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Research Article

MDCT Evaluation Of Anatomical Variation Of Para Nasal Sinuses And Their Importance In Functional Endoscopic Sinus Surgery

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ABSTRACT

Objective: To evaluate the anatomical variations of Paranasal Sinuses on Multi Detector Computed Tomography and how it helps in Functional Endoscopic Sinus Surgery.

Materials And Methods: The study was conducted on 50 cases those who were clinically diagnosed as patients with pathology in Paranasal Sinuses region and referred for Multi Detector Computed Tomography and then underwent Functional Endoscopic Sinus Surgery during the period from November 2015 to September 2017. The anatomical variations in maxillary sinus , ethmoid sinus, sphenoid sinus , frontal sinus, olfactory fossa and optic nerve were evaluated. The post operative complications were recorded.

Results: The best modality of choice to assess anatomic variations of Paranasal Sinuses is Multi Detector Computed Tomography which provided a road map for the surgeons and helped avoid any intra operative complications.

Conclusion: The paranasal sinus region is subject to a large variety of anatomical variations and Multi Detector Computed Tomography helps in evaluating these variations as it gives very high spatial resolution both in soft tissue and bone window. We inferred from our study that Multi Detector Computed Tomography Para Nasal Sinuses is very useful to assess the anatomic variations of paranasal sinuses. Follow up revealed there were no intra or post operative complications thus proving Multi Detector Computed Tomography is essential before Functional Endoscopic Sinus Surgery for better results.

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INTRODUCTION:

Evaluation of anatomic variations of the paranasal sinuses (PNS) is important in patients who are undergoing Multi Detector Computed Tomography (MDCT) scan evaluation for various rhinologic reasons. Knowledge of the anatomic variations does reduces the surgical complication rates during Functional Endoscopic Sinus Surgery (FESS), helps explain recurrence. It is important for surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications and help avoid possible complications and improve success of management strategies.(1)

During fetal development, the paranasal sinuses originate as invagination of the nasal mucosa into the lateral nasal wall, frontal, ethmoid, maxilla and the sphenoid bones.(2) This unique development explains the enormous amount of anatomical variation. The success of functional endoscopic surgery depends on adequate knowledge of the complicated anatomy of the paranasal sinuses, which is variable.

Certain anatomic variations are thought to be predisposing factors for the development of sinus diseases and thus it becomes necessary for the radiologist to be aware of these variations, especially if the patient is a candidate for FESS.(3) With the advent of MDCT, imaging of paranasal sinuses prior to FESS has become mandatory.(4) Multiplanar imaging, particularly coronal reformations, offers precise information regarding the anatomy of the sinuses and its variations, which is an essential requisite before surgery.

This study offers local statistics on paranasal sinus anatomy and its variants. It acts as a baseline research for anyone who wishes to carry further studies on particular paranasal sinuses. This data will help the otorhinolaryngologist to build a complication free learning curve, assist in local training and also emphasize on the need for radiological evaluation. This study helps in standardization of the cuts size and view to request for in terms of Paranasal Sinus MDCT scans. Clear information on trends of variation among the local population can be obtained in the study. Paranasal air sinuses are important in FESS and knowledge of its anatomical variants helps a surgeon in his/ her orientation during FESS.

MATERIALS AND METHODS:

The study was a prospective study that was conducted at the department ofradio- diagnosis on 50 cases those who were clinically diagnosed as patients withpathology in PNS region like sinusitis, maxillary hypertrophic turbinates etc and referred from Department of ENT, for MDCT scan and then underwent Functional Endoscopic Sinus Surgery during theperiod from November 2015 to September 2017. The patients were subjected to MDCT scans of PNS taking 3 mm slices thickness with 1 mm reconstruction using SIEMENS Somatom Perspective 128 slice CT. The images were reviewed in both bone and soft tissue algorithms for the variations. The anatomical variations in maxillary, ethmoid, sphenoid and frontal sinuses, olfactory fossa and optic nerves were evaluated. All of the patients in this study underwent FESS. The post operative complications were recorded.

RESULTS:

The mean age in the present study was 35.84 years minimum age was 11 year, maximum age was 67 years , most cases were in the age group 41-50 years (26%) [Table-1].

[Table-1]:Age distribution of patients

Age in years	No. of patients	%
11-20	8	16.0
21-30	11	22.0
31-40	12	24.0
41-50	13	26.0
51-60	4	8.0
61-70	2	4.0
Total	50	100.0

In the present study of the 50 cases studied, males predominated the study with a population of 54% where as females population was 46% [Table 2].

[Table- 2]: Gender distribution of patients

Gender	No. of patients	%
Female	23	46.0
Male	27	54.0
Total	50	100.0

Deviated nasal septum was commonly seen in most of the patients and they were distributed as follows right (22%), left (20%), right with spur (20%), left with spur (12%), S shaped septum were seen in 2 patients (4%) and in one case DNS was erosed (2%) [Table 3].

[Table- 3]: DNS distribution of patients

DNS	No. of patients	%
Nil	10	20.0
Right	11	22.0
Left	10	20.0
Right with spur	10	20.0
Left with spur	6	12.0
S shaped	2	4.0
Erosed	1	2.0
Total	50	100.0

Frontal recess were obliterated in 22 patients (44%) on the right side and 32 patients (64%) on the left side [Table 4].

[Table- 4]: Frontal recess distribution of patients

Frontal recess	No. of patients (n=50)	%
Right		
• Normal	28	56.0
• Obliterated	22	44.0
Left		
• Normal	18	36.0
• Obliterated	32	64.0

Ethmoid infundibulum were obliterated in 30% cases on the right side and 34% on the left side [Table 5].

[Table- 5]: Ethmoid infundibulum distribution of patients

Ethmoid infundibulum	No. of patients (n=50)	%
Right		
• Normal	20	40.0
• Obliterated	30	60.0
Left		
• Normal	16	20.0
• Obliterated	34	80.0

Maxillary sinus ostium were obliterated in 62% cases on the right side and in 72 % cases on the left side [Table 6].

[Table- 6]: Maxillary sinus ostium distribution of patients

Maxillary sinus ostium	No. of patients (n=50)	%
Right		
• Normal	19	38.0
• Obliterated	31	62.0
Left		
• Normal	14	28.0
• Obliterated	36	72.0

50% cases had bilateral, 26 % and 10 % cases had left and right inferior turbinate hypertrophy respectively [Table 7].

[Table-7]: Turbinates distribution of patients

Turbinates	No. of patients	%
Nil	7	14.0
Bilateral ITH	25	50.0
Left ITH	13	26.0
Right ITH	5	10.0
Total	50	100.0

Concha bullosa was present in 34% patients bilaterally, 6 % and 14% cases had on left and right side respectively [Table 8].

[Table- 8]: Concha bullosa distribution of patients

Concha bullosa	No. of patients	%
Nil	23	46.0
Bilateral	17	34.0
Left	3	6.0
Right	7	14.0
Total	50	100.0

Paradoxical curvature abnormality (PDC) were seen in 4% cases on the left and 8% cases on the right side [Table 9].

[Table-9]: PDC distribution of patients

PDC	No.of patients	%
Nil	44	88.0
Left	2	4.0
Right	4	8.0
Total	50	100.0

Agger nasi cells were bilateral in 44% of cases, 12% on left side and 20% on right side [Table 10].

[Table- 10]: Agger nasi distribution of patients

Agger Nasi	No. of patients	%
Nil	12	24.0
Bilateral	22	44.0
Left	6	12.0

Right	10	20.0
Total	50	100.0

Haller cells were seen bilateral in 2%, 10% on right side and 2% on left side [Table 11].

[Table- 11]: Haller Cells distribution of patients

Haller Cells	No. of patients	%
Nil	42	84.0
Bilateral	1	2.0
Left	2	4.0
Right	5	10.0
Total	50	100.0

2% cases had bilateral bulla ethmoidalis, 6% and 4% had on left and right side respectively [Table 12].

[Table- 12]: Bulla ethmoidalis distribution of patients

Bulla ethmoidalis	No.of patients	%
Nil	42	84.0
Bilateral	1	2.0
Left	3	6.0
Right	4	8.0
Total	50	100.0

Onodi cells were present in 24% cases. Sphenoid sinus showed septations in 56% of cases [Table 13].

[Table- 13]: Onodi cell distribution of patients

Onodi Cell	No. of patients	%
Negative	38	76.0
Positive	12	24.0
Total	50	100.0

Optic nerve type I was the most common variant seen in the study with 94%, type IV on right with type I on left was seen in 2%, type I on right with type IV on left was seen in 2% and type IV on right with type II on left was seen in another 2% of the population [Table 14].

[Table-14]: Optic Nerve distribution of patients

Optic Nerve	No. of patients	%
Type I	47	94.0

Type IV(Rt); Type I(Lt)	1	2.0
Type I (Rt) ; Type IV(Lt)	1	2.0
Type IV(Rt); Type II (Lt)	1	2.0
Total	50	100.0

Depth of the olfactory fossa were evaluated separately on right and left sides. Type II (20%) being the most common followed by type I (6%) and type III (4%) on the right side. And same finding was noted on the left side, type II (76%) being most common followed by type I (18%) and type III(6%) [Table 15].

[Table-15]: Olfactory fossa: Type distribution of patients

Olfactory fossa	**No. of patients (n=50)**	**%**
Right		
• <4mm	7	14.0
• 4-8mm	42	84.0
• >8mm	1	2.0
Left		
• <4mm	9	18.0
• 4-8mm	40	80.0
• >8mm	1	2.0

Follow up revealed there were no intra or post operative complications (100%) [Table 16].

[Table-16]: Intra Operative Finding distribution of patients

Intra operative findings	**No. of patients**	**%**
No Complications	50	100.00
Complications	0	0.0
Total	50	100.0

DISCUSSION:

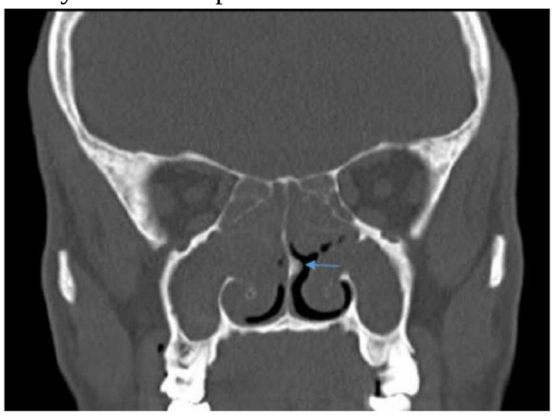
Diseases of the PNS include wide spectrum ranging from inflammatory conditions to neoplasms, both benign and malignant. MDCT plays an important diagnostic role in patients with sinonasal disease and determines the treatment. The paranasal sinus region is subject to a large variety of anatomical variations. Congenital anomalies and normal anatomical variations in this region are important as they may have pathological consequence or may be the source of difficulty / complication during surgery. Stammberger et al proposed that stenosis of the osteomeatal complex, from either the anatomical configuration or hypertrophied mucosa, can cause

obstruction and stagnation of secretions that may become infected or perpetuate infection.[5] It is now mandatory to evaluate PNS on MDCT before FESS, as this provides a base to guide the otolaryngologist during surgery and serves to direct the surgical approach.

Pradeep Kumar et al who conducted a study on 100 patients found male predominance (59%) their study.[4] Another study by Dr.Bhumikaben P. Suthar et al comprised of 46 males (i.e. 73%) and 17 females (i.e. 27%). In this study of 50 patients, males predominance was noted with 52%. Gender does not have any statistical value.[6]

Dr. Bhumikaben P. Suthar carried out a study on 63 patients, comprising of 46 males and 17 females, between the age groups of 00-72 years. [6] The peak age incidence was that of 31-50 years, with 27 cases. The average age of the cases was 38.75 years. Pradeep Kumar et al who conducted a study on 100 patients found the mean age of the patients was 29.81+12.08 years.[4] In our study mean age was found to be 35.84±13.49 years.

Mamatha H et al in 2010 did a study where she found 6 (30%) CTs showed centralized nasal septum, 5 (25%) showed left side deviation and 9 (45%) had right side deviation of the nasal septum. Right side being the most common.[7] Whereas, Perez-Pinas et al the numbers of left and rightward deviations were similar.[8] In our study deviated nasal septum were distributed and right (22%) being the most common followed by left (20%)[Figure 1]. We have also categorized septum deviation in association with bony spur in which right with spur (20%) , left with spur (12%), S shaped septum were seen in 2 patients (4%) and in one case DNS was erosed (2%).

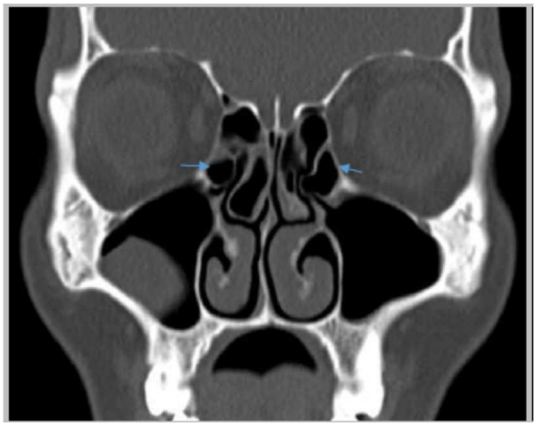


[FIGURE-1]: MDCT coronal reformatted image showing deviated nasal septum to left with bony spur (arrow)

In the study conducted by Pradeep Kumar et al on 100 patients out of which 43 patients had concha bullosa bilaterally of about 41.8% followed by right side of about 32.5% and least is on the left side of about 25.5%.[4] Our study Concha bullosa was present in 34% patients bilaterally, 6 % and 14% cases had on left and right side respectively[Figure 2]. Bilateral being the most common.

[FIGURE-2]: MDCT coronal reformatted image showing bilateral concha bullosa (arrows)

Agger nasi cells lie just anterior to the anterosuperior attachment of the middle turbinate and frontal recess [Figure 3]. These can invade the lacrimal bone or the ascending process of maxilla. These cells were present bilateral in 44% of cases, 12% on left side and 20% on right side in our study. The incidence is less as compared to 98.5% by Bolger and more compared to study by Dua K et al which had 40% incidence. [9]

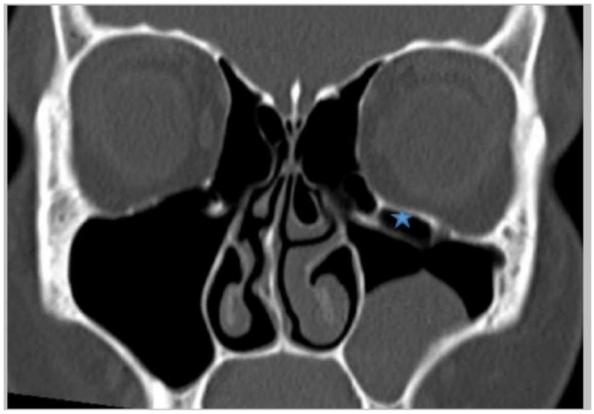


[FIGURE-3]: MDCT coronal reformatted image showing bilateral agger nasi cells (arrows)

The middle turbinate may be paradoxically curved i.e. bent in the reverse direction [Figure 4]. This may lead to impingement of the middle meatus and thus to sinusitis. In our study it was found in 4% cases on the left and 8% cases on the right side. The incidence is similar to that of 12% by Asruddin et al and 15% by Llyod.[10,11] It is less than that reported by Bolger et al (27%).[12]

[FIGURE- 4]: MDCT coronal reformatted image showing paradoxical curvature of middle turbinate on the left side (arrow)

Haller's cells are ethmoid air cells that project beyond the limits of the ethmoid labyrinth into the maxillary sinus. They are considered as ethmoid cells that grow into the floor of orbit and may narrow the adjacent ostium. The incidence of Haller's cell in the present study (8/50 patients) was bilateral in 2%, 10% on right side and 2% on left side which correlates with the earlier studies of Llyod (15%) and Dua (16%)[Figure 5].[9,11] Higher values were reported earlier by Bolger 45.9%.[12]

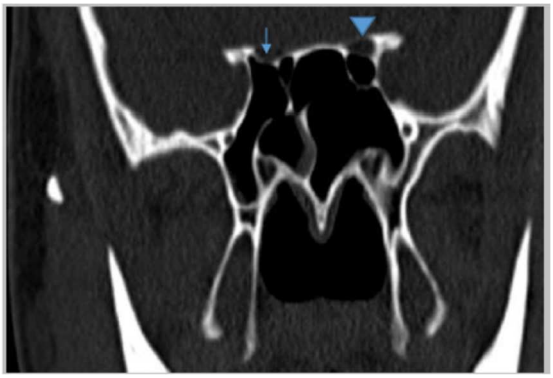


[FIGURE-5]: MDCT coronal reformatted image showing haller cells on the left side (star)

Onodi cells are posterior ethmoid cells that extend posteriorly, laterally and sometimes superior to sphenoid sinus, lying medial to the optic nerve. The chances of per operative injury to optic nerve are increased when the bony canal of the nerve is lying dehiscent. Shin et alanalyzed 162 preoperative CTs and intraoperative endoscopic endonasal findings and demonstrated the incidence of Onodi cells on preoperative CT to be 32.7%.[13] In this study Onodi cells were present in 24% cases [Figure 6]. It was less compared to incidence in Bolger et al study which was 11%. [12]

[FIGURE- 6]: MDCT coronal reformatted image showing onodi cells (star)

In our survey of 50 patients, Optic nerve type I was the most common variant seen in the study with 94%, type IV on right with type I on left was seen in 2%, type I on right with type IV on left was seen in 2% and type IV on right with type II on left was seen in another 2% of the population [Figure-7]. Delano, et al, found that 85% of optic nerves associated with a pneumatized anterior clinoid process were of type II or type III configuration, and of these, 77% showed dehiscence, indicating the vulnerability of the optic nerve during FESS. [14]



[*FIGURE-7]: MDCT coronal reformatted image showing optic nerve type 1(star) on the right side and type iv on the left side(arrow head)*

CONCLUSION

DNS was the most common anatomic PNS variant in our study. There were no intra operative complications as our study provided a roadmap to the surgeons.

In view of presence of these significant anatomical variations, we emphasize the need for proper preoperative assessment in every patient in order to accomplish a safe and effective endoscopic sinus surgery. We inferred from our study that MDCT PNS is very useful to assess the anatomic variations of paranasal sinuses.

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