37	74
Nasal discharge	20	40
Post nasal discharge	19	38
Sneezing	13	26
Epistaxis	9	18
Others	4	8

**Table 4: Signs.**

Sign	No. of patients	Percentage (%)
Nasal mucosa: congested	17	34
Nasal mucosa: Pale	13	26
Nasal mucosa: normal	11	22
Nasal mucosa: Oedematous	9	18
Inferior turbinate hypertrophy	21	42
Middle turbinate hypertrophy	17	34
Middle meatus: Non purulent	15	30
Middle meatus: Purulent discharge	38	76
Nasal polyps	16	32
Granular posterior pharyngeal wall	31	62

**Table 6: Correlation between CT scan and FESS in patients with chronic rhinosinusitis.**

Variables	FESS positive		FESS negative		KAPPA
	CT scan positive	CT scan negative	CT scan positive	CT scan negative	
Mucosal thickness	28	2	5	15	0.71
OMC	32	2	0	16	0.86
Inferior turbinate hypertrophy	32	1	3	14	0.88
Middle turbinate hypertrophy	7	1	1	41	0.85
Septal deviation	27	4	1	18	0.81
Polyp	8	4	0	38	0.77
Cyst	6	0	0	44	1
Choanal atresia	0	0	0	50	0
Concha bullosa	4	0	2	44	0.7

The level of agreement with kappa statistics with 0.80-0.90 was taken as strong and >0.90 is taken as almost perfect agreement with approximated data reliability of more than 80%.

In the present study, inferior turbinate hypertrophy, OMC, middle turbinate hypertrophy and septal deviation had a strong level of agreement whereas cyst had a perfect agreement level.

Common symptoms of the patients in the present are Headache (78%), Nasal obstruction (74%), Nasal Discharge (40%), Epistaxis (18%) and other symptoms (8%) like ear block, foul smell etc. are less common. Postnasal discharge is seen in 38% of patients, sneezing in 26% with other symptoms.

The study showed nasal mucosa congestion in 34%, pale mucosa in 26%, and edematous in 18%. The rest 18% had a normal nasal mucosa. Inferior turbinate hypertrophy was seen in 42% of cases while middle turbinate was hypertrophied in 34% of cases. Middle meati showed purulent discharge in 76% of cases, while polypi were noted in 32% of cases. Granular posterior pharyngeal wall was seen in 62% of cases.

**Table 5: Patterns of the simultaneous involvement of various sinus groups shown by CT scan.**

No. of involved sinuses	No. of patients	Percentage (%)
One	12	24
Two	20	40
Three	10	20
Four	8	16
Total	50	100

The simultaneous involvement of 2 sinus groups was commonly seen in 40% of cases, and all sinuses involvement i.e., pan sinusitis was noted in 16% of cases. The involvement of single sinus group was in between with an occurrence of 24% as observed from the CT scan sections.

Mucosal thickness, polyp and concha bullosa had a moderate level of kappa agreement while choanal atresia poor strength of agreement.

## DISCUSSION

In this study, clinically diagnosed 50 patients of chronic rhinosinusitis, from department of ENT, government ENT hospital, Peddawalair, Visakhapatnam. Who

underwent CT scan and FESS during the period from July 2019 to September 2021, who were willing to undergo both CT Paranasal sinus and FESS were included.

### **Demographic data**

In the present study age of patients varies between 15 and 75 years, with the maximum number of patients in 21 to 40 years category. In study conducted by Sheetal et al with 45 patients the majority of patients is in the age group of 21 to 40 years.<sup>1</sup> By above study we understand this age group are predominant because they are more exposed to the environment, recurrent upper respiratory tract infections, irregular check-up and treatment. The mean age of the patients is 34.4 years in this study. The study conducted by Zojaji et al of 51 patients the mean age of the patients is 33 years, and the mean age of the patients is 36.4 years in the study conducted by Geminani et al.<sup>2,9</sup> All the above studies show 4<sup>th</sup> decade of age is affected with CRS more.

The maximum number of patients are male 51.5% (18) as compared to female 48.5% (17). The study of Zojaji et al<sup>2</sup> shows there are 69% male (35) and 31% female (16). All of the studies including the present study have a male predominance then female.

### **Clinical features**

In the present study nasal obstruction and headache are the commonest symptoms which are present in 74% (37) and 78% (39) cases respectively. The next frequently occurring complaint is nasal discharge present in 40% (20) cases. The other symptoms are postnasal discharge 38% (19), sneezing 26% (13), epistaxis 18% (9) and symptoms like fever, anosmia/cacosmia etc in 8% (4) cases. In majority of the cases the duration of symptoms is more than 4 weeks and is not responding to medical line of management. In the study conducted by Sheetal et al the commonest complaints are headache in 90% followed by nasal discharge in 80%. The other complaints such as sneezing are seen in 9% of the patients. The average duration of symptoms varies from 1-5 years. In the study conducted by Zojaji et al nasal obstruction is the most common symptom with 51 patients and headache is noted in 72.5% (37) patients and nasal discharge in 90.1% (46) patients and other related complaints such as hyposmia seen in 15 cases, cough in 11 and asthma in 6 cases.<sup>2</sup> The signs and symptoms ranged from 12 weeks to many years. The results of the present study are comparable with all of these studies showing a chronic Sino nasal pathology taken into consideration in all the studies.

In the present study by anterior rhinoscopic examination the commonest clinical sign is purulent discharge in middle meatus seen in 76% (38) patients and granular posterior pharyngeal wall seen in 62% (31) patients. Deviated nasal septum is seen in 46% (23) patients with

majority being asymptomatic DNS. Inferior turbinate hypertrophy 41% (21) and middle turbinate hypertrophy 34% (17). Congested nasal mucosa in 34% (17) patients, while pale mucosa, is present in 26% (13) patients.

### **Comparative findings in CT and FESS of nasal cavity**

#### *Deviated nasal septum*

was seen in 66% (33) patients during FESS and 56% (28) patients on CT scan. In the study conducted by Fikret Kasapoglu et al the most common findings are deviated nasal septum noted in 41.9% (18) cases on CT scan.<sup>5</sup> In the study conducted by Jareoncharsri et al septal deviation is obvious in 72.3% (60) of the patients out of 83 cases in endoscopic finding in FESS.<sup>6</sup> No conclusive literature is presents to compare CT scan and endoscopy of deviated nasal septum on the same patients.

#### *Maxillary ostium patency*

patency of the maxillary ostium is seen in 66% (33) cases in right and 68% (34) cases on the left on FESS. The patency is assessed with an angled endoscope and in many of the cases with the help of a curved suction tube which can be passed into the ostium, thereby confirming patency even though it is a blind procedure, On CT scan the present study shows 62% (31) on right and 64% (32) cases on left, has patency. In the study conducted by Zojaji et al maxillary sinus patency is seen in 62.7% (32) on right and 64.7% (33) on left when seen by CT scan and 68.6% (35) on both right and left when seen by FESS.<sup>2</sup> On comparison the present study shows similar results.

#### *Anatomical variants*

*Uncinate process:* Pneumatized uncinat process is seen in 2 cases (4%) on the right and one case on the left on CT scan, while on FESS only 1 case (2%) is seen on the left. In the study conducted by Fadda et al pneumatized uncinat process is noted in 0.7% (1) case on the right and 2.8% (4) on left.<sup>7</sup> On comparison both the studies show almost equal percentage of patients with pneumatized uncinat.

*Agger nasi:* 16% (8) cases on the right and 28% (14) cases were demonstrated with FESS whereas on CT scan shows 30% (15) on right and 36% (18) cases on the left. In the study conducted by Sheetal D et al on CT scan the Agger nasi cells are present in 37% and 33% of the cases on the right and left sides respectively.<sup>1</sup> On comparing both studies showed similar number of cases with Agger nasi cells.

*Onodi cells:* It is only seen on CT scan in 4% (2) cases on the right side. Importance of Onodi cells is its close relation to the optic nerve and it can be only appreciated completely in axial cuts of the CT scan hence making axial cuts to be a must in CT study of paranasal sinus.

**Middle turbinate concha bullosa and paradoxical turbinate:** Middle turbinate concha bullosa is the most common variation present, seen both in FESS and CT scan 4 (8%) cases show concha bullosa on FESS whereas CT scan shows 5 (12%). The advantage of CT scan is that it detects both lamellar as well as concha pneumatization with more accuracy. The presence of concha is more important, because pneumatization of middle turbinate causes compression of the middle meatus and hence causes narrowing of the hiatus semilunaris. Paradoxical middle turbinate is seen only on left side in 3 (6%) during FESS whereas on CT scan 1 (2%) case is seen on the right and 5 (10%) is seen on the left side. In the study by Sheetal et al on CT scan Concha bullosa is seen in 35% and 42% of the patients on the right and left sides respectively.<sup>1</sup> In FESS concha bullosa is seen in 33% and 40% of the patients on the right and left sides respectively. On CT scan paradoxical middle turbinate is seen in 17% and 8% of the patients on the right and left sides respectively. On comparison, present study has a smaller number of paradoxical middle turbinate as well as concha bullosa. Comparative study of CT and FESS on mucosal changes and other pathological conditions.

**Hypertrophy of middle turbinate:** It is seen in 16% (8) cases on FESS and CT scan. The hypertrophy of the middle turbinate is mostly seen in cases with allergy. In the similar study conducted by Zojaji et al out of 51 patients, middle turbinate hypertrophy is seen in 15.6% (8) cases endoscopically and 13.7% (7) cases in CT scan. On comparison both the studies have almost similar number of cases seen with middle turbinate hypertrophy.

**Inferior turbinate hypertrophy:** It is seen in 66% (33) patients on the right and left on FESS, whereas on CT scan shows 70% (35) on both the left and right side. The striking finding seen both in CT and FESS is the inferior turbinate hypertrophy is always bilateral and in no case can a unilateral hypertrophy be seen and in most of the cases it is associated with pale mucosa indicating allergic condition. Pale inferior turbinate is evident in 62% cases on the right (31) and 62% cases on the left (31). Whereas this finding is not appreciated on CT scan, hence indicating that the condition of the mucosa whether pale, congested and oedematous can only be clearly appreciated in FESS, whereas CT scan holds no diagnostic value about the condition of the mucosa. In the study conducted by Naghibi et al Hypertrophy of the inferior turbinate is the most obvious finding in the CT scan (70.6%) as well as in FESS (68.6%).<sup>2</sup> On comparison with the present study both the study shows both FESS as well as CT scan can detect hypertrophied inferior turbinate in almost equal percentage of cases.

**Polyp:** It is seen in 24% (12) cases detected on FESS whereas CT scan did not show the findings, thereby showing that FESS is of more diagnostic value in evaluating polyps as mild polyposis could only be seen in FESS. On CT, only extensive polyposis can be identified. In the study conducted by Patel et al nasal polyposis is

seen in 23.91% (22) cases of which bilateral is seen in 10.86% (10) and unilateral in 13.04% (12), whereas a total of 34% (17) cases is seen in the present study. CT scan and FESS showed almost similar results.<sup>8</sup>

#### *Mucosal thickness*

Frontal sinus haziness can be better seen in CT scan compared to FESS. Maxillary mucosal thickening noted in 46% (23) cases on CT scans and 40% (20) in FESS. Anterior ethmoidal and sphenoid sinus haziness is seen in 24% (12) cases in CT scans and 16% (8) in FESS. Maxillary mucosal thickening is mostly seen associated with other sinus involvement. Endoscopically drainage of secretions from the superior or supreme meatus or from the sphenoid-ethmoidal recess may be the only indication of posterior sinus disease. The approach to the superior meatus is restricted or is inaccessible in majority of the cases due to high DNS or any other pathology. In the study of Sheetal D et al<sup>1</sup> on CT scan maxillary sinus is found to be the most common sinus to get affected (57% on the right and 46% on the left side), followed by the anterior ethmoid cells (40% on the right and, 37% on the left side), the posterior ethmoid cells (33% on the right and, 28% on the left side), the frontal sinus (28% on the right and, 26% on the left side) and, sphenoid (20% on the right and, 13% on the left side) respectively.

CT has become the standard diagnostic tool in the evaluation of paranasal sinuses. When coupled with nasal endoscopy, it provides most of the objective data needed for diagnosing CRS. Despite the widespread use of CT, its true accuracy in diagnosing CRS is less clear. The aim of this study was to determine the correlation between preoperative CT and intraoperative ESS findings in patients with CRS. The results of our study indicated that for most of the findings, there was a good to excellent level of agreement between the results of 2 methods.

The main limitations we encountered in the present study results are the finding of hypertrophic concha more evident in CT scan compared to sinus endoscopy (88% vs 84%). In 66% (33) of 50 patients we found mucosal thickness evidenced by CT: only 60% (30) of 50 patients had the same problem in FESS. This discrepancy may be due to the fact that up to 40% of asymptomatic individuals have incidental opacification of the paranasal sinuses on CT. In children, the prevalence of mucosal change is even larger. These results can be optimised by prior through clinical history for symptoms and nasal endoscopy findings.

However, CT scans form an important and reliable objective assessment tool for patients undergoing surgery for CRS.

## **CONCLUSION**

From the present study it is concluded that Sino-nasal pathology has a higher preponderance in male patients



and is commonly seen in the age group of 20 to 40 years. CT scan has got a better advantage compared to FESS in detecting the anatomical variants as well as to know the condition of sinus cavity and the extent of disease in sinuses. FESS can prove to be a better diagnostic modality compared to CT scan when conditions like middle meatal secretions, condition of mucosa, polyps are looked for. The study stresses that in all patients with Sino nasal disease CT scan has to be done to know the exact pathology and to plan for FESS, if required. CT scan provide findings almost similar the preoperative findings of FESS and helps in management and provides “road map” to the surgeons if FESS is indicated.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Killu S, Dakkata SR, Sreerama SPR. Correlation and evaluation of computed tomographic scan findings with findings of functional endoscopic sinus surgery in cases of chronic rhinosinusitis. Int J Res Med Sci 2022;10:604-9.