

Correlation between pre-operative CT scan findings and operative findings during Endoscopic Sinus Surgery in chronic sinusitis patients

Dr. Rashmi Prashant R (Author), Dr. Anil S Harugop (Author)

¹(Asst. Prof) Department of ENT, Dr. D. Y. Patil Medical College, Pimpri, Pune, India.; ²(Professor) Department of ENT, K.L.E Society's Jawaharlal Nehru Medical College, Belgaum, India.
Email: rashmiprashant80@gmail.com

ABSTRACT

Background and objectives:

Chronic sinusitis is one of the frequently encountered problems in otorhinolaryngological practice.

The objective is to correlate preoperative CT scan findings with Endoscopic Sinus Surgery(ESS) findings in chronic sinusitis patients undergoing ESS. To understand anatomical variations during the surgery.

Method:

The patients underwent CT scanning of the Paranasal sinuses both coronal and axial views. Finally, the patients underwent Endoscopic Sinus Surgery by Messerklinger technique as described by Stammberger.

Results:

In our study, the CT scan and operative findings correlated excellently in cases of paradoxical middle turbinate, bony destruction, concha bullosa, polypoidal changes in ethmoidal sinuses and ostiomeatal complex normal widening. There was very good agreement between preoperative CT scan and operative findings for concha bullosa, paradoxical middle turbinate, bony destruction, ostiomeatal complex normal widening, polypoidal change in sphenoid sinus.

Concha bullosa was the most common anatomical variant of the middle turbinate.

Interpretation and Conclusion:

Preoperative CT scan helps the surgeon to assess the disease before the surgery and clear the sinuses accordingly. Based on preoperative CT scan, the surgeon can predict the anatomical variations and pathological changes. Therefore CT scan helps the operating surgeon to execute appropriate precautions during Endoscopic Sinus Surgery.

Keywords : Chronic sinusitis, preoperative CT scan, Endoscopic Sinus Surgery.

1 INTRODUCTION

Chronic sinusitis is one of the frequently (16.3%) encountered problems in otorhinolaryngological practice.¹

Sinusitis is best defined as an inflammatory condition of the paranasal sinuses. Classically, sinusitis was thought of as an infection, primarily of bacterial origin. However, today it is recognized that sinus inflammation can derive from a number of causes. Especially in chronic sinusitis, the rate of infection in the aetiology of sinus inflammation is unclear.^{2,3}

“If the ethmoids were placed in any other part of the body, it would be an insignificant and harmless collection of bone cells. In the place where nature has put it, it has major relationships so that diseases and surgery of labyrinth often leads to tragedy. Any surgery in this region should be simple but it has proven one of the easiest ways to kill the patient” was said by Mosher in 1929.⁴

The two cardinal factors in the maintenance of normal physiology of the paranasal sinuses and their mucous membranes are drainage and ventilation. Normal drainage of the paranasal sinuses depends on effective mucociliary clearance; this is dependent, among other things, on the condition of the sinus ostia. Mucous transport from the sinuses into the nose is greatly enhanced by unipedal nasal airflow creating negative pressure within the nasal cavity during inspiration.⁵

The secretions of the various sinuses do not reach their respective ostia randomly but by definite pathways which seem genetically determined.⁶

In a study conducted by Daniel F. Jannetto and Michael F. Pratt (1989-1994), the hypothesis tested was that the experienced otolaryngologist, using computed tomographic (CT) scan interpretation along with clinical correlation, can best evaluate the extent of disease and need for functional endoscopic sinus surgery (FESS).

OBJECTIVES

1. To correlate the preoperative computed tomography (CT) findings with operative findings in functional endoscopic sinus surgery in patients with chronic sinusitis.
2. To understand the anatomical variations in patients undergoing FESS.
3. Discrepancies of CT findings with operative findings.

METHODOLOGY

Source of data: ENT OPD

Study design: Cross sectional study

Sample size: 30 cases

Duration: one year

All patients attending ENT & HNS OPD with chronic sinusitis for more than three months duration, not responding to medical treatment.

CT scan was taken in both coronal and axial views with 3mmcuts. Endoscopic sinus surgery was done using 0 degree, 30 degree and 45 degree endoscopes under local anaesthesia.

Inclusion criteria:

- All patients proved to have sinusitis for more than three months duration not responding to medical treatment in whom CT scan could be done and needed Endoscopic Sinus Surgery.
- Age : Between 20-80yrs.

Exclusion criteria:

- Patients with chronic sinusitis who responded to medical treatment.
- Patients who were not willing to undergo ESS.
- Patients with osteomyelitis and infiltrating tumours.

Method of collection of data:

- The cases selected for the study were subjected to detailed history and evaluation.
- Routine investigations like hemogram, bleeding and clotting time and routine urine evaluation were done for the patients.
- The patients underwent CT scanning of paranasal sinuses.

Procedure:

The surgical technique used was the Messerklinger technique as described by Stammberger.

The extent of the procedure was dictated by the extent of disease as determined by CT scanning and intraoperatively. A typical complete procedure included the following:

- 1.Uncinectomy
- 2.Middle meatal antrostomy
- 3.Clearance of frontal recess and frontal sinus
- 4.Opening bulla and exenteration of anterior ethmoids
- 5.Posterior ethmoid exenteration
- 6.Sphenoid exenteration.

Following the above procedures, the findings were recorded in the proforma .

The results were tabulated. The various variations were analysed as a percentage of the total and reported.

Statistical Analysis: Correlation between CT scan and Endoscopic sinus surgery findings is done on the basis of:

1. Sensitivity
2. Specificity
3. Positive Predictive Value(PPV)
4. Negative Predictive Value(NPV)
5. Kappa's measure of agreement
6. P value

The study is Qualitative Analysis of the following parameters:

- Paradoxical middle turbinate
- Concha bullosa
- Bony destruction
- Ostiomeatal Complex widening, total or partial occlusion
- Mucosal thickening
- Polypoidal changes
- Sinuses involved like maxillary, frontal, anterior ethmoid, posterior ethmoid and sphenoid

OBSERVATION AND RESULTS

Table 1: Middle turbinate assessment

Middle turbinate	CT Scan		ESS	
	No	%	No	%
Concha bullosa	14	46.66	16	53.33
Paradoxical middle turbinate	8	26.66	8	26.66

Graph 1: Middle turbinate assessment

According to our study, the commonest anatomical variant related to middle turbinate was concha bullosa followed by paradoxical middle turbinate. Concha bullosa was found in 46.66% in CT scan while during surgery it was found in about 53.33% patients.

Table 2: Assessment of ostiomeatal complex

Ostiomeatal complex	CT Scan		ESS	
	No	%	No	%
Normal Widening	3	10	3	10
Total occlusion	10	33.33	14	46.66
Partial occlusion	7	23.33	9	30

In our study, total occlusion was present in 46.66% of patients intraoperatively as compared to 33.33% in CT scan. Similarly, partial occlusion was found in about 30% intraoperatively and 23.33% in CT scan. According to our study, total occlusion was common pathology found in middle meatus followed by partial occlusion.

Table 3: Assessment of polypoidal disease

Polypoidal changes	CT Scan		ESS	
	No	%	No	%
Intranasal	12	40	14	46.66
Sinuses	17	56.66	23	76.66

Polypoidal change was most commonly found in sinuses as compared to nasal cavities. As compared to intranasal polypoidal changes, the polypoidal changes in the sinuses showed more discrepancy between CT scan(56.66%) and intraoperative(76.66%) findings.

Table 4: Assessment of polypoidal changes in individual sinuses

Polypoidal changes in sinuses	CT Scan		ESS	
	No	%	No	%
Maxillary	11	36.66	15	50
Frontal	3	10	3	10
Anterior ethmoidal	13	43.33	12	40
Posterior ethmoidal	15	50	15	50
Sphenoidal	3	10	3	10

Posterior ethmoid was commonly involved followed by anterior ethmoid, maxillary sinus, frontal and sphenoidal sinuses. A wide range of discrepancy(about 15%) was found in CT scan(36.66%) and operative(50%) findings in case of maxillary sinus. The CT scan and operative findings correlated well in all other sinuses.

CORRELATION BETWEEN PREOPERATIVE CT SCAN AND ENDOSCOPIC SINUS SURGERY FINDINGS IN CHRONIC SINUSITIS PATIENTS

Table:5

	Sensitivity	Specificity	PPV	NPV	Correlation
CB	87.5	100	100	87.5	Good
PMT	100	100	100	100	Excellent
BD	100	100	100	100	Excellent
OMC-W	100	100	100	100	Excellent
OMC-TO	64.3	93.7	90	75	Poor
OMC-PO	66.7	95.2	85.7	86.9	Poor
MT-N	66.7	88.9	80	80	Poor
MT-S	100	75	85.7	100	Excellent
PC-N	78.5	93.7	91.6	83.3	Acceptable
PC-S	73.9	85.7	94.4	50	Acceptable
M	60	86.7	81.8	68.4	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
S	75	100	100	96.3	Acceptable

Sensitivity of > 90 is excellent correlation
 > 80 is good correlation
 > 70 is acceptable
 > 60 is poor correlation.

Excellent correlation was found in cases of paradoxical middle turbinate(PMT), bony destruction(BD), ostiomeatal complex widening(OMC-W) and polypoidal change in anterior ethmoid.

Correlation was good for concha bullosa and polypoidal change in posterior ethmoid.

Polypoidal changes in nasal cavity and sinuses and polypoidal change in sphenoidal sinus was acceptable.

KAPPA'S VALUE OF AGREEMENT AND 'P' VALUE

Table:6

	Kappa's Value	Agreement	P value	Statistical Significance
CB	0.867	Very good	0.000	Significant
PMT	1.0	Very good	0.000	Significant
BD	1.0	Very good	0.000	Significant
OMC-W	1.0	Very good	0.000	Significant
OMC-TO	0.591	Moderate	0.001	Significant
OMC-PO	0.661	Good	0.000	Significant
MT-N	0.571	Moderate	0.002	Significant
MT-S	0.783	Good	0.000	Significant
PC-N	0.730	Good	0.000	Significant
PC-S	0.478	Moderate	0.005	Significant
M	0.467	Moderate	0.008	Significant
F	0.630	Good	0.001	Significant
AE	0.795	Good	0.000	Significant
PE	0.733	Good	0.000	Significant
S	0.839	Very good	0.000	Significant

Kappa's value:

0.81 - 1.0 is very good agreement between CT scan and operative findings. 0.61 - 0.80 is good agreement

0.41 - 0.60 is moderate agreement

0.21 - 0.40 is fair agreement

<0.2 is poor agreement.

Concha bullosa, paradoxical middle turbinate, bony destruction, ostiomeatal complex normal widening and polypoidal change in sphenoid sinus showed very good correlation of agreement between preoperative CT scan and operative findings. While OMC total occlusion, mucosal thickening in nasal cavity, polypoidal changes in sinuses and maxillary sinus showed moderate correlation.

P value <0.05 is statistically significant.

In our study, all parameters were statistically significant.

DISCUSSION

The study included 30 patients with chronic sinusitis who underwent Endoscopic Sinus Surgery after undergoing CT scan of the paranasal sinuses.

1) Age and sex distribution: According to Ron.G, Eric J prevalence of chronic sinusitis in males was 32.3% and in females was 67.7%.⁷ In our study, males(76.66%) were more commonly affected than females(23.33) with ratio of 3:1. The age of patients varied from 20-64yrs.

Common age group suffering from chronic sinusitis was 20-40yrs.

2) Duration of symptoms: Majority i.e 66% patients with chronic sinusitis had symptoms for 1 to 5 years and about 26% had for more than 5 years. Only about 6% had symptoms for less than a year.

3) Concha bullosa: In our study, concha bullosa was found in 53.33% of patients.

In a study done by GAS Lloyd and VJ Lund (1991) concha bullosa was found in 24% patients.⁸

Another study by Jones (1995) showed concha bullosa in 20% patients.⁹

Similarly, study by Bolger (July 1987-Dec 1988) showed concha bullosa in 53% patients.¹⁰

Kennedy and Zeinrich (1985) found 36% patients with concha bullosa.¹¹

4) Paradoxical middle turbinate: In our study, paradoxical middle turbinate was found in 26.66% of patients.

Other authors have found the following incidences:

In another study, Bolger(July 1987-Dec 1988) found 26.1% patients with paradoxical middle turbinate.¹⁰

In our study, sensitivity was 100% suggesting an excellent correlation between CT scan and ESS findings.¹²

5) Bony destruction: Bony destruction was not present either in CT or during surgery.

Concurrent agreement for bony destruction in a study done by Daniel F and Michael F(1995) was 96.43% and P value was 0.00.

In our study, sensitivity was 100% showing excellent correlation between CT scan and ESS findings.

6) Ostiomeatal complex normal widening: In our study we have seen OMC normal widening in 10% of patients.

In our study, sensitivity was 100% suggesting an excellent correlation between CT scan and ESS findings.

7) Ostiomeatal complex total occlusion: In our study we have seen OMC total occlusion in 46.66% of patients forming one of the main causes of chronic sinusitis.

In another study conducted by Daniel F, Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for ostiomeatal complex total occlusion was 51.19% and *P* value was 0.11.¹²

In our study, sensitivity was only 64.3% suggesting a poor correlation between CT scan and ESS findings. That is, if CT scan is showing total occlusion, then only 64% of them will have same findings during surgery.

8) Ostiomeatal complex partial occlusion: In our study we have seen OMC partial occlusion in 9% of patients.

According to studies conducted by Jones(1995) and Bolger(July 1987 to December 1988), they found ostiomeatal complex partial occlusion in 37.5% and 41% patients respectively.^{9,10}

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for ostiomeatal complex partial occlusion was 64.29% and *P* value was 0.01.¹² On comparing our study with that of Daniel F and Michael F(1995) the results of correlation were very much the same.

9) Mucosal thickening intranasally: In our study it was found in 40% patients.

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for mucosal thickening intranasally was 77.38%. *P* value was 0.08.¹²

In our study, sensitivity was 66.7 suggesting a poor correlation between CT scan and ESS findings. On comparing our study with the above study, the results of correlation showed some difference in case of intranasal mucosal thickening.

10) Mucosal thickening in sinuses: In our study it was found in 60% patients.

In our study, sensitivity was 100 suggesting an excellent correlation between CT scan and ESS findings.

11) Polypoidal changes intranasally: In our study it was found in 46.66% patients.

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for mucosal thickening intranasally was 78.57%. *P* value was 0.00.¹²

In our study, sensitivity was 78.5 suggesting an acceptable correlation between CT scan and ESS findings.

On comparing our study with that of Daniel F and Michael F(1995) the results of correlation same.

12) Polypoidal changes in sinuses: In our study it was found in 76.666% patients during ESS, while in only about 56% in CT scan.

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for mucosal thickening intranasally was 48.81%. *P* value was 0.79.¹²

In our study, sensitivity was 73.9 suggesting an acceptable correlation between CT scan and ESS findings.

On comparing our study with that of Daniel F and Michael F(1995) the results of correlation showed a difference.

13) Polypoidal change in maxillary sinus: In our study it is found in 50% patients.

In other studies conducted by GAS Lloyd (1991) and William.E.Bolger(July 1987 to December 1988), polypoidal change in maxillary sinus was found in 18% and 68.8% patients respectively.^{13,10}

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for polypoidal change in maxillary sinus was 66.97%. *P* value was 0.12.¹²

In our study, sensitivity was 60 suggesting a poor correlation between CT scan and ESS findings. On comparing our study with the other studies, the correlation results were almost similar.

14) Polypoidal change in frontal sinus: In our study it was found in 10% patients.

In other studies conducted by GAS Lloyd (1991) and William.E.Bolger(July 1987 to December 1988), polypoidal change in frontal sinus was found in 2% and 30.5% patients respectively.^{13,10}

15) Polypoidal change in anterior ethmoidal sinus: In our study it was found in 40% patients.

In other studies conducted by GAS Lloyd (1991) and William.E.Bolger(July 1987 to December 1988), polypoidal change in frontal sinus was found in 28% and 78.2% patients respectively.^{13,10}

According to a study conducted by Daniel F and Michael F(1995) concurrent agreement between radiologist's CT scan findings and surgeon's operative findings for polypoidal change in anterior ethmoidal sinus was 76.19%. *P* value was 0.02.⁶

16) Polypoidal change in posterior ethmoidal sinus: In our study it was found in 50% patients.

In other studies conducted by GAS Lloyd (1991) and William.E.Bolger(July 1987 to December 1988), polypoidal change in posterior ethmoidal sinus was found in 28% and 32.2% patients respectively.^{13,10}

In our study, sensitivity was 86.7 suggesting a good correlation between CT scan and ESS findings.

17) Polypoidal change in sphenoid sinus: In our study it was found in 50% patients.

In other studies conducted by GAS Lloyd (1991) and William.E.Bolger(July 1987 to December 1988), polypoidal change in posterior ethmoidal sinus was found in 3% and 22.3% patients respectively.^{13,10}

In our study, sensitivity was 75 suggesting an acceptable correlation between CT scan and ESS findings.

CONCLUSION

There was excellent correlation between preoperative CT scan and Endoscopic Sinus Surgery in cases of paradoxical middle turbinate, bony destruction, ostiomeatal complex widening, anterior ethmoidal polypoidal change. Correlation was good for concha bullosa, posterior ethmoidal polypoidal change. Correlation was not good but acceptable for polypoidal changes in nasal cavity and sinuses and also for polypoidal changes in sphenoid sinus. While correlation was poor in cases of ostiomeatal complex total and partial occlusion, mucosal thickening in nasal cavity and polypoidal change in maxillary and frontal sinuses.

P value was statistically significant for all parameters. Thus considering *P* value, the findings noted in CT scan and during surgery showed good correlation for all the parameters. In our study, concha bullosa was the most common anatomical variant of the middle turbinate.

Kappa's measure of agreement was very good for concha bullosa, paradoxical middle turbinate, bony destruction, ostiomeatal complex normal widening, polypoidal change in sphenoid sinus. Hence, according to Kappa's measure there was very good agreement between preoperative CT scan and operative findings for the above parameters. Kappa's measure of agreement was good for ostiomeatal complex partial occlusion, mucosal thickening in sinuses, intranasal polypoidal change and polypoidal change in frontal, anterior ethmoidal and posterior ethmoidal sinuses. Hence, according to Kappa's measure there was good agreement between preoperative CT scan and operative findings for the above parameters.

To conclude, preoperative CT scan is of significant value in guiding the surgeon during Endoscopic Sinus Surgery. Based on preoperative CT scan, the surgeon can predict the anatomical variations and pathological changes. Therefore CT scan helps the operating surgeon to execute appropriate precautions during Endoscopic Sinus Surgery.

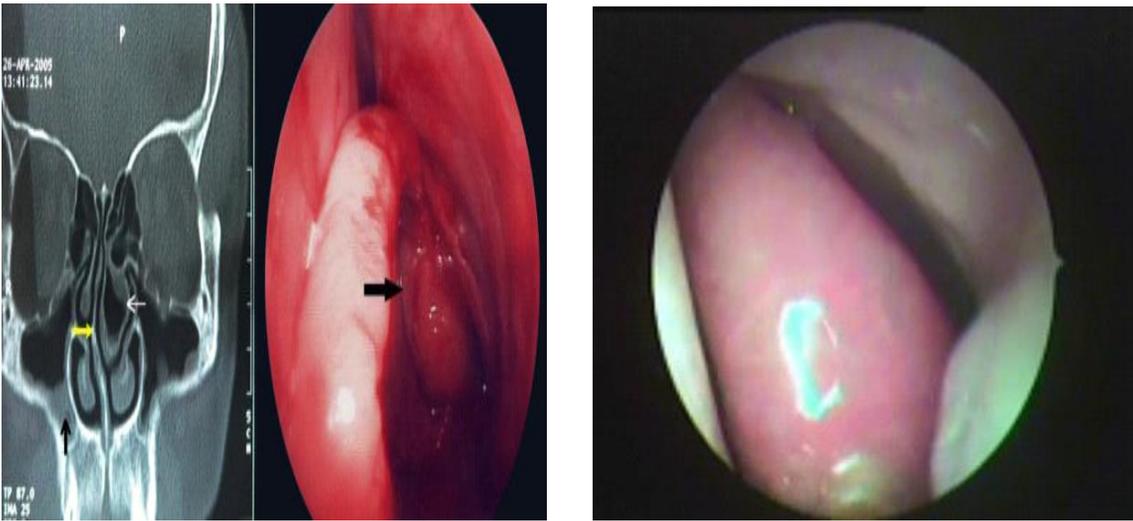
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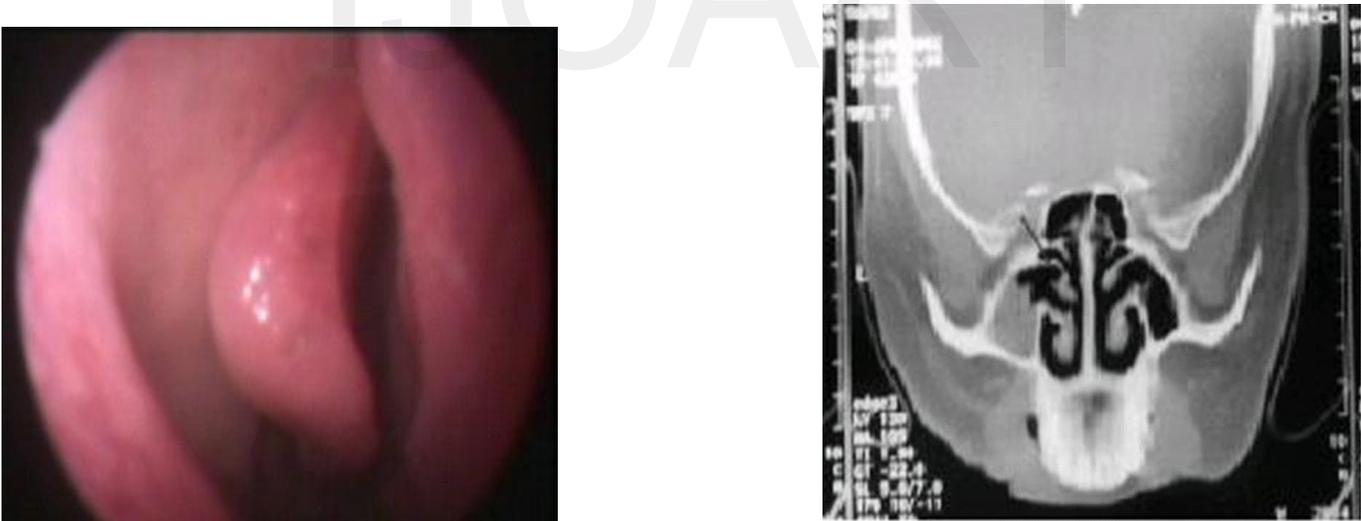
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Correlating finding of left concha bullosa on CT scan and during ESS



Correlating finding of right paradoxical middle turbinate on CT scan and during ESS.



CT scan(Axial view) showing B/L anterior and posterior ethmoiditis and B/L sphenoiditis

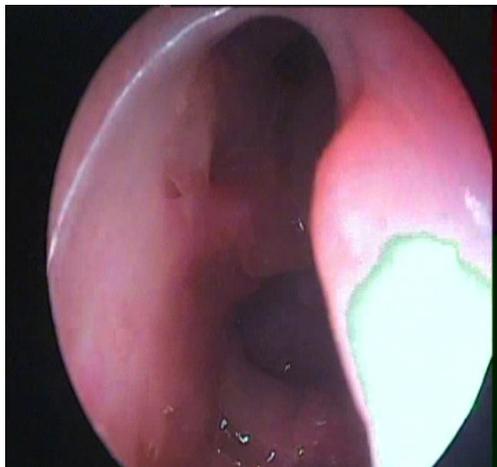
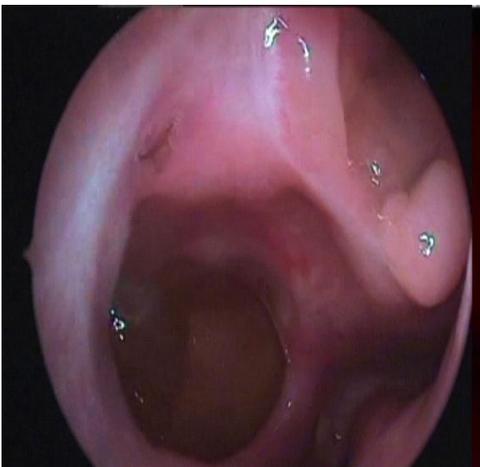


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Endoscopic pictures showing

Right middle meatal antrostomy

Left frontal recess from 45 degree endoscope



MASTER CHART

Key to master chart

1. CB – Concha Bullosa
2. PMT – Paradoxical Middle Turbinate
3. BD – Bony Destruction
4. OMC – W – Ostiomeatal Complex normal widening
5. OMC – TO - Ostiomeatal Complex Total Occlusion
6. OMC – PO - Ostiomeatal Complex Partial Occlusion
7. MT – N – Mucosal thickening in Nasal cavity
8. MT – S - Mucosal thickening in Sinuses
9. PC – N – Polypoidal changes in Nasal cavity
10. PC – S - Polypoidal changes in Sinuses
11. M – Maxillary Sinus
12. F – Frontal Sinus
13. AE – Anterior Ethmoidal Sinus
14. PE – Posterior Ethmoidal Sinus
15. Sp – Sphenoidal Sinus.

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