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Original Research Paper

Radio-Diagnosis

ANATOMICAL AND FUNCTIONAL VARIATIONS IN PARANASAL SINUSES WITH SPECIAL EMPHASIS ON CRITICAL ANATOMICAL LANDMARK IN PATIENTS UNDERGOING MULTIDETECTOR COMPUTED TOMOGRAPHY OF PARANASAL SINUSES.

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ABSTRACT

Objectives:

- To study various types of anatomical and functional variations of Paranasal sinuses.
- To study the important anatomical as well as functional variations of Paranasal sinuses seen multi-detector computed tomography evaluation pre-operatively.
- To specifically assess detailed variations of cribriform plate, Lamina papyracea, Onodi cell, Haller cells, Sphenoid sinus pneumatization, Anterior Ethmoidal artery, turbinates, Supraorbital pneumatization and optic canal types that are speculated pose difficulties during FESS.
- To determine the frequency of detection of these variations of paranasal sinuses on 256 slice MDCT.

Conclusion And Results:

- During the period of 18 months of the study 112 patients who fulfilled inclusion criteria were studied, out of which 28 (25.7 %) were female and 84 (74.3 %) were male (Chart-1).
- Of the 112 cases studied, type I cribriform plate was found in 14 (11.9%) of patients, type II cribriform plate was found in 90(80.7%) of patients, type III cribriform plate was found in 8 (7.3%) of patients (Chart-2)
- Uncinate process was attached to lamina papyracea in 98 (88.9%) individuals, to skull base in 12 (10.09%) patients and middle turbinate in 2 (0.91%) patient.
- Presence of Haller cells was noted in 12 (13.01%) of individuals.
- Onodi cell was identified among 45 (41 %) patients. This was identified in the right side alone in 26 (23.8%), in the left side alone in 19 (17.4%).
- Depending on the pneumatization of the sphenoid sinus, type I course of optic nerve was noted in 48 (44.03 %) on the right side and 51 (46.7%) on the left side. Type II course was seen in 46 (42.2 %) on the right side and 47 (43.1%) on the left side. Type III course was seen in 6 (5.5 %) on the right side and in 6 (5.5%) on the left side. Type IV course was seen in 9 (8.2%) on the right side and 5(4.5%) on left side.
- Sellar variety of sphenoid sinus was observed in 90 (82.5%) patients. Whereas, 19 (17.4%) patients had presellar variety of sphenoid sinus.
- Anterior ethmoidal notch abuts the fovea ethmoidalis in 89 (81.6%) and lateral lamella in 20 (18.3%) patients. Presence of supraorbital pneumatization was identified in 79 (72.4%) patients among total subjects.

Inference:

- Computed Tomography of the paranasal sinus has improved the visualization of paranasal sinus anatomy and has allowed greater accuracy in evaluating paranasal sinus disease.
- It evaluates the osteomeatal complex anatomy which is not possible with plain radiographs. Improvement in FESS and CT technology has concurrently increased interest in the paranasal region anatomy and its variations.
- Anatomical variations studied of PNS were found along with sinusitis.
- The radiologist must pay close attention to anatomical variants in the preoperative evaluation.
- 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.

KEYWORDS : OMU, ONODI CELLS, HALLER CELLS, PNEUMATIZATION.

INTRODUCTION:

Paranasal sinuses are air-filled spaces within the facial skeleton, surrounding the nasal cavity, a system of air channels that connect the nose with the throat. They are lined by ciliated respiratory epithelium. First description of the paranasal sinuses was given by anatomist Emily Zuckerkandl in early 19th century.

There are 4 pairs of paranasal sinuses communicating with the nasal cavity through individual openings such as: frontal, maxillary, sphenoid and ethmoid sinuses. Basic function of these sinuses is to perform the function of humidification of air to provide resonance to the voice (1).

Precise knowledge of the anatomy of the paranasal sinuses is essential for the clinician. In Functional Endoscopic Sinus Surgery (FESS), the surgeon requires adequate knowledge of the anatomy, variations and varieties of pathologies preoperatively to avoid the intraoperative complications.

Multi-detector computed tomography (MDCT)is the choice of imaging modality for the accurate evaluation of the PNS. Multiplanar imaging of cribriform plate, lamina papyracea, onodi cell,turbinates, Haller cells, sphenoid sinus pneumatization, anterior ethmoidal artery, supraorbital pneumatization and optic canal type helps in acquiring the surgical anatomy for the radiologist (2). Thereby it helps the surgeon to take a calculated approach with minimal risk of complications to vital structures like brain, eyes, meninges, vessels and neural elements.

MDCT provides a road map for the surgeon in preoperative evaluation before opting for Functional endoscopic sinus surgery (FESS). Both MDCT and diagnostic endoscopy has become the corner stone in the management of various pathologies involving paranasal sinuses (3). MRI is used as an important modality regarding to its multiplanar capability and excellent soft tissue resolution, in the evaluation tumors and other pathologies involving soft tissue elements of PNS. The major limitation of MRI as a modality is its inability to adequately characterize osseous elements as compared to MDCT.

Thus, MDCT is now is a method of choice in the evaluation of the paranasal sinuses, adjacent structures such as osseous elements.

MATERIALS AND METHODS:

The study was conducted in a tertiary care hospital, in the Department of Radio-diagnosis.

Data Source:

Study of 112 patients who are referred to the Department of Radio-diagnosis for MDCT evaluation of paranasal sinuses and fulfilling the patient selection criteria as per the inclusion and exclusion criteria were included in the study.

Study Design:

Prospective Cross-sectional study

Inclusion Criteria:

- Patients above 18 years age with developed paranasal sinuses who are referred to our department.
- Patients who had given consent.

Exclusion Criteria:

- Patients with history of previous nasal surgery or trauma.
- Patients with Paranasal sinus malignant neoplasm.
- Pediatric age group where paranasal sinuses are still not well pneumatized.
- Pregnant women and patients with past history of surgery in the paranasal region.

Ethical Justification For Study:

The study was carried out only after approval by Institutional Ethical Committee of this tertiary care institute.

DISCUSSION:

The paranasal sinus region is subject to a large variety of lesions. 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. Stumberger 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.

Cribriform plate refers to the horizontal lamina cribrosa, which is located in midline and separates the roof of the nasal cavity from the anterior cranial fossa. It is best visualized and evaluated in the coronal plane.

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 (4).

Kenedy and Zinreich reported an almost similar incidence of 10%. It is less than that reported by Bolger (45.9%) and Asruddin (28%).

The lamina papyracea is a thin layer of the ethmoid bone that Comprises the medial orbital wall. It is best evaluated in the coronal and axial planes. When dehiscent from a prior injury, the bony margin of the lamina papyracea is displaced medially into the ethmoid sinus, along with intraorbital fat and occasionally portions of the medial rectus muscle.

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 peri-operative injury to optic nerve are increased when the bony canal of the nerve is lying dehiscent. Most authors have found an incidence of 8-14%, 10.9% by Pere and 11% by Bogler (5).

Delano et al, found that 85% of optic nerves associated with a pneumatized anterior clinoid process were of the Type II or Type III configuration and 77% were dehiscent.

It is important for surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications (4,6)

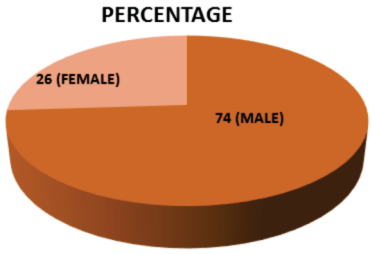

Chart 1 - Number Of Patients And Gender

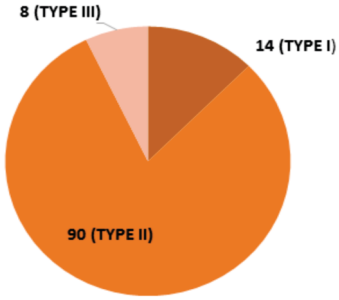

Chart 2 - Various Types Of Cribriform Plate

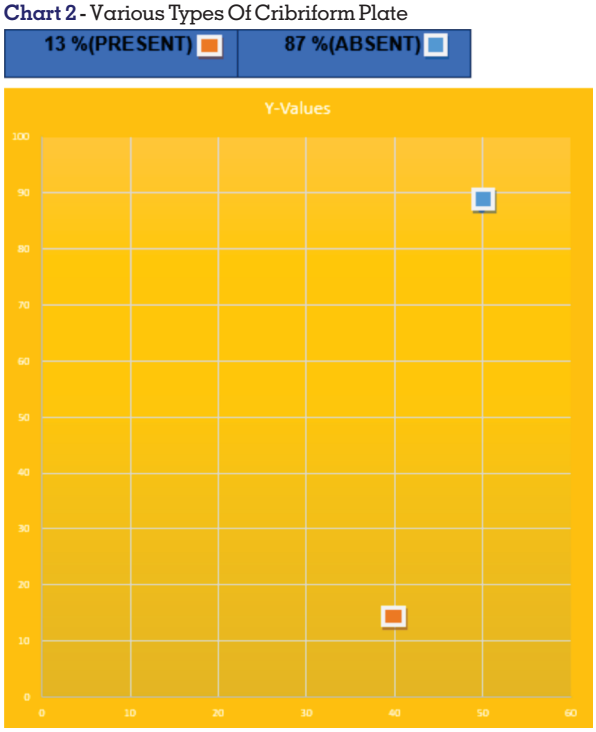

Chart 3 - CT Scan Detection Of Presence And Absence Of Haller Cells.

Chart 4 - Attachment Of Uncinate Process.

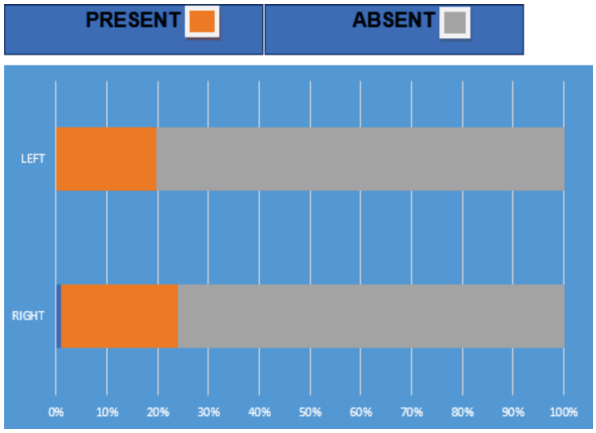

Chart 5- Presence And Absence Of Onodi Cells (identified Among 44 Patients)

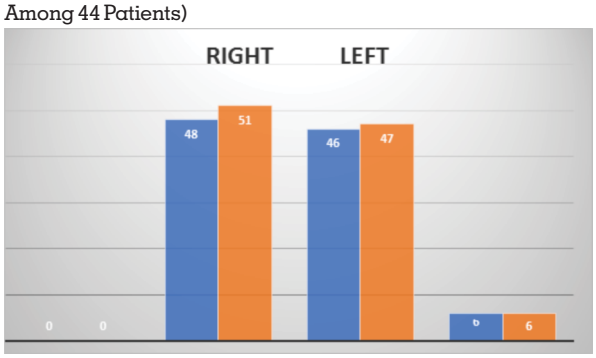

Chart 6 - Types Of Optic Canal

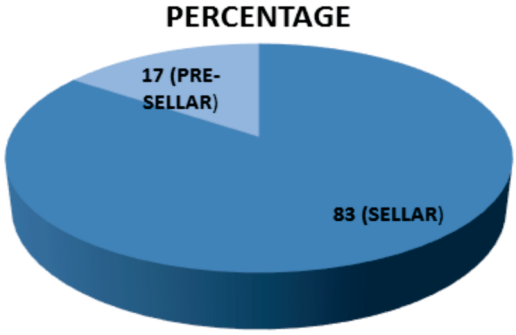

Chart 7 - Varieties Of Spnenoid Sinus Pneumatization

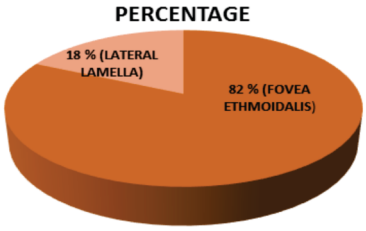

Chart 8 - Abuttment Of Anterior Ethmoidal Artery To Fovea Ethmoidalis Or Lateral Lamella

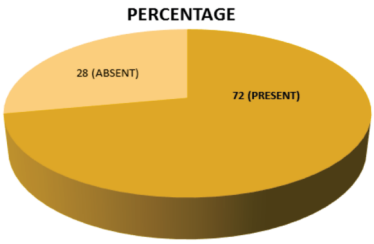

Chart 9- Supra-orbital Pneumatization

Table 1 Demonstrates Most Common Prevalence Of Type 2 Cribriform Plate With Gender Predominance In Females

Cribriform plate	MALE	FEMALE	% M	% F
Type I	14	4	13.25 %	12.24 %
TYPE II	62	22	81.02 %	86.44 %
TYPE III	8	2	6.73 %	2.32 %
TOTAL	84	28	100 %	100 %

Table 2 Demonstrates Relationship Of Attachment Of Uncinate Process With Number Of Males And Females From My Study Population

Uncinate process attachment	MALE	FEMALE	Total
PRESENT	91	8	99
ABSENT	1	10	11
TOTAL	93	19	112

Table 3 Demonstrates Relatively More Occurrence Of Supra-orbital Pneumatization In Males As Compared To Females From Total Subjects

Supra-orbital pneumatization	MALE	FEMALE	Total	%
LP	91	8	99	89.24
SB	1	10	11	10.09
MT	1	1	2	0.9
TOTAL	93	19	112	100 %

Table 4 Demonstrates Number Onodi Cells As Anatomical Variation In Reference With Gender From Total Subjects

Onodi cell	Right	Left	Bilateral	Total
Male	12	5	8	25
Female	1	1	5	7

Few Rare Variant Anatomy Cases

Case 1: Paradoxical Curvature

Normally the convexity of the middle turbinate is directed medially toward the nasal septum. When the convexity is directed laterally, it is termed a paradoxical middle turbinate . Most authors agree that the paradoxical middle turbinate can be a contributing factor to sinusitis.

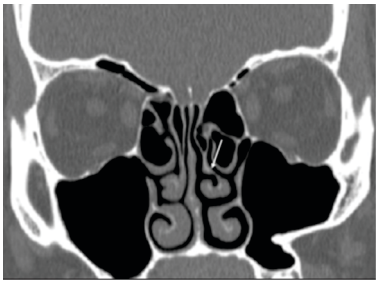

Figure 27 Coronal CT showing paradoxical left middle turbinate(arrow)

Case 2: Concha Bullosa

This is an aerated turbinate, most often the middle turbinate. When pneumatization involves the bulbous portion of the middle turbinate, it is termed concha bullosa. If only the attachment portion of the middle turbinate is pneumatized, it is termed lamellar concha. A concha bullosa may obstruct the ethmoid infundibulum.

Figure 28 Coronal CT showing pneumatized bulbous portion of middle turbinate—concha bullosa—bilaterally (arrows)

Case 3: Posterior Nasal Septal Air Cell

Air cells may be seen in the postero-superior portion of the nasal septum and may communicate with the sphenoid sinus. Any inflammatory disease that occurs within the paranasal sinus may affect these cells. It can resemble a cephalocele. CT scan and magnetic resonance imaging (MRI) are useful to differentiate this entity.

Figure 30 Coronal CT showing posterior nasal sepal air cell (star)

Case 4: Agenesis Of Sphenoid Sinus

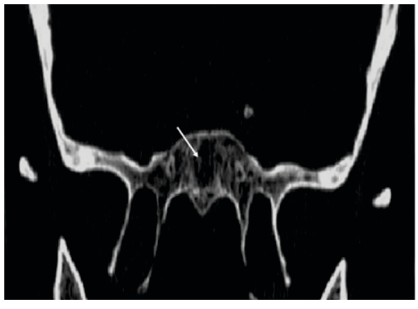

Figure 31 Coronal CT showing agenesis of the sphenoid sinus

Case 5: Pneumatised Crista Galli

Case 6: Conchal Type Of Sphenoid Pneumatization

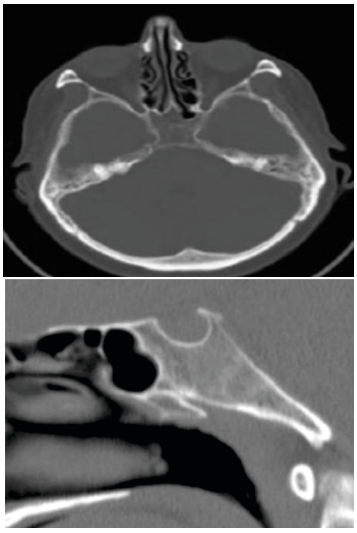

Figure 33 Conchal type: Axial and coronal CT scan paranasal sinus showing the degree of pneumatization is limited to the anterior portion of the sphenoid body and not reaching the level of the anterior wall of Sella turcica (1–4%)

Abbreviations:

OMU-Osteometal Unit, OF-olfactory fossa, CT- Computed Tomography.

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