

## Research Article

# The role of diagnostic imaging in evaluation of nasal and paranasal sinus pathologies

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## ABSTRACT

**Background:** The objective of the study was to evaluate the role of radiological imaging in correlation with clinical finding in assessing the severity of nasal and paranasal diseases and in differentiating benign pathologies from malignant sinonasal masses.

**Methods:** In this study 50 patients with complaints of nasal obstruction, nasal discharge, epistaxis were subjected to detailed clinical examination and evaluated radiologically with X ray PNS, CT and MRI of PNS and biopsy taken from nasal and paranasal masses for histopathological confirmation.

**Results:** The main presenting complaints were nasal obstruction (82%) followed by nasal discharge (66%), headache and allergic symptoms (52%). The most common type of disease involving nose and paranasal sinuses was inflammatory disease (86%), followed by benign disease (10%) and malignant disease were found in (4%) of cases. The most common benign disease involving nose and paranasal sinuses were inverted papilloma (80%), followed by hemangioma of nasal septum (20%). The most common radiological pattern of sinus involvement is osteomeatal type seen in 38% of cases, followed by unclassified pattern in 23.8%. Maxillary sinuses were most commonly involved in the study 82% cases.

**Conclusions:** CT is the modality of choice in imaging the paranasal sinuses for evaluating the chronic diseases and associated complication and provides a reliable pre-operative road map. MR imaging plays a critical role in evaluation of sino nasal tumors.

**Keywords:** Radiological imaging, Sinonasal masses, Osteomeatal type, Inverted papilloma, CT PNS, MR imaging

## INTRODUCTION

The nose and paranasal sinuses are important structures of the head which are affected by a number of inflammatory and neoplastic conditions include both benign and malignant.

Millions of people suffer from inflammatory sinus disease in India and all over the world. Radiologic evaluation has been relied upon for many years in the diagnosis of paranasal sinus pathology. Plain film

radiography was once the modality of choice for evaluating sinonasal cavity as, it allows for quick, non-invasive evaluation of lower nasal cavity, maxillary and frontal sinuses. However, these standard views provide only limited display of anterior ethmoid cells, osteomeatal complex, middle turbinate, upper two thirds of nasal cavity and frontal recess area which plays key roles in the pathogenesis of sinusitis. Plain radiographs have now been replaced by high-resolution CT (HRCT) for the evaluation of sinonasal disease.

High resolution CT scanning provides excellent bone detail and accurate soft tissue mapping. High resolution CT is used routinely before endoscopic surgery to evaluate extent of the inflammatory disease and to assess important anatomic landmarks and their variations.<sup>1</sup>

CT is accepted as the gold standard for pathological-anatomical evaluation of paranasal sinus disease. CT is especially considered an obligatory part of planning surgical procedures.<sup>2</sup>

For sinonasal tumors, both CT and MRI provide information that is complementary. CT provides bone detail and anatomic landmarks at the skull base, while MRI has the potential to differentiate tumor from adjacent inflammation. Soft tissues are more clearly imaged by MRI and most tissues can be more accurately differentiated as being infected, neoplastic or hemorrhagic, than by CT scans. MRI best assesses intracranial complications of inflammatory diseases.<sup>1,3</sup>

## METHODS

This study included 50 patients of age group below 65 years who presented to the department of Otorhinolaryngology and Head neck surgery, MGM Medical College and MY group of Hospital, Indore (MP) with complaints of unilateral or bilateral nasal obstruction, nasal discharge and epistaxis between September 2010 to October 2012.

Detailed assessment of clinical history and routine general examination done to exclude general disease and/or spread of cancer to other systems with thorough ENT examination.

The examination of polyp/mass including the possible site of origin, number, surface, colour, the result of probing was specifically recorded as to know its site of origin, vascularity and friability. Nasal cavity decongested with 4% xylocaine with 1 in 1,00,000 dilution of adrenaline to see whether polyp/mass shrink in size with rigid nasal endoscope. Nasopharyngeal extensions if present were documented

Patients were subjected to routine blood examination for Hb%, T&D, ESR, BT, CT and radiological assessment.

X-ray paranasal sinuses (Water's view) were done routinely in all patients for initial screening. These views were considered positive for nasal polyp/mass, paranasal sinusitis if there was evidence of mucosal thickening, opacification (partial/complete) or thickened polypoid mucosa. Subsequently, the patients were subjected to CT scan PNS coronal section routinely and if needed axial section also and if feasible MRI of paranasal sinuses in few selective case.

CT Scan PNS (coronal section) were carefully analyzed for mucosal thickening/polypoid changes/soft tissue

opacification of nose and paranasal sinuses, bone destruction and anatomic variation.

All PNS CT Scans were performed on Siemens Somatom 64 Multi slice CT scanner. This is a fourth generation rotate only scanner with slip-ring technology. The scanner have multi detector 64 slice configuration with gantry rotation time of 0.33 seconds

Patients preparation before performing CT scan view included administration of full course of antibiotics, antihistaminic and decongestant followed by vigorous nose blowing so as to have better assessment of various anatomic variation predisposing of blockade of normal drainage channels. CT scan were then analyzed for the presence of any abnormal finding as rhinosinusitis ,polyp or mass, any bone erosion.

## RESULTS

Female comprised 54% of patients in the study and the commonest age group involved were between 16 to 34 years (36%).The most common symptoms were nasal obstruction (82%), followed by nasal discharge (66%), nasal mass was found in 56% cases, headache and allergic symptoms were found in 52% cases. Other symptoms were hyposmia, epistaxis, mouth breathing etc.

**Table 1: Various diseases included in the study.**

Disease	No. of cases	Percentage
<b>Chronic rhinosinusitis</b>	22	44
<b>Nasal polyp</b>	19	38
<b>Rhinosporidiosis</b>	1	2
<b>Rhinoscleroma</b>	1	2
<b>Inverted papilloma</b>	4	8
<b>Angioma of septum</b>	1	2
<b>Sinonasal adenocarcinoma</b>	1	2
<b>Squamous cell carcinoma</b>	1	2
<b>Total</b>	50	100

As in above table there were 22 (44%) cases of chronic rhinosinusitis, 19(38%) cases of nasal polyps, 4(8%) cases of inverted papilloma and 1(2%) case each of rhinosporidiosis, rhinoscleroma, angioma of nasal septum, sinonasal adenocarcinoma, squamous cell carcinoma.

Out of 19 cases of nasal polyps included in the study, 13 (68.42%) were of antrochoanal polyp and 6 (31.58%) cases were ethmoidal polyps. The most common type of disease involving nose and paranasal sinuses was Inflammatory disease 43(86%), followed by Benign disease 5 (10%), and Malignant disease were found in 2 (4%) of cases. The most common benign disease involving nose and paranasal sinuses were inverted papilloma (80%), followed by angioma of nasal septum

(20%). As in above table 1(50%) case each of sinonasal adenocarcinoma and squamous cell carcinoma.

**Table 2: CT findings in paranasal sinuses disease.**

Finding	No. of cases (n=50)	%
Frontal sinus involvement	15	30
Maxillary sinus involvement	41	82
Sphenoid sinus involvement	14	28
Ethmoid sinus	Anterior	27
	Posterior	19

Maxillary sinuses were most commonly involved in the study 82% cases, followed by anterior ethmoid sinus 54%, posterior ethmoid 38%, frontal sinus involvement 30% and sphenoid sinus involvement in 28% cases.

**Table 3: Radiological pattern of rhinosinusitis.**

Radiological pattern	No. of cases	%
Sphenoethmoidal recess pattern	2	9.52
Sinonasal polyposis	2	9.52
Infundibular pattern	4	19
Ostiomeatal pattern	8	38
Unclassified	5	23.8
Total	21	100

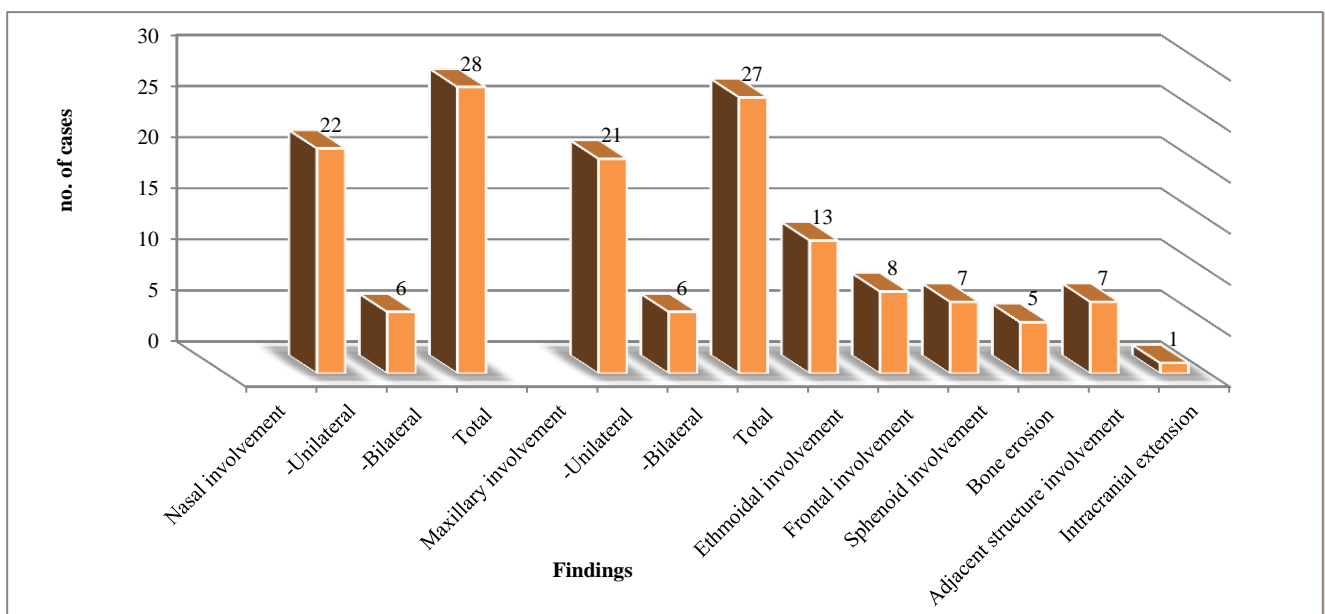
The most common radiological pattern of sinus involvement is ostiomeatal type seen in 38% of cases, followed by unclassified pattern in 23.8%.

**Table 4: Radiological finding in nasal disease (x-ray PNS waters view).**

Finding	No. of cases	%
<b>Nasal haziness</b>		
-unilateral	27	54
-bilateral	5	10
<b>Total</b>	32	64
<b>Maxillary sinus mucosal thickening</b>		
-unilateral	10	20
-bilateral	6	12
<b>Total</b>	16	32
<b>Maxillary sinus haziness</b>		
-unilateral	27	54
-bilateral	11	22
<b>Total</b>	38	76

In 32 (54%) cases, there was nasal haziness of which it unilateral in 27 (54%) cases and bilateral in 5(10%). Maxillary sinus mucosal thickening was found in 16 (32%) cases in which unilateral involvement in 10 (20%) cases & bilateral involvement in 6(12%) cases. in 38 (76%) cases maxillary sinus was hazy, unilateral in 27(54%) cases & bilateral in 11(22%) cases.

Out of cases with nasal polyp and other nasal masses unilateral involvement was in 22 (78.57%) and bilateral involvement in 6 (21.43%). Maxillary sinus involvement in 27 (96.43%) cases, with unilateral involvement in 21(75%) and bilateral involvement in 6(21.43%) cases. In 13 (46.42%) cases ethmoid sinuses were involved while frontal sinus were involved in 8(28.57%) cases and CT has shown bone erosion in 5 (17.85%) cases. In 7 (25%) cases adjacent structures (commonly nasopharynx and orbit) were involved. In 1 (3.57%) cases there was intracranial extension.



**Figure 1: CT evaluation in nasal polyp and other nasal masses.**

**Table 5: CT findings in different disease of nose and paranasal sinuses.**

Disease	Nasal involvement	Maxillary involvement	Ethmoidal	Sphenoid	Frontal	Bone erosion	Adjacent structure	Intracranial involvement
CRS	10	17	11	7	8	2	1	-
Sinonasal polyp	17	17	5	3	3	0	4	-
Inverted papilloma	4	4	4	2	3	2	1	1
Angioma of septum	1	-	-	-	-	-	-	-
Granulomatous	2	1	1	1	1	1	1	-
Sinonasal adenocarcinoma	1	1	1	1	-	1	-	-
Squamous cell carcinoma	1	1	1	-	-	1	-	-
<b>Total</b>	<b>36</b>	<b>41</b>	<b>27</b>	<b>14</b>	<b>15</b>	<b>8</b>	<b>8</b>	<b>1</b>

## DISCUSSION

Conventional plain films still provide the screening studies in various diseases of nose and paranasal sinuses and give orientation and direction to further indicated examination with computed tomography. The CT is currently most common radiologic method used to assess nose and paranasal disease because of better and definitive images.

CT screening of sinus not only confirm or exclude the mucosal disease but more importantly delineates the important anatomical relationship with skull base and orbit to paranasal sinuses, it is a road map for the surgeon.

Chronic sinusitis associated with inspissated mucous has characteristic hyperdense CT appearance. Polyposis of nasal cavity and paranasal sinuses, mucocele and benign tumour tend to expand the area of origin of their slow growth. Gradual pressure atrophy and erosion of the bone can be demonstrated by contrast enhanced CT scan.

In the present study, 50 patients were subject to computed tomographic evaluation following a preliminary radiological assessment by plain x-ray PNS (water's view) and nasal endoscopy.

The patients included were from different age group. The youngest patient was of the 10 year old male and the eldest was of 65 year old male. The male:female ratio was 1:1.18 with 23 male and 27 female.

The main presenting complaints were nasal obstruction (82%), nasal discharge (66%), Nasal mass (58%), headache & allergic symptoms (52%), external nose involvement (14%), hyposmia (14%), epistaxis (10%). which is consistent with the study conducted by Nair S et al.<sup>4</sup>

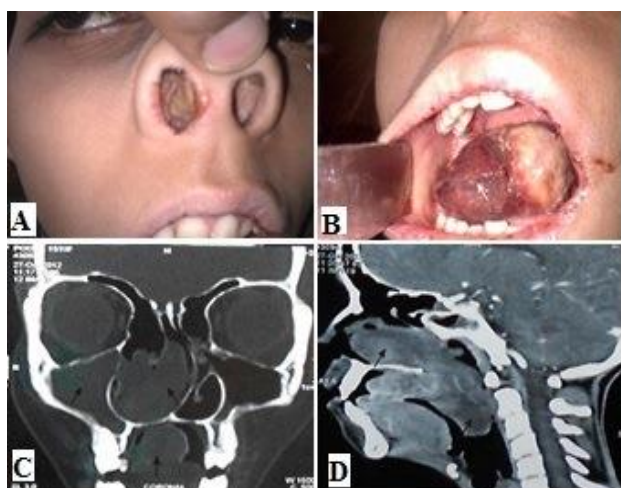
In our study, the most common type of disease involving nose and paranasal sinuses was inflammatory disease 43 (86%), among them chronic rhinosinusitis was the most common, account (51.16%) cases. Maxillary sinuses were most commonly involved in the study 82% cases, followed by Anterior ethmoid sinus 54%, posterior ethmoid 38%, frontal sinus involvement 30% and sphenoid sinus involvement in 28% cases, which is consistent with the study done by Zojaji R et al.<sup>5</sup> There are 5 basic pattern of mucosal involvement seen in patients of chronic sinusitis they are,

- Infundibular
- Ostiomeatal unit
- Sphenoethmoidal recess
- Sinonasal polyposis
- Unclassified

Most common pattern in our study was ostiomeatal unit pattern (38%), followed by unclassified pattern in 23.8%, infundibular pattern 19%, sphenoethmoidal recess pattern and sinonasal polyposis 9.52%. The findings are consistent with the study done by Naimi et al and Babbal et al.<sup>6,7</sup>

### *Nasal polyp*

In the present study there were 19 cases (44.18%) of nasal polyps of which 9 were males and 10 were females, male:female ratio were 1:1.12. Maximum patients were from 11-20 years of age. The youngest patient was 10 year old male and eldest was 65 year old male patient. Out of 19 case of nasal polyps included in the study, 13 (68.42%) were of antrochoanal polyp and 6 (31.57%) cases were ethmoidal polyps. Among antrochoanal polyps there were 5 patients male and 8 patients female (M:F ratio were 1: 1.6 ). The findings are consistent with the study done by Kaushal A et al.<sup>8</sup>



**Figure 2: (A and B) Preoperative photographs showing infected antrochoanal polyp right nasal cavity and prolapsed part in oropharynx. (C and D) CT scan PNS coronal section and sagittal section showing homogenous soft tissue opacification in Rt maxillary sinus, Rt nasal cavity and nasopharynx and oropharynx.**

Also CT scan of nasal polyps shows the smooth expansion of nasal fossae and pressure atrophy of the adjacent bony wall of the sinonasal cavity. Bone erosion is not common with polyps. However, in aggressive long standing polyposis, there may be significant expansion of the sinuses as well as bone erosion.<sup>9</sup> Dua K et al reported ethmoidal polyp to be most prevalent but in the present study 6 cases out of 17 were of ethmoidal polyp, this difference may be due to patient selection.<sup>10</sup>

#### ***Inverted papilloma***

In present study there were 4 cases (8%) of inverted papilloma of which 1 was male and 3 were females, male:female ratio were 1:3. Maximum patients were from 40-60 years of age. Unilateral nasal obstruction is the most common presenting complaint, noted in 100% of patients. The findings are consistent with the study done by Woodruff et al except M:F ratio it was almost revert in present study this difference may be due to patient selection.<sup>11</sup>

In present study maxillary and ethmoid sinuses were involved in all 4 (100%) cases, frontal sinus were involved in 3 (75%) cases, sphenoid sinuses were involved in 2 (50%) cases and also bone erosion were found in 2 (50%) cases and intracranial extension was found in 1(25%) cases.

#### ***Granulomatous disease***

In present study two cases were diagnosed as granulomatous disease.



**Figure 3: (A and B) Post contrast CT scan PNS coronal & axial section showing heterogeneous enhancing soft tissue opacification in Lt maxillary, ethmoid sinus and Lt nasal cavity with bony erosion and widened Lt maxillary ostium and intra cranial extension. (C and D) Post contrast MR scan brain and PNS coronal and sagittal scan showing irregular heterogeneous enhancing soft tissue mass lesion in Lt nasal cavity and ethmoidal air cells causing erosion on cribriform plate frontal bone with intra cranial extension in to Lt basifrontal resion.**

#### ***Rhinosporidiosis***

In our study one case of rhinosporidiosis, 60 year old male presented as nasal obstruction right side, epistaxis from right nasal cavity on & off, polypoidal mass with surface erythematous in right nasal cavity. CT reveals inflammatory mucosal thickening in right maxillary, ethmoid, frontal and sphenoid sinuses. This patient was operated as endonasal excision of mass with cauterization of base and diagnosis was confirmed by histopathology report.

#### ***Rhinoscleroma***

In our study one case of rhinoscleroma of nose, 50 year old female presented with blockage of B/L nasal aperture and difficulty in nose breathing. CT scan reveals soft tissue thickening in the region of nostril on either side almost complete obliterating the external nasal aperture. The findings are consistent with the study done by Poetker DM et al and Gaafar HA et al.<sup>12,13</sup>

#### ***Malignant lesions***

Lango MN et al reported that Sinonasal malignancies, account for less than 1% of all cancers and less than 3% of all upper aerodigestive tract tumors.<sup>14</sup> Sixty percent of sinonasal tumors arise in the maxillary sinus, whereas approximately 20% arise in the nasal cavity, 5% in the ethmoid sinuses, and 3% in the sphenoid and frontal sinuses. Fifty-five percent of sinonasal malignancies are

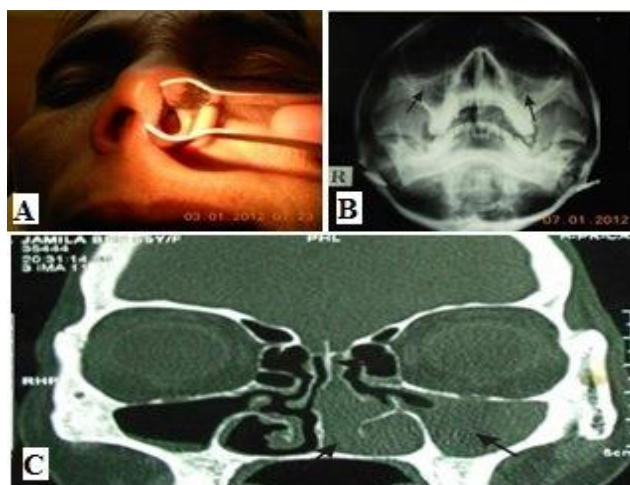
carcinomas. Squamous cell carcinomas are more common within the nasal cavity or maxillary sinus, whereas tumors of the ethmoid sinus and superior nasal vault are usually adenocarcinomas. In the present study malignancy occurred in 2 out of 50 cases, 2% (one case) was of squamous cell carcinoma, and 2% (one case) was of sinonasal adenocarcinoma,

### Squamous cell carcinoma

Khan N et al reported that Squamous cell carcinoma was the most common malignancy observed in the study and it constituted 37.5% of all the malignancy and 6.25% of all the sinonasal region. Majority of the patients were in sixth or seventh decade of life and M:F ratio was 2:1.<sup>15</sup>

The present complaints were nasal obstruction, rhinorrhoea, epistaxis and pain. An important radiographic finding for malignancies is bone destruction, best seen on CT and noted on initial exams in approximately 80% of sinonasal SCCAs.

In the present study, there was one case of squamous cell carcinoma, 30 year female presenting with nasal mass right side, foul smelling discharge, swelling over nose and pain over nasal bridge. CT findings revealed complete soft tissue opacification involving right maxillary sinus blocking the osteomeatal complex and also extending and occupying the right nasal cavity and ethmoid air cells completely. There were also seen bone erosion of right nasal turbinates and bone ethmoid septae.



**Figure 4: (A and B) Preoperative photograph of adenocarcinoma of LT nasal cavity showing mass in Lt nasal cavity X ray waters view showing haziness in B/L maxillary sinus. (C) CT scan PNS coronal section showing the homogenous soft tissue opacification seen in Lt maxillary Lt ethmoid sinus and Lt nasal cavity.**

### Adenocarcinoma

Orvidas IJ et al studies 24 cases of adenocarcinoma, there were 17 cases males and 7 cases were females.<sup>16</sup> Nasal

obstruction was the most common presenting symptom (75%), and the nose was the most common site of involvement (83%).

In present study, there was one case of sinonasal adenocarcinoma, 55 years old female presented with mass left nasal cavity, nasal obstruction left side, nasal discharge and on & off epistaxis. CT reveals heterogeneously enhancing soft tissue mass lesion in the left nasal cavity with involvement of ethmoidal air cells and causing remodelling of the adjacent bones.

### CONCLUSION

A variety of inflammatory and neoplastic diseases affect the paranasal sinuses and nasal cavity. High resolution CT scanning is the modality of choice for evaluation of sinus inflammatory diseases. Systematic analysis of the anterior and posterior ostiomeatal complex and anatomical variants leads to a meaningful report for the surgeon. MR imaging plays a critical role in evaluation of sinonasal tumors because of its ability to differentiate neoplasm from surrounding inflammatory changes, oedema, and retained secretions.

The following conclusions are drawn from the study.

- CT is the modality of choice in imaging the paranasal sinuses for evaluating the chronic diseases and associated complication.
- CT is the modality of choice in evaluating the bone erosion or destruction.
- CT evaluation of PNS in symptomatic patients help in planning the further management of the patients.
- Accurate delineation of disease and microanatomy locates by CT scan provides a reliable pre-operative road map.
- Most of the patients with sinonasal disease were from 2nd and 3rd decade.
- Slight female preponderance was noted.
- Majority of the patients presented with nasal obstruction (82%).
- Most common sinus involved was maxillary (82%). The most common disease was inflammatory (86%). The most common benign lesions were inverted papilloma. 4% of cases had malignancy.

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