"STUDY OF VARIATIONS OF OSTIOMEATAL COMPLEX ON COMPUTED TOMOGRAPHY SCAN OF PARANASAL SINUSES: A 1 - YEAR OBSERVATIONAL STUDY."

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LIST OF ABBREVIATIONS

FESS	Functional endoscopic sinus surgery
CT	Computed tomography
MRI	Magnetic resonance imaging
OMU	Ostiomeatal unit
F	Frontal sinus
IT	Inferior turbinate
MT	Middle turbinate
S	Sphenoid sinus
ST	Superior turbinate
OMC	Ostiomeatal complex
PNS	Paranasal sinuses
NCCT	Non contrast computed tomography
DNS	Deviated nasal septum

ABSTRACT

TITLE: STUDY OF VARIATIONS OF OSTIOMEATAL COMPLEX ON COMPUTED TOMOGRAPHY SCAN OF PARANASAL SINUSES: A 1 - YEAR OBSERVATIONAL STUDY.

BACKGROUND: There has been a significant shift from external and headlight sinus surgery to Endoscopic sinus surgery (ESS) in recent times. Messerklinger's work showed that the sinuses had a predetermined mucociliary clearance pattern to their natural ostium irrespective of additional openings that may have been created into the sinuses. This philosophy of opening the natural ostium of the diseased sinus was then popularized by Stammberger and Kennedy. ESS is now accepted as the surgical management of choice for chronic sinusitis. The key underlying concept behind minimally invasive functional endoscopic sinus surgery is the ostiomeatal complex (OMC). Stammberger and Kennedy defined ostiomeatal complex as a functional unit of the anterior ethmoid complex representing the final common pathway for drainage and ventilation of the frontal, maxillary and anterior ethmoid sinuses. The advent of relatively less invasive techniques of functional endoscopic sinus surgery has provided an important role for coronal computed tomography (CT) of the paranasal sinuses, both as a diagnostic tool and as an important part of preoperative planning.

OBJECTIVES: To determine the profile of variation in Ostiomeatal complex using Computed Tomography of Paranasal Sinuses in patients attending ENT OPD in Dr. KLES Prabhakar Kore Hospital and MRC, Belagavi, Karnataka, India.

MATERIALS AND METHODS: This is a retrospective observational study of patients who attended Department of ENT & HNS and underwent CT scan of paranasal sinuses in KLE Dr.Prabhakar Kore Hospital & MRC during period of January 2019- December 2019. CT scan was performed with a 128-slice GE machine in Department of Radiology, KLE Dr. Prabhakar Kore Hospital & MRC, Belagavi. Contiguous axial and coronal scans of 3mm slice thickness were taken from frontal sinus to sphenoid sinus. All films are taken without contrast. These scans were then analysed for numerous anatomical variations of ostiomeatal complex.

RESULTS: In this study of 36 CT-PNS scans, analysis of demographic data shows that age range of patients falls between 18to 65 years, with a mean age of 39.69 years. Among all the cases studied 19 were male and 17 were female. In this study 100% of cases had at least one variation anatomically. Deviation of nasal septum was most common type of variation noted and was seen in all the patients. Most common variation in ostiomeatal complex was a Concha bullosa seen in 50% (18 patients) either unilaterally and/or bilaterally. Next followed by Onodi cell in 22.22 %. Next common variation was large Aggar nasi cell seen in 5 patients i.e, 13.8%. Paradoxical Middle turbinate was present in 4 patients. Bulla Ethmoidalis was noted in only 3 patients. Uncinate process was found to be medialized in 3 patient. Pneumatised crista galli was noted in 2(5.55%) patients. Haller cell was noted in only 1(2.7%) patient. Ostiomeatal unit was involved in 6(16.6%) patients. Maxillary sinusitis was seen in 24 patients. Anterior ethmoids were involved in 16 patients. Posterior ethmoids involved in 14 patients. 10 patients had frontal sinus involvement and 8 had sphenoiditis. Pansinusitis is seen in 2(5.55%) patients.

CONCLUSION: Knowledge of paranasal sinuses anatomy and their pathology has improved along with better visualization and accuracy with the advent of CT PNS. Evaluation of OMC anatomy which is otherwise not possible by conventional radiography has been possible owing to CT scan. Numerous variations in anatomy of PNS are implicated in blockage of OMC, which are unique to the patient and result in impaired drainage and ventilation of sinuses, causing unresolved chronic rhinosinusitis. It was observed that a combination of variations were noted in OMC in a single individual compared to a single variety.It was seen that deviated nasal septum was present in all the subjects and among the OMC, Concha Bullosa was the most common variation seen in 50% and Haller cell was the rarest.

Keywords: Endoscopic sinus surgery, Ostiomeatal Complex, Anatomic variations, Computed tomography

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INTRODUCTION

Nasal cavities and paranasal sinuses are characterized by high inter-individual anatomical variability. [1,2] These variations in shape and morphology have ability to alter airflow in nose and also cause significant sequelae in lower respiratory tract. [2]

Emphasis on need for study of anatomical alteration as a leading cause of sinonasal disease, especially with respect to ostiomeatal complex, was established by numerous authors. Variations of ostiomeatal region such as variations of Middle turbinate, Uncinate, Bulla Ethmoidalis, Haller cells, Agger nasi cells, Onodi compromise narrow drainage pathways and causes significant obstruction and do not represent a diseased state as such. [3,4] Each episode of rhinosinusitis interferes with movement of cilia and results in mucus retention in sinus. Eventually, mucosa of nasal cavities and sinuses block ostia. It is reversible mostly, but in presence of any anatomical variant narrowing this area, even modest oedema predisposes to frequent infection, thereby inducing long standing inflammatory changes in sinus. [5]

Treatment for these chronic sinus infections is clearance of disease surgically, while maintaining ventilation as well as drainage of sinus.[6] **Fundamental concept of "functional endoscopic sinus surgery" (FESS)** is meticulously treating minor alterations in ostiomeatal complex which come in way of mucociliary clearance of sinuses.[5] To accomplish this goal, diagnostic modalities that can guide us toward exact diagnosis and safe intervention are needed.[6]Advanced surgical methods combined with skilled instrumentation and knowledge of regional anatomy with availability of better imaging methods make operations success along with fewer complication rate in paranasal sinus region.[7] CT of PNS acts as an appropriate modality both for diagnostic purpose and as a part of planning preoperatively for

precise assessment of this area for anatomic variation that is interfering with ventilation and drainage of sinuses.[4,6]

Mucosal disease is not recognized on plain film radiography as can be done using a CT scan. MRI is not usually used in evaluation due to poor delineation of bone-air interface resulting in poor visualization of OMU, necessary in determining patients for FESS. Diagnostic nasal endoscopy helps in fine visualization of middle meatus. However, may not give any information about ethmoidal infundibulum and/ or maxillary ostium. [8]

CT- PNS especially, coronal plane cuts are frequently used by surgeons as it is similar to surgical orientation [1] data from these CT scans and that seen on anatomic dissection are quite similar and acquaintance with these variations ahead of surgery will guide surgeon while performing endoscopic procedures of sinuses. [9]

OBJECTIVE

To determine the profile of variations in Ostiomeatal complex using Computed Tomography of Paranasal Sinuses in patients attending ENT OPD in Dr. KLES Prabhakar Kore Hospital and MRC, Belagavi, Karnataka, India.

REVIEW OF LITERATURE

LATERAL NASAL WALL

"Lateral nasal wall" is compound structure anatomically and has immense clinical relevance. [10] It extends from nasal vestibule anteriorly to choanae posteriorly and is built up of maxillary bone as its major framework.[11] Its osteology is complex and formed by eight separate bones. There are four large bones; maxilla, frontal, ethmoid and sphenoid, and four small bones; inferior turbinate, lacrimal, palatine and nasal bones.[10,11]

It can be divided into three areas in anteroposterior direction. Processus frontalis from maxilla and lacrimal form anterior part. Ethmoid labyrinth, maxilla, inferior turbinate form its middle third and its posterior portion is formed by perpendicular plate of palatine along with medial pterygoid. Lateral wall initially begins in a smooth, undifferentiated fashion, and by seventh week of intrauterine life, it begins developing into complex one. A total of seven turbinals appear but as a result of repositioning and fusion only three or sometimes four ridges remain at time of birth. First turbinal to develop is maxilloturbinal which forms inferior turbinate ultimately, followed by five ethmoturbinals and a nasoturbinal. It is an independent bone. First ethmoturbinal stems from region of junction of septum with lateral wall superiorly, developing into middle turbinate. Between maxilloturbinal (inferior turbinate) and nasal floor is a furrow which forms inferior meatus and a space present between inferior and middle turbinates becomes middle meatus. Second ethmoturbinal transforms into superior turbinate ultimately. Furrow between superior turbinate and middle turbinates is superior meatus. Supreme turbinate formed by third ethmoturbinal is present in about 26% adults only. Between superior and supreme turbinate is the supreme meatus. Supreme, superior, middle are turbinates of ethmoid

origin. Anterosuperior to middle meatus is a prominence formed by nasoturbinal, that develops into Agger nasi. On Agger nasi's posterosuperior border, a mesenchymal ridge forms process of uncinate. It extends superiorly upto anterior ethmoid bone and along upper surface of IT posteriorly. An evagination develops at about 13 weeks of gestation in region of middle meatus, as a blind diverticulum which forms embryonic infundibulum.(10)

Attachments of ethmoturbinals, uncinate process, agger nasi, and ethmoid bulla to lateral wall are called lamellae. There are five lamellae. Extension of uncinate process laterally is called first lamella that of Bulla Ethmoidalis is called second lamella, junction of middle and superior turbinates to lateral wall are considered third and fourth basal lamellae respectively. Supreme turbinate's attachment is fifth lamella, when it is present. (10)

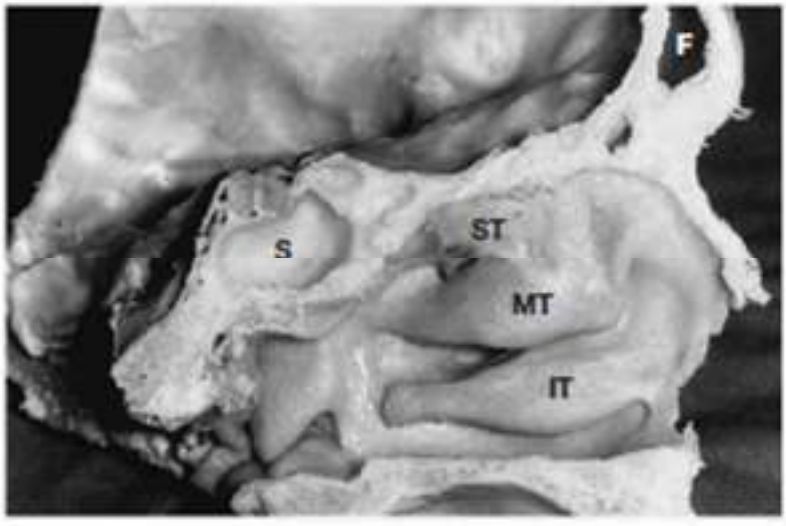


Fig 1: Sagittal section of structures of lateral wall of nose. F- frontal sinus, IT - inferior turbinate, MT - middle turbinate , S - sphenoid sinus, ST- superior turbinate .(12)

DRAINAGE OF PARANASAL SINUSES:

Secretion and transport mechanisms function together in establishing natural drainage of PNS. Mucus quality, cilia and ostial patency and clefts into ostia of sinuses open, play an important role. [1]

Maxillary Sinus secretion transport:

Transport of secretions inside MS follows stellate type pattern. Mucus gets transported by itself along anterior, medial, posterior, and lateral walls inside sinus, also on roof and converge at around natural ostium of MS which opens in floor of posterior one third in ethmoid infundibulum. This further opens in middle meatus from an opening called hiatus semilunaris. Via hiatus semilunaris, secretions are transported over medial surface on inferior turbinate and posteriorly to nasopharynx. Natural ostium is always preferred path for transport even when an accessory ostium is present or in case of a surgically created inferior meatal antrostomy.

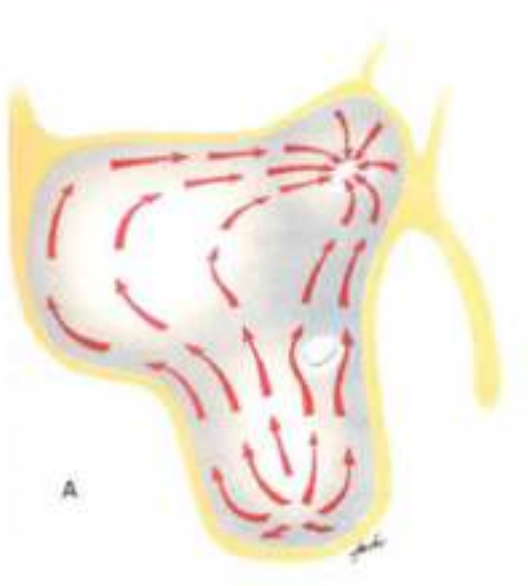


Fig 2 : Normal transport of mucus in maxillary sinus

Secretion Transport in Frontal Sinus:

Mucus transportation in frontal sinus occurs in an actively inward fashion. Secretions travel along interfrontal septum, later along roof in lateral direction and medially via floor and also from posterior and anterior walls to exit via lateral aspect ostium. All mucus doesn't leave sinus after single "round trip" and forms whorl-like formation in shallow groove just above frontal ostium and also inferiorly in frontal recess. Once sinus ostium is crossed, secretions are transported through frontal recess which drains into ethmoid infundibulum directly from above, also even medial to it. Depending on or anatomic variations, frontal secretions may collect mucus from other regions like lateral sinus, agger nasi, concha bullosa, and anterior most ethmoidal cells. In end, frontal sinus secretions merge with those from maxillary sinus and get transported together back towards nasopharynx.

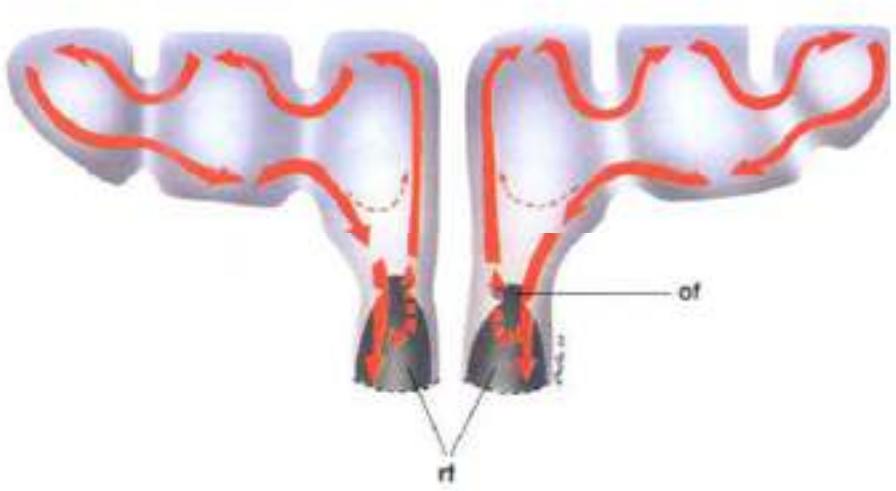


Fig 3: Normal transport of mucus in frontal sinus. rf-frontal recess, of- frontal sinus ostium

Mucociliary transport from Anterior Ethmoids, Posterior Ethmoids and Sphenoidal Sinuses:

Location of ostium determines direction of transport of secretions in ethmoidal cells. If it is located at its floor, then secretions are transported toward ostium directly and if it is located above in one of its walls, as seen in posterior wall of bulla ethmoidalis, then a spiral transport pattern is seen toward ostium. Ground lamella serves as a division between anterior- posterior groups of ethmoid cells. All cells opening anteroinferiorly with respect to ground lamella are called anterior ethmoid and they drain into middle meatus. All cells that have ir opening posteriorly and superiorly to ground lamella are called posterior ethmoid and this drain into sphenoethmoidal recess via superior meatus. Supreme or also called fourth turbinate if present, also drains into sphenoethmoidal recess. In sphenoid sinus, secretions usually follow a spiral pattern toward sinus ostium depending on its location.

ROUTES OF MUCOCILIARY TRANSPORT:

Two dominant routes of transport of mucociliary clearance are recognised in lateral nasal wall. One has a mixture of secretions from frontal and maxillary sinuses along with anterior ethmoidal complex. These secretions join at ethmoidal infundibulum and pass over uncinate's posterior margin and also medial surface of inferior turbinate, to finally drain into nasopharynx. They pass inferior to eustachian tube opening and in front of it. Occasionally minor amounts of secretion from superior meatus at posterior most end of middle turbinate can also join with first or inferior secretion pathway. Till the end of ciliated and squamous epilium of nasopharynx, active transport occurs and n secretions move under effect of gravity and assisted by swallowing mechanism ultimately.

Secretions from posterior ethmoids and sphenoid sinus follow a second route. They meet in sphenoethmoidal recess and from there, transported posteriorly towards nasopharynx and to eustachian tube orifice superiorly. Those from nasal septum usually pass vertically downward toward floor of nose and backwards from there, and then they join first secretion route inferior to eustachian tube.(2)

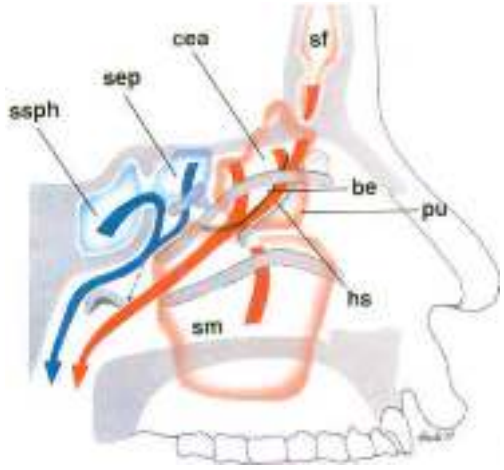


Fig4: Secretion pathways in lateral nasal wall(12)

sf - frontal sinus; sm- maxillary sinus; cea- anterior ethmoidal complex; be- ethmoidal bulla; pu -uncinate process; hs -hiatus sem1lunarls: sep- posterior ethmoidal sinus: and ssph- sphenold sinus.

OSTIOMEATAL COMPLEX (OMC):

Ostiomeatal complex is a term given by Naumann H for a pathway that is common to drainage of secretions of maxillary , frontal sinus and anterior ethmoidal cells. (13) OMC is functional component of anterior ethmoid complex and it represents final pathway in drainage and ventilation of frontal , maxillary, and anterior ethmoids that finally drain in middle meatus. OMC comprises “anterior” ethmoid cells and their ostia, hiatus semilunaris, maxillary MS ostia, ethmoid infundibulum, and middle meatus.(14)

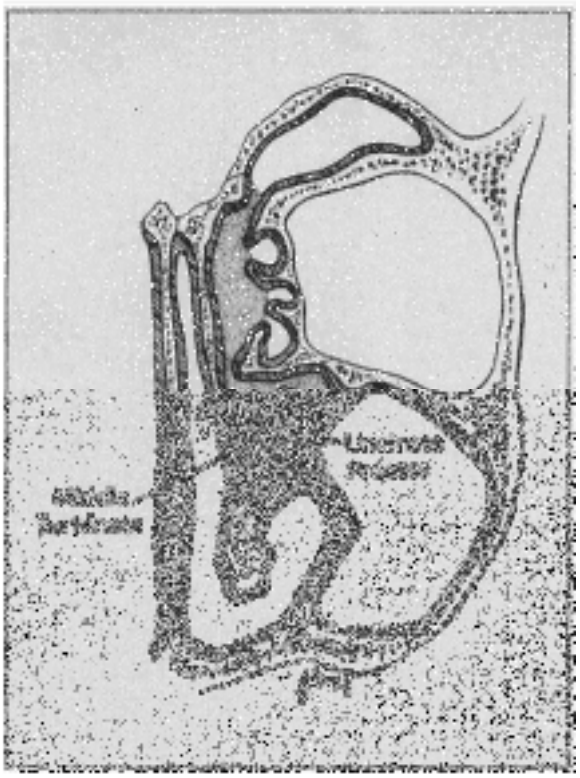


Fig 5: Structures of ostiomeatal complex[13]

OMC is bound medially by middle turbinate, lamina papyracea on lateral side, basal lamella posteriorly, and superiorly by ethmoid roof , anteriorly and inferiorly it is open and communicating with middle meatus. [15] It has a complex anatomy, and a narrow middle meatus drainage pathway, making it an important area as minor blockage in this region may lead to impaired drainage of secretions from frontal, anterior ethmoids, and from maxillary sinus. Basis of Messerklinger's "functional endoscopic sinus surgery" is clearing OMC area alone may reverse changes in draining sinuses.[11]

ANTERIOR ETHMOID CELLS:

Ethmoid cells can be divided into two groups. Ones that lie anteriorly to ground lamella of MT and open into middle meatus are called anterior ethmoid sinus cells. They are small, variable in number. Bulla ethmoidalis most constant and well

pneumatized cell of anterior ethmoid group.[11] Majority of drainage pathways from anterior ethmoid join in ethmoidal infundibulum. Any anatomic variations of structures of anterior ethmoid like those of ethmoidal bulla or marked pneumatization of agger nasi cells can produce stenosis of area of frontal recess.

MAXILLARY OSTIUM:

Th primary ostium of MS is ovoid and measures about 2-4 mm diameter and usually located over medial wall of MS in its superior aspect through which it drains into ethmoid infundibulum and hiatus semilunaris. Location is frequently seen at posterior half of infundibulum and behind intermediate portion of uncinate process but it can vary in its position. Inferiorly it is related to inferior turbinate, superiorly with lamina papyracea (1-2mm) and orbit, posteriorly with posterior fontanelle, and to nasolacrimal duct in front of it. Distance between ostium and anterior maxillary wall (toward nasolacrimal duct) ranges about 5 mm and its posterior edge is continuous with lamina papyracea.[11]

HIATUS SEMILUNARIS:

In Latin it means a semilunar cleft or gap. Hiatus semilunaris forms curved or sickle shaped groove between posterior free edge of uncinate anteriorly and and bulla ethmoidalis' antero-inferior surface posteriorly. Superiorly, it communicates with ethmoid infundibulum. Cleft is 2-dimensional and it leads into 3-dimensional space i.e, infundibulum, acting like a door.[16]

ETHMOID INFUNDIBULUM:

Ethmoidal infundibulum is three-dimensional space within lateral wall. It is part of anterior ethmoid group. It serves as a drainage site for frontal sinus along with anterior ethmoid cells. Its location is anterior to bulla ethmoidalis. Uncinate process

forms its medial wall. Lamina papyracea, along with frontal process of maxilla forms lateral wall. Anteriorly, a blind sac is formed at site of attachment of uncinate to inferior turbinate. Posterior border of infundibulum is formed by anterior surface of ethmoidal bulla. It opens through hiatus semilunaris into middle meatus.(17)

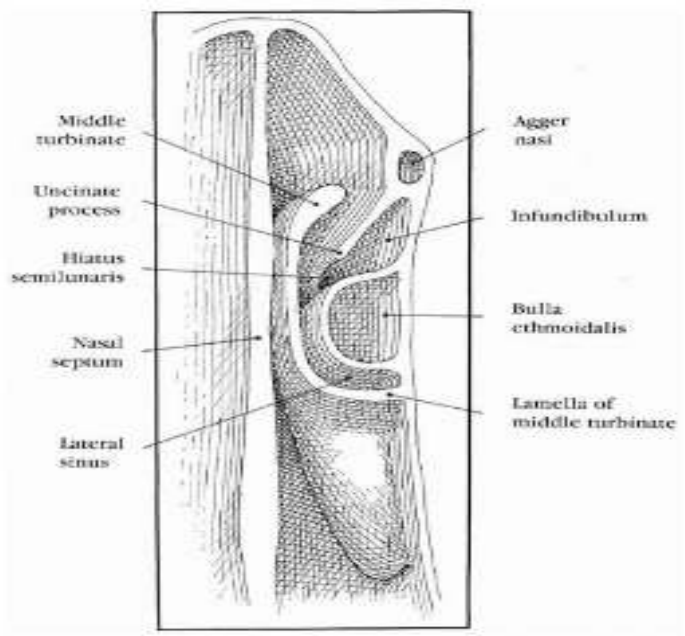


Fig 6: Hiatus semilunaris and ethmoid infundibulum(4)

MIDDLE MEATUS:

Middle meatus underlies bony prominence of middle turbinate and leads to structures located laterally on nasal wall.(18) . It is most significant space of nose, considering drainage of PNS. Frontal, anterior ethmoid cells and maxillary open into middle meatus. Its dimensions depend on structure of MT and also its relationship with nasal septum. Uncinate , bulla ethmoidalis, hiatus semilunaris, horizontal & vertical portions basal lamella, middle turbinate's lateral surface, infundibulum's opening, and depending on insertion of uncinate, drainage of frontal may be visualized through endoscopic examination of middle meatus(19)

ANATOMICAL STRUCTURES AND VARIATIONS AFFECTING OMC:

NASAL SEPTUM**:**

- Nasal septal deviations can compromise OMC resulting in impaired sinus drainage. Ostiomeatal complex & frontal recess diameters are narrower in deviated side when compared to contralateral side depending on severity of deviation. Septal deviations may be paired with a concha bullosa or enlarged turbinates on opposite side. se combination of variations in turn may severely narrow ostiomeatal unit.
- Septal spurs when large, impinge upon, or compromise patency of ostiomeatal unit.
- Septum can have pneumatization.[11]

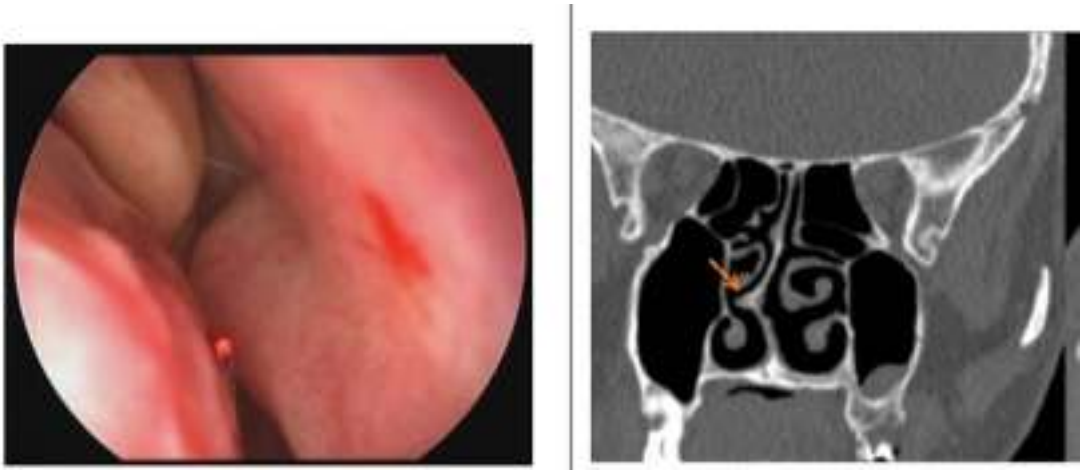


Fig 7: Septal Spur [20] [21]

MIDDLE TURBINATE**:**

- **Concha bullosa**: Middle turbinate when pneumatized may appear ballooned out due to

an air cell enclosed within it from aggar nasi, frontal recess or anterior ethmoids. Such MT is called Concha bullosa. It's tendency is to block OMC and thereby drainage of sinuses (anterior group).

- **Interlamellar cell of Grunwald**: Pneumatized vertical lamella of MT from superior cleft.
- **Paradoxical middle turbinate**: Middle turbinate curves medially in normal individuals. Few may have a paradoxical curve bending laterally towards middle meatus.
- **Bifid middle turbinate**
- **Turbinate sinus:** lower part of a normally curved middle turbinate may curve far laterally to produce a concavity within it.

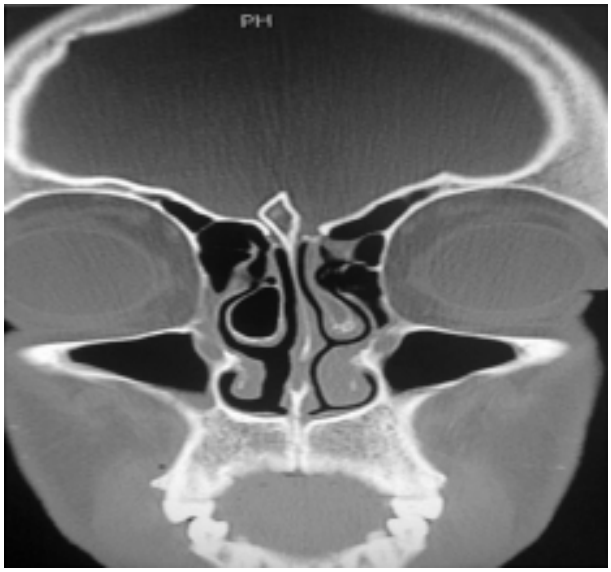


Fig 8: Unilateral concha bullosa[22]

Fig 9: Bilateral paradoxical middle turbinate[23]

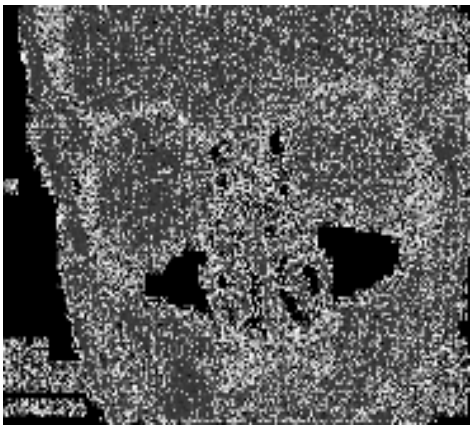


Fig 10: Bifurcate middle turbinate[24]

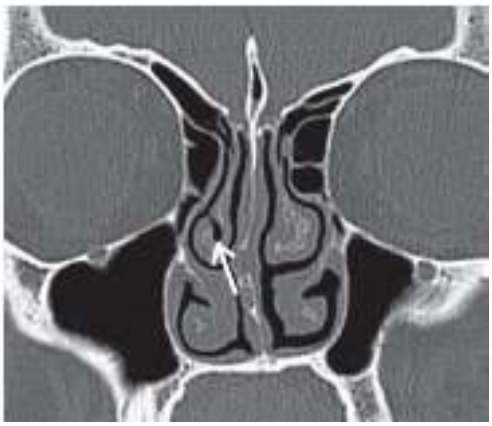


Fig 11: Turbinate sinus[11]

AGGER NASI:

Agger nasi area usually pneumatizes from frontal recess and form agger nasi cell. These are anterior most air cells of ethmoid and also most constant. They are situated anteriorly, laterally & inferiorly to frontal recess.[7] Frontal process from maxilla forms its border anteriorly. Superiorly, frontal recess and sinus lie , anterolaterally nasal bones, lacrimal bone infero-laterally, uncinate infero-medially, ethmoidal infundibulum is seen posterior.[25] A huge agger nasi cell can constrict frontal recess area significantly even if it is non-diseased.[26] Extensively pneumatized agger nasi encroaches upon frontal sinus floor medially or displaces middle turbinate attachment more medially and also superiorly, resulting in a narrower frontal recess area. It is an important factor associated with fronto-ethmoid pain and frontal sinus infections chronically.[25]

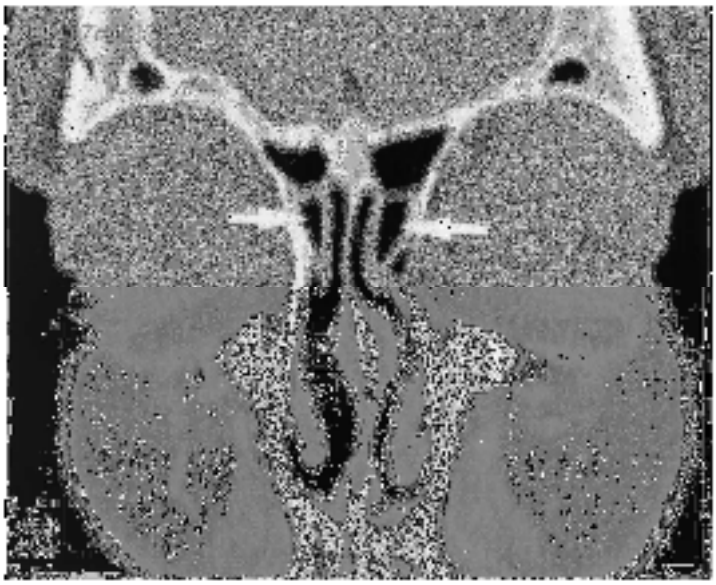


Fig 12: Aggar nasi cell[27]

UNCINATE PROCESS:[28]

Uncinate is a thin bone, sickle shaped or semicircular process of varied length and with surrounding mucosa. It is extension of lateral wall superiorly. It has vertical and horizontal limbs with an intermediate part. Uncinate is attached at its anterior end to lacrimal bone and at posterior end to inferior turbinate. It has a free supero-posterior edge,that forms lower margin of hiatus semilunaris.

Upper end of uncinate is located within frontal recess and shows numerous variations in its anatomy. It can extend upto base skull, get attached to middle turbinate, attach to lamina papyracea, lie in middle meatus freely or be pneumatized.[11]

Variability of its attachment superiorly, determines drainage of frontal recess. Most commonly it's attached to lamina papyracea and agger nasi anteriorly where in, frontal recess drainage is medial to process of uncinate and into a middle meatus. If it is pushed by large agger nasi, it attaches to middle turbinate causing frontal recess drainage into ethmoidal infundibulum. In such variation, frontal sinusitis resulting from narrowed frontal recess also affects maxillary sinus. Uncinectomy can end up causing inadvertent damage in skull base & also lamina papyracea if surgeon is unaware of variable attachment sites.

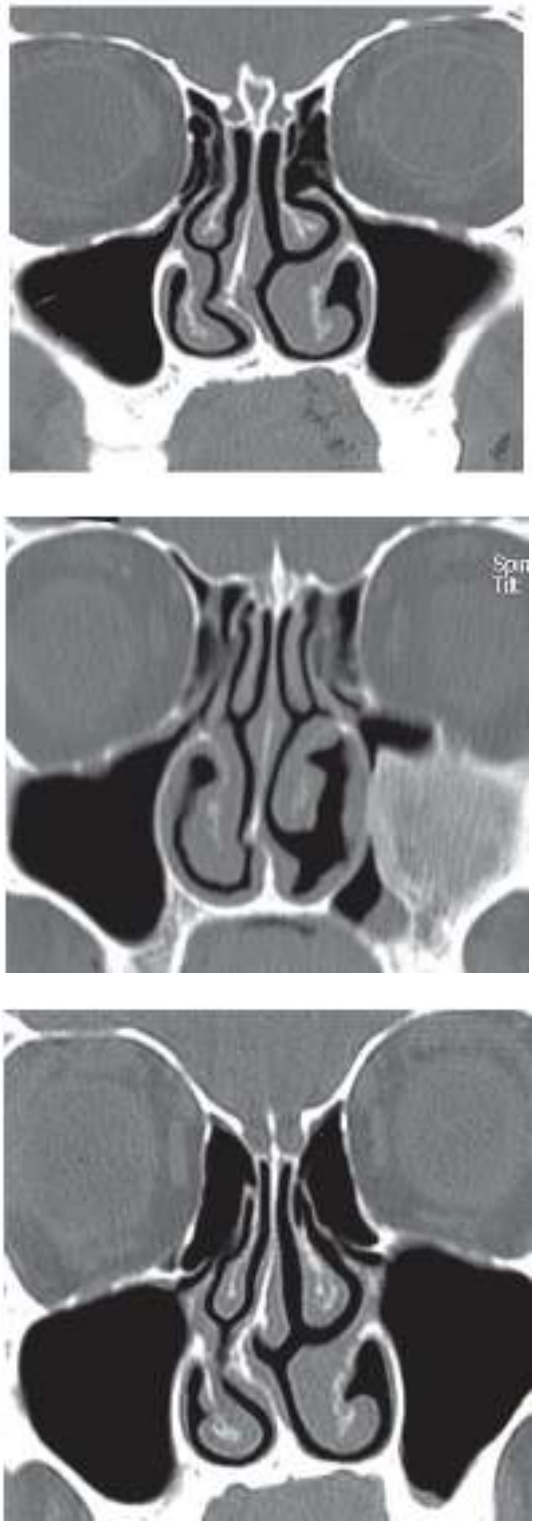


Fig 13: Attachments of uncinate process[11]

Uncinate bulla

Pneumatized uncinate process is called uncinate bulla. It is considered as a rare variation which has potential to alter ventilation by affecting infundibulum, anterior ethmoid and frontal recess.

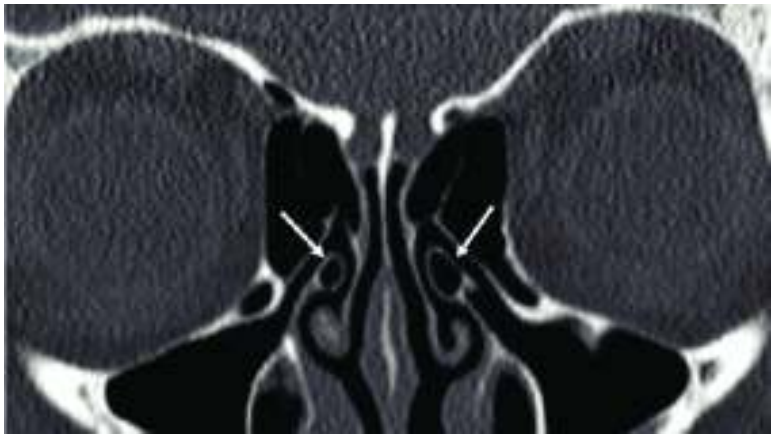


Fig 14: Bilateral pneumatized uncinate process[29]

Deviated tip

Uncinate that is deviated laterally obstructs infundibulum & Hiatus semilunaris or medially, affecting middle meatus. It can also be spiral very rarely, that can occlude middle meatus.

Curved uncinate

Medially curved uncinate is most commonly observed variant. If it is more anterior and exits from middle meatus, its called 'Kaufmann's double middle turbinate'. Adjacent structures determine horizontal & vertical orientation. Horizontal uncinate almost always is related to enlarged bulla ethmoidalis.

Atelectatic uncinate

Sometimes, free end of uncinate process is hypoplastic and attaches to lower section of lamina papyracea. Such variation is called an atelectatic uncinate process. It is observed along opacified hypoplastic maxillary sinus routinely. If not determined beforehand, it can result in complications and threat to orbit and also optic nerve while performing uncinectomy.

HALLER CELLS :

Ethmoid cells situated beneath bulla ethmoidalis, and above maxillary sinus & along inferior most segment of lamina papyracea (floor of orbit), including ones that are within ethmoid infundibulum are called "Haller cells".[30] They have varied appearances and sizes. Large cells cause narrowing of ethmoidal infundibulum.[11] Haller cells can develop adjacent & above MS ostium. Significantly large cells constrict posterior area of infundibulum & also maxillary sinus ostium resulting in a negative consequence pertaining to maxillary sinus ventilation and subsequent recurrent maxillary sinusitis.[7]

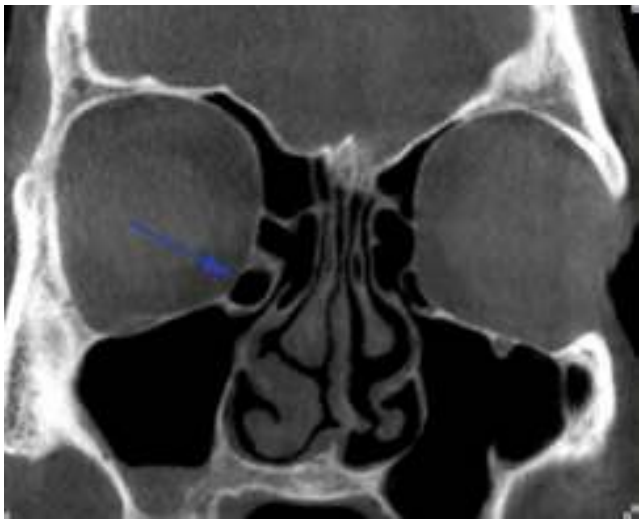


Fig 15: Haller cell[31]

BULLA ETHMOIDALIS:

Latin word for hollow bony prominence with thin walls is bulla.[32] It is consistently largest and also most constantly pneumatized anterior ethmoid cell. It may be hypoplastic or rarely even a solid non-pneumatized hillock. More commonly it may be extensively pneumatized to produce a large bulge, which abuts against uncinate process anteriorly or middle turbinate, compromising ethmoidal infundibulum and/or sometimes middle meatus respectively. Bulla may not be extending upto base of skull, and space formed between upper margin of bulla and skull base becomes a suprabullar recess. Bulla or its adjacent air cells may not extend upto ground lamella. This space formed between ground lamella and bulla is called retrobullar recess. Occasionally both these suprabullar and retrobullar recesses are present. They form a space above and behind bulla which is semilunar in shape and is called Sinus lateralis which opens in middle meatus via a cleft called Hiatus semilunaris superioris. Frontal recess may drain into sinus lateralis.[11]

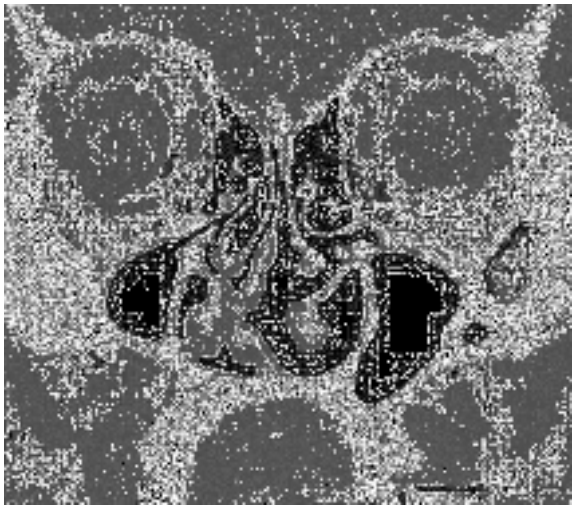


Fig 16: Left bulla ethmoidalis[33]

LAMINA PAPYRACEA

In facial trauma and sometimes in congenital conditions, medially deviated or dehiscent lamina papyracea is seen. At basal lamella's site of insertion into lamina papyracea, bony dehiscence and excessive medial deviation tend to be seen most often. This portion is most delicate. Common dehiscences in this area put intraorbital contents at some risk while performing surgeries, also because medially located bulge can be confused with bulla ethmoidalis.

AERATED CRISTA GALLI

Anterior ethmoid cells may also pneumatize crista galli. This cell drains into frontal recess, either medial and in front of internal frontal ostium, or into frontal sinus.[34] Obstruction of ostium may lead to sinusitis, sometimes along with mucocele. Recognizing this variation preoperatively and differentiating from ethmoid air cell helps to avoid inadvertent injury by preventing extension of surgery into cranial vault.

Fig 17: Pneumatized crista galli with mucosal thickening[35]

ONODI OR SPHENOETHMOIDAL CELLS:

Most posterior of ethmoid air cells that tend to extend supero-laterally to sphenoid sinus and pneumatize it are "Onodi cells". Carotid artery and Optic nerve are related to Onodi cells on their lateral aspect.[36] Sphenoethmoidal cells are uncommon. Identification of Onodi prior to surgery is of paramount importance. It can increase risk of injury of Optic nerve(ON) & ICA when surgeons do not expect ON in posterior ethmoids. Compression of ON occurs when it runs inside cavity of Onodi cell resulting in retrobulbar optic neuropathy.[7]

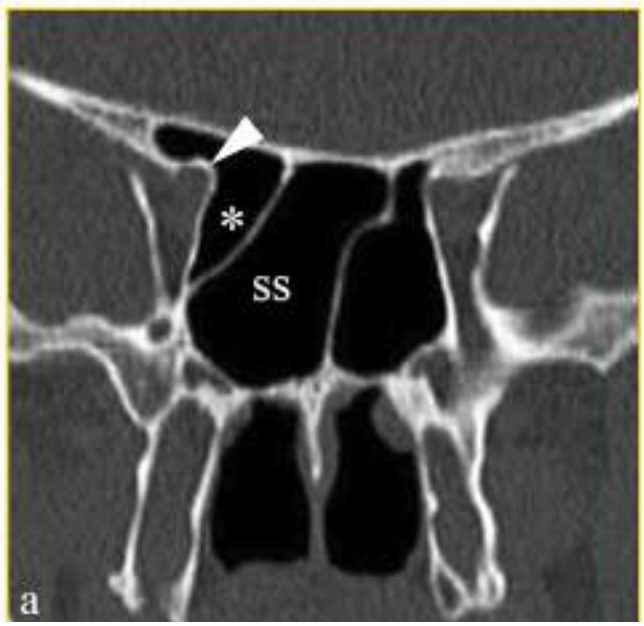


Fig 18: Onodi cell with optic nerve projecting within sphenoid sinus [37]

CAUSES OF OMC OBSTRUCTION:[38]

Factors contributing to ostiomeatal complex obstruction

Anatomic abnormalities	Septal deviation
	Mass lesions
	a.Polyp
	b.Foreign body
	c.Tumor
	Middle turbinate abnormalities
	a.Paradoxical middle turbinate
	b.Concha bullosum
	Abnormalities of lateral nasal wall
	a.Enlarged uncinate process
	b.Enlarged extramural ethmoid cells
Mucosal edema	Infection
	Allergy
	Rhinitis medicamentosa
	Hormonal aberrations
	Vasomotor rhinitis
	Stress, temperature change, eating
	Cigarette smoke, air pollution, chemical exposure

Many factors are involved in obstruction of ostiomeatal complex which include normal anatomical variants and pathological processes.

Certain normal anatomic variations can contribute to physical obstruction of OMC and may predispose individuals to frequent appearance and persistence of acute and chronic inflammations.

These anatomic variations are not pathological processes by themselves and simple presence of these variations is not an indication for a surgical procedure. These variations may considerably constrict narrow clefts of ostiomeatal unit, especially if multiple variations occur in combination.

RADIOGRAPHY OF PNS:

Conventional radiography (X rays) of paranasal system was previously used as screening tool for diagnosing sinusitis. Its value has been limited for detailed evaluation owing to superimposition of various structures. "Computed tomography" is now considered a preferred tool for analysis of anatomy and detect pathology in paranasal sinus system. Differentiation between soft-tissue structures and secretions is not always clear on CT scan. Pivotal information regarding localization of disease process and osseous integrity is given well by CT .[39] Severe drawback of conventional X ray imaging is that it gives only 2-D projections of 3-D object which reduce spatial information.

'Tomography' word is a combination of two Greek words namely 'tomos' (slice) and 'graphein' (draw).[40] CT utilises ionizing radiation in creating cross-sectional images thereby allowing for greater visualization of wide variety of structures which is beyond just regular four densities (air, bone, soft tissue, and fat) seen on an X ray.[41]

CT scan PNS is regarded as gold standard investigation for every case preoperatively. MRI cannot replace CT as it gives detailed bony anatomy essential for

a rhinologic surgeon. anatomical details can be seen well in coronal sections. Sagittal reconstruction also helps in studying anatomy of lateral wall and frontal recess. Dental fillings present as artefacts in coronal sections. In such cases, axial films are taken and coronal reconstruction is done. A basic PNS scan includes 3mm cuts of bony and soft tissue windows taken anterior to posterior in coronal plane. coronal sections are frequently read in anterior-posterior direction whereas axial sections are analyzed inferiorly to superior. Before reading any scan one should study scout film provided first.[11] Coronal slices are evaluated systematically followed by axial slices. Paranasal sinuses are screened sequentially and bilaterally along with or important structure.

OSTIOMEATAL COMPLEX:

Endoscopic sinus surgery played an important role in making Ostiomeatal complex as a principal region for radiologic and pathophysiologic investigation in patients with sinus disease. Non Contrast CT with thin coronal sections are best for demonstrating this area.

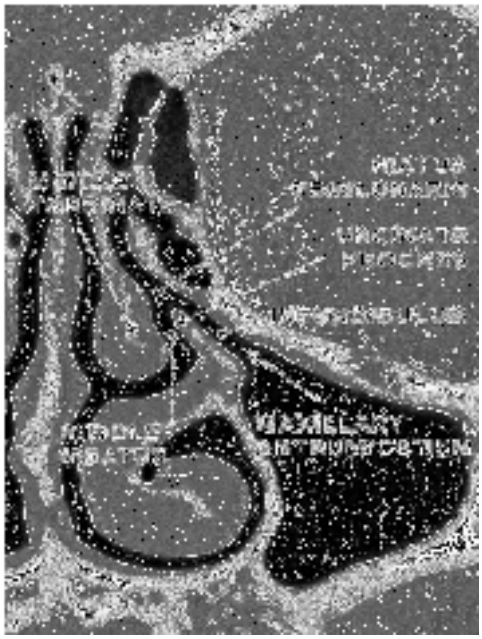


Fig 19: Ostiomeatal complex[42]

Observation must include:

(1) Individual sinonasal anatomy of patient and detection of presence of anatomic variants.

(2) Obstructed cells and their location.

(3) Extent of disease and its consistency with obstruction of ostiomeatal complex.

(4) Identification of previous surgical alterations. OMC obstruction resulting from inflammation, polyps or anatomical compression.[38]

MATERIALS AND METHODS

INCLUSION CRITERIA:

All patients who underwent CT - PNS in Department of ENT&HNS in KLE Dr. Prabhakar Kore hospital & MRC during period of January - December 2019.

EXCLUSION CRITERIA:

- CT- PNS scans of those who underwent surgery of sinonasal region, invasive fungal sinusitis, malignancy of PNS and trauma.
- CT scans of patients of altered ciliary motility like in immotile cilia syndrome, Kartagener's syndrome, Down's syndrome and cystic fibrosis.

CT scan was performed by a 128-slice GE machine in Department of Radiology, KLE Dr. Prabhakar Kore Hospital & MRC, Belagavi. Contiguous axial and coronal scans of 3mm slice thickness were taken from frontal sinus to sphenoid sinus. All films are taken without contrast.

ETHICS APPROVAL:

Ethical clearance for the study was obtained from JNMC Institutional Ethical Committee on Human Subjects Research, Belagavi after reviewing the study design & protocol and the reference number was **MDC/DOME/432**. Consent was waived as it was a retrospective study.

RESULTS AND STATISTICAL ANALYSIS

This is a retrospective study of analysis of anatomical variations in OMC seen in 36 patients that attended ENT OPD in KLE Dr. Prabhakar Kore hospital &MRC and underwent CT-PNS.

Analysis of demographic data shows that age range of patients falls between 18to 65 years, with common age group between 21 and 29 years and a mean age of 39.69 years. Among 36 cases studied 52.78 % (19) were male and 47.22% (17) were female.

Table 1: AGE DISTRIBUTION

AGE	NUMBER	PERCENTAGE
< 20	3	8.33
20 - 29	9	25.00
30 - 39	7	19.44
40 - 49	6	16.67
50 - 59	5	13.89
60 - 69	6	16.67

Graph 1: AGE DISTRIBUTION

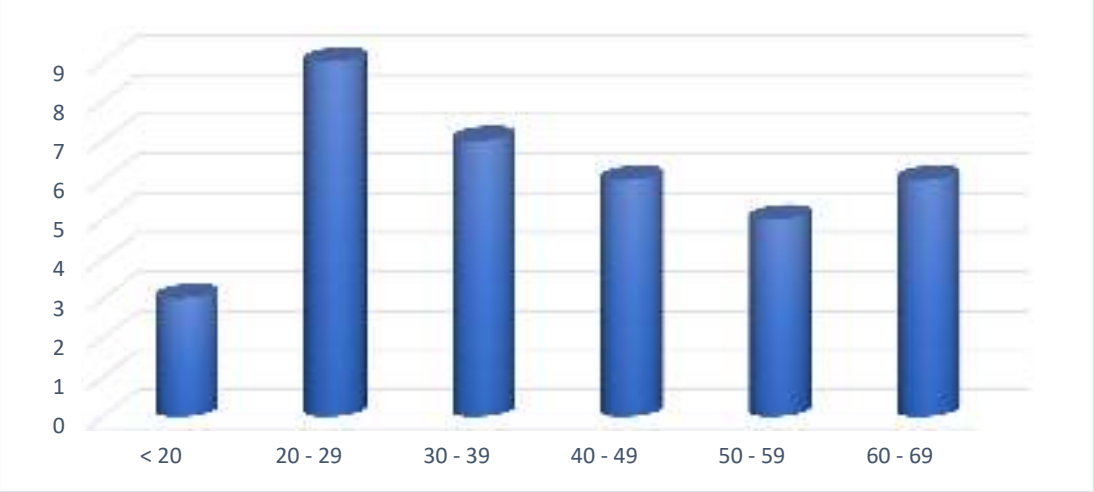
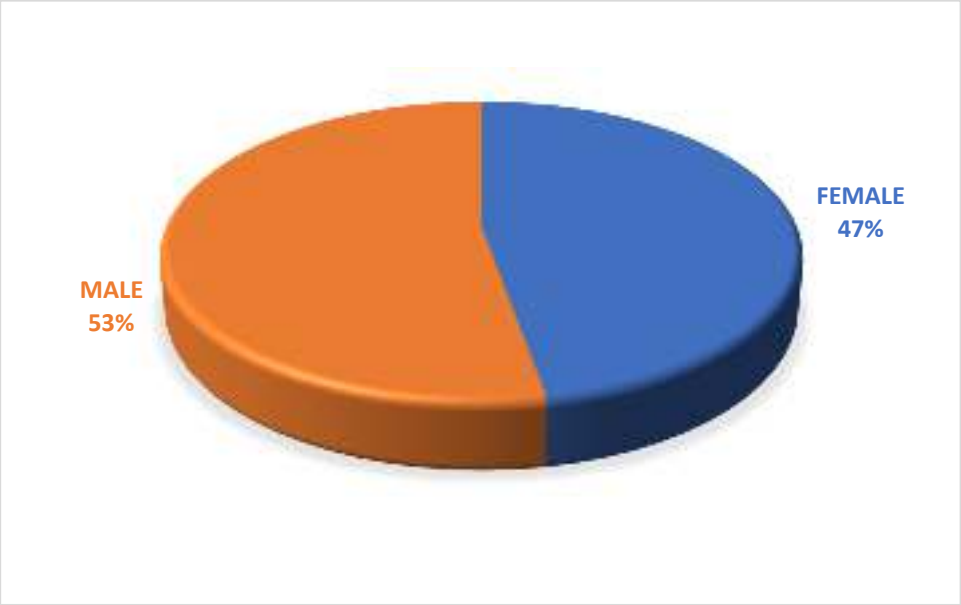


Table 2: SEX DISTRIBUTION

GENDER	NUMBER	PERCENTAGE
M	19	52.78
F	17	47.22

Graph 2: SEX DISTRIBUTION



In this study 100% of cases had at least one variation anatomically. Deviation of nasal septum was most common type of variation noted. “Deviated nasal septum” was noted among 100% (36) patients. Among these, Type I or normal septum was noted in 10 (27.77%) patients, mild DNS or Type II was noted in 21 (58.33%) patients, whereas Type III or moderate DNS was seen in 5 (13.88%) patients. No patients had severe or Type IV DNS. Among these Right sided DNS was seen in 19 (52.77%) patients while 17 (47.22%) patients had left sided DNS.

Table 3: DEVIATION OF NASAL SEPTUM

DNS	R	L	T
M	8	11	19
F	11	6	17

Graph 3: DEVIATION OF NASAL SEPTUM

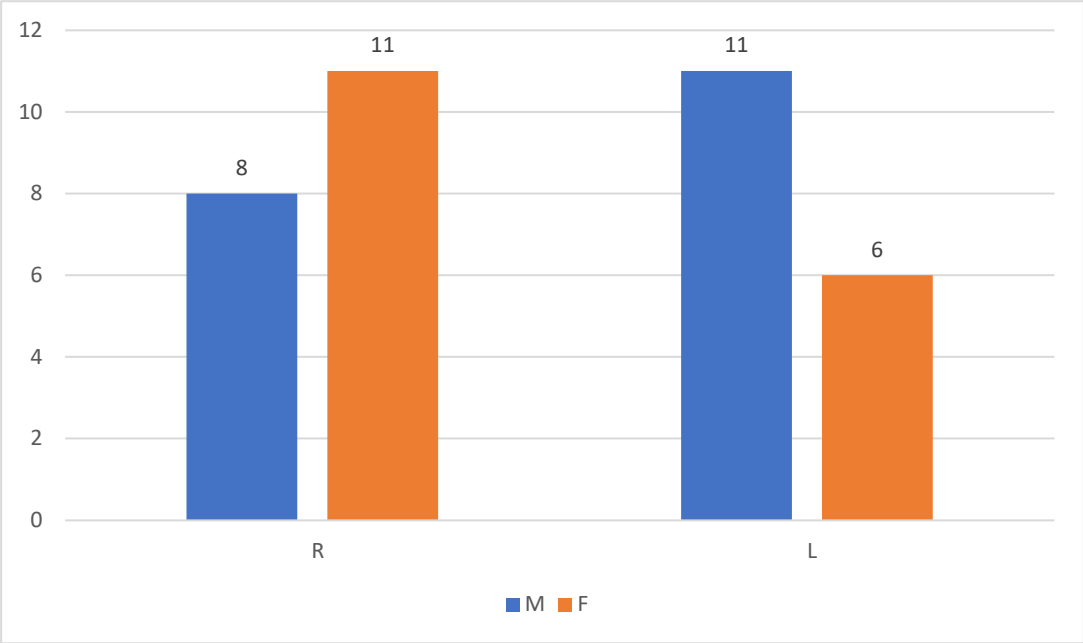
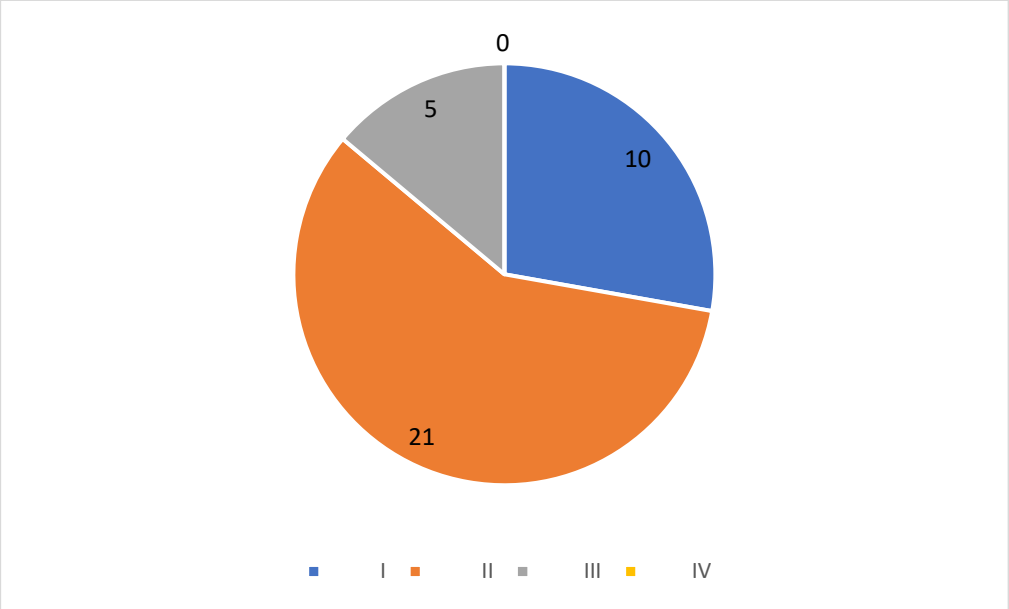


Table 4: GRADING OF DEVIATED NASAL SEPTUM

GRADE	I <5 DEGREE	II 5-10 DEGREE	III 10-15 DEGREE	IV >15 DEGREE
T	10	21	5	0
M	7	11	1	0
F	3	10	4	0

Graph 4: GRADES OF DNS

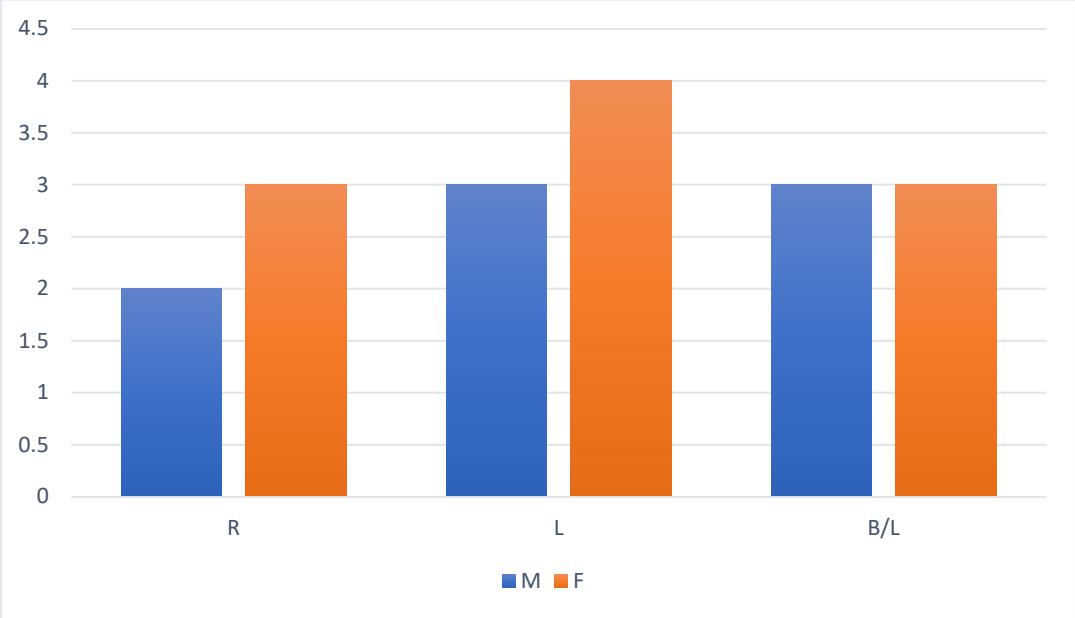


Most common variation in ostiomeatal complex was a Concha bullosa 50% (18 patients) noted unilaterally and/or bilaterally. Most commonly it was unilateral presentation of concha bullosa in 12(33.33%) cases. Of which left sided presentation was more common i.e, in 7 (19.44%) and on right sided was 5 (13.88%) patients. Bilateral presentation was seen in 6 (16.6%).

Table 5: CONCHA BULLOSA

CB:	R	L	B/L	T
M	2	3	3	8
F	3	4	3	10

Graph 5: CONCHA BULLOSA

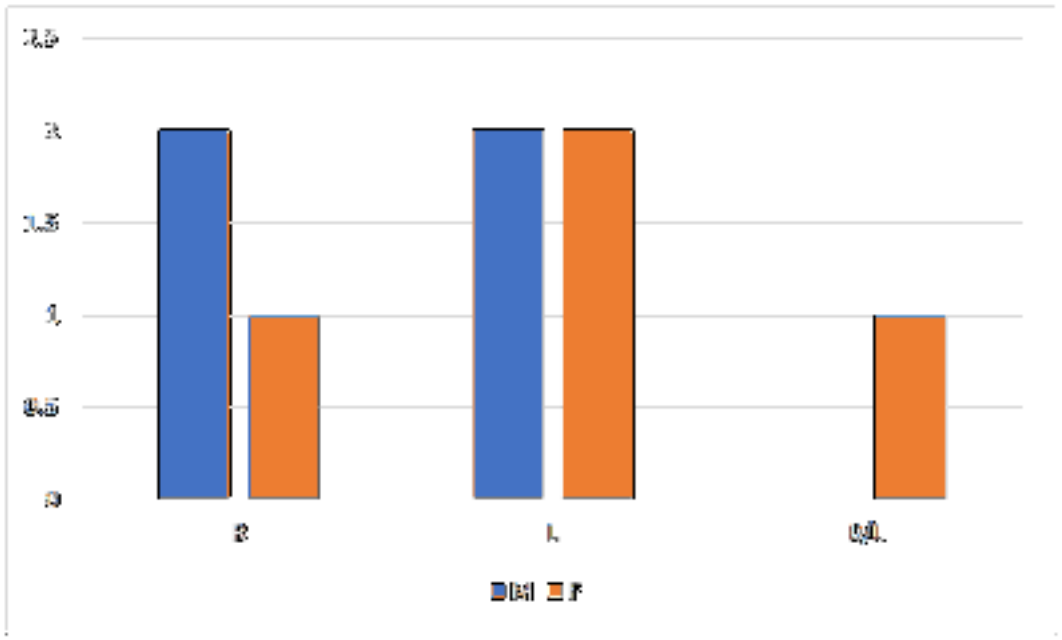


Next common anatomical variation was Onodi cell 22.22 % [8] that may present unilaterally or bilaterally. Unilateral onodi seen in 7(19.44%) patients, of which 3(8.3%) were noted on right where as 4 (11.11%) on left. Only 1(2.7%) patient had bilateral onodi cells.

Table 6: ONODI CELLS

ONODI CELLS	R	L	B/L	T
M	2	2	0	4
F	1	2	1	4

Graph 6: ONODI CELLS

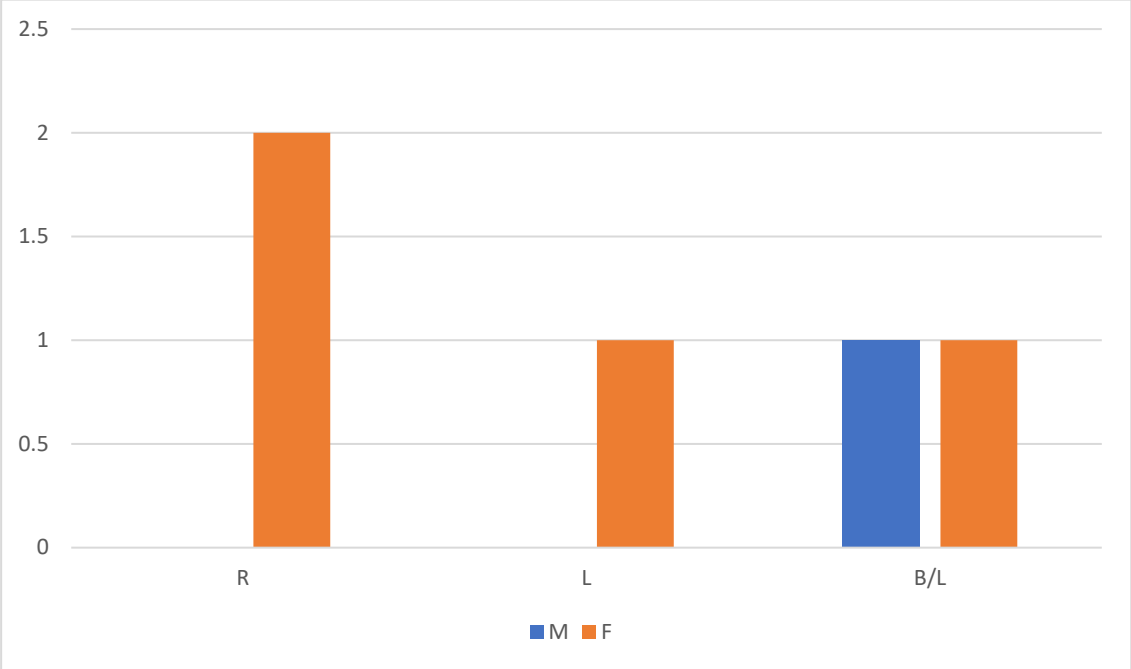


Next common anatomical variation was large Aggar nasi cell seen in 5 patients i.e, 13.8%. Unilateral presentation seen in 3(8.33%) patients, of which 2 (5.55%) were noted on right where as 1 (2.77%) on left. 2(5.55%) patients had bilateral presentation.

TABLE 7: LARGE AGGAR NASI

LARGE AGGAR NASI	R	L	B/L	T
M			1	1
F	2	1	1	4

Graph 7: LARGE AGGAR NASI

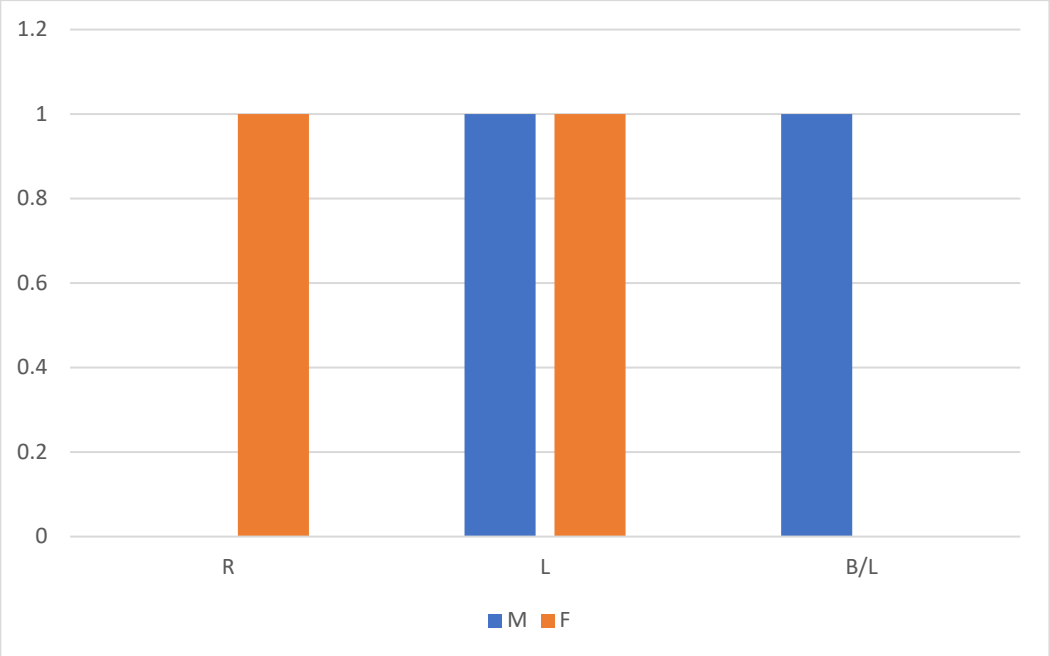


Paradoxical Middle turbinate was seen in 11.11% (4 patients). 1(2.7%) on right & 2(5.55%) on left & 1 (2.7%) patient had bilateral paradoxical middle turbinate.

Table 8: PARADOXICAL MIDDLE TURBINATE

PMT	R	L	B/L	T
M	0	1	1	2
F	1	1	0	2

Graph 8: PARADOXICAL MIDDLE TURBINATE

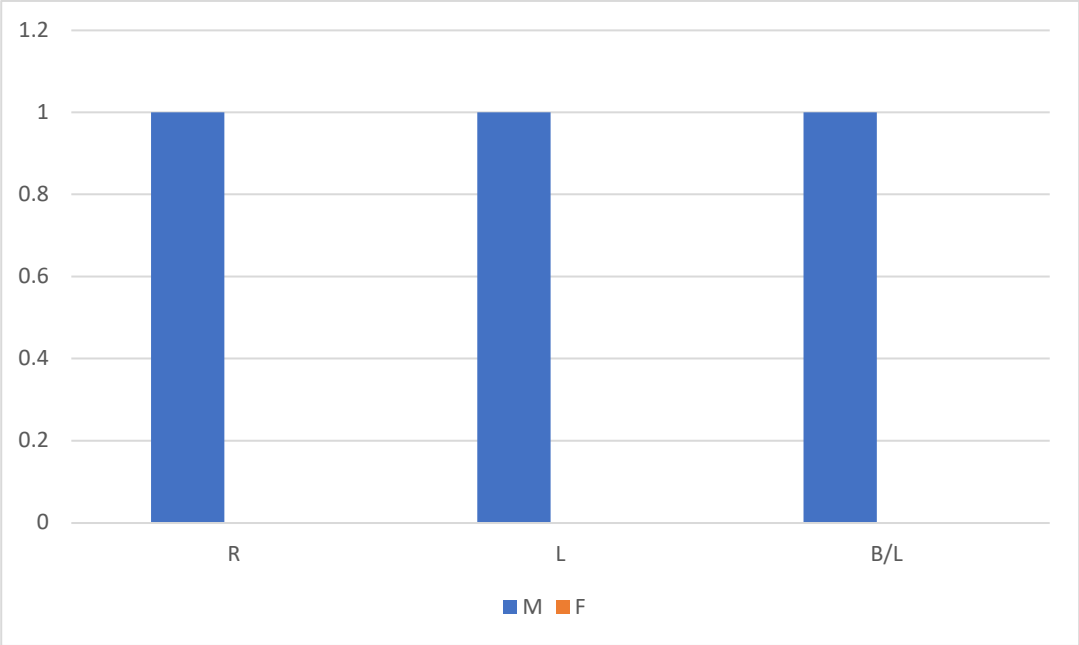


Bulla Ethmoidalis was noted in only 3 (8.3%) patients. Unilateral presentation is seen in 2 patients (5.55%) and bilaterally in 1 (2.7%).

Table 9: BULLA ETHMOIDALIS

BULLA ETHMOIDALIS	R	L	B/L	T
M	1	1	1	3
F	0	0	0	0

Graph 9: BULLA ETHMOIDALIS



Uncinate process was found to be medialized in 3 (8.3%). All of these are seen as unilateral presentation on left side. Pneumatised uncinate is seen in 2(5.55%) patient one of either side.

Table 10: MEDIALISED UNCINATE

MEDIALISED UNCINATE	R	L	B/L	T
M	0	1	0	1
F	0	2	0	2

Graph 10: MEDIALISED UNCINATE

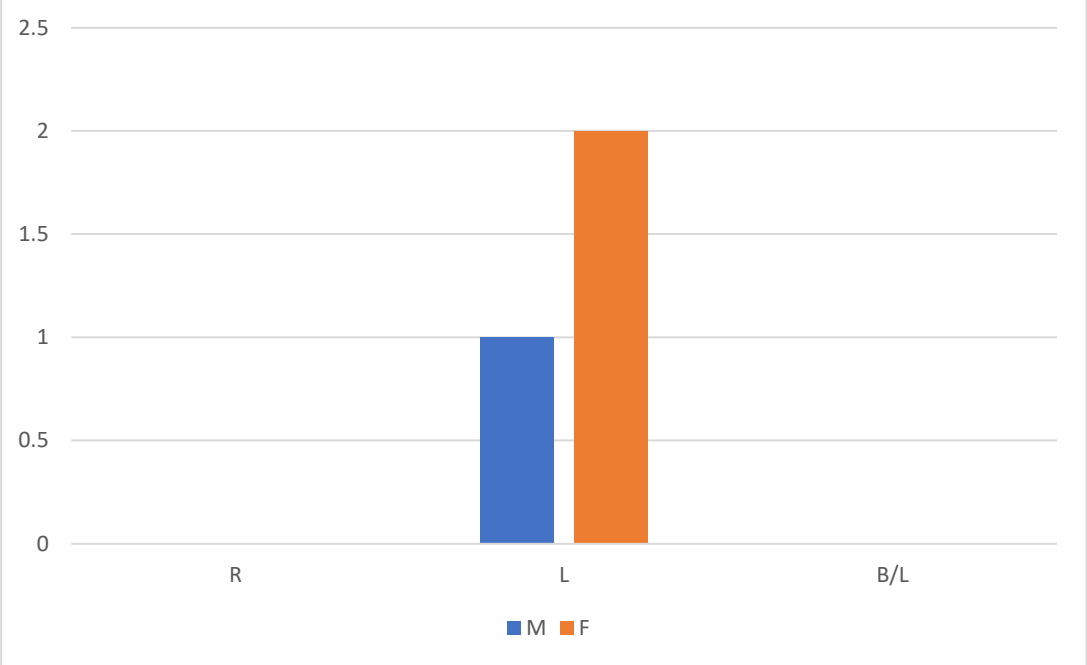


Table 11: PNEUMATISED UNCINATE

PNEUMATISED UNCINATE	R	L	B/L	T
M	1	1	0	2
F	0	0	0	0

Graph 11: PNEUMATISED UNCINATE

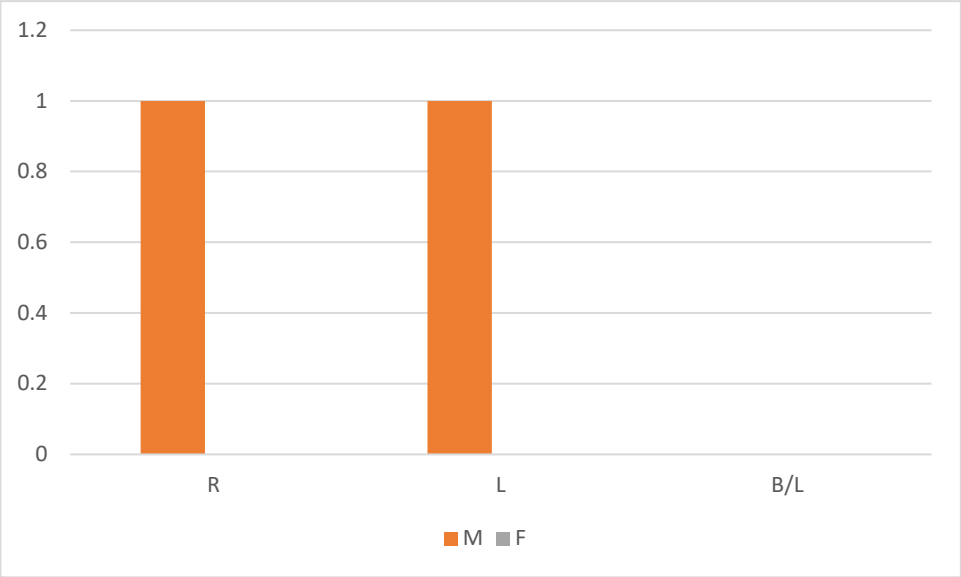
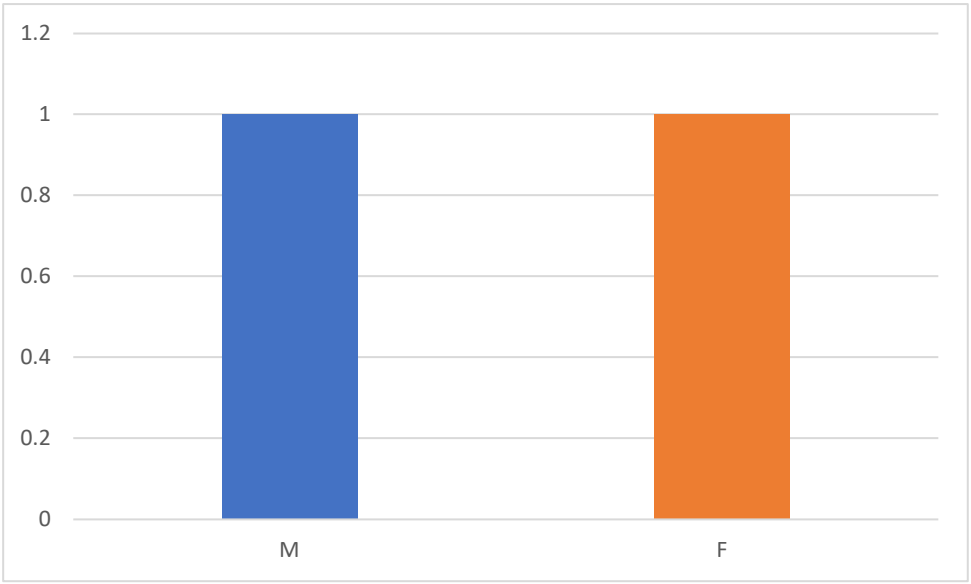


Table 12: PNEUMATISED CRISTA GALLI

PNEUMATISED CRISTA GALLI	M	F	T
NUMBER	1	1	2

Graph 12: PNEUMATISED CRISTA GALLI



Haller cell was noted in only 1(2.7%) patient on left side.

Table 13: HALLER CELLS

HALLER' CELLS	R	L	B/L'	T
M	0	1	0	1
F	0	0	0	0

Graph 13: HALLER CELLS

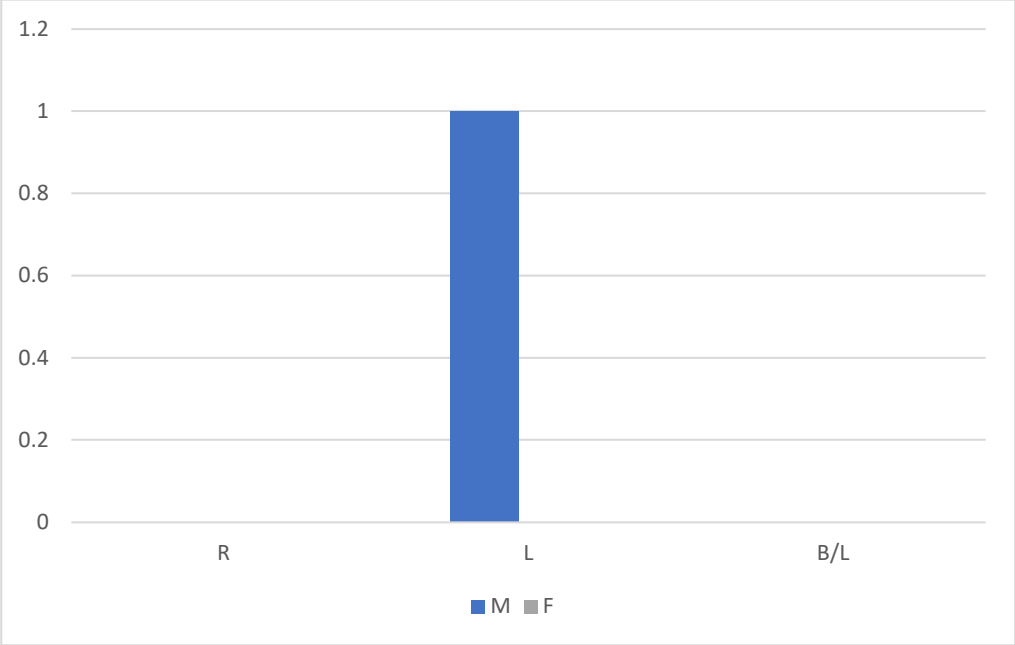


Table 14: DISTRIBUTION OF ANATOMICAL VARIATIONS

ANATOMICAL VARIATION	M	F	T
Deviated nasal septum	19	17	36
Concha Bullosa	8	10	18
Onodi cell	4	4	8
Aggar nasi	1	4	5
Paradoxical middle turbinate	2	2	4
Bulla ethmoidalis	3	0	3
Medialised uncinate	1	2	2
Pneumatized uncinate	2	0	2
Pneumatised crista galli	1	1	2
Haller cells	1	0	1

Graph 14: DISTRIBUTION OF ANATOMICAL VARIATIONS

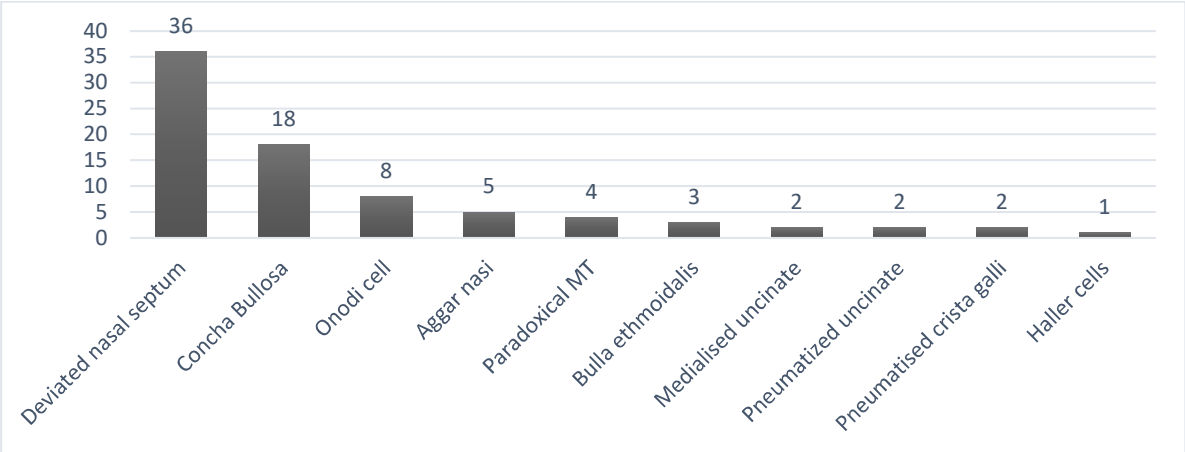


Table 15: LUND MACKAY SCORING

SINUS INVOLVED	MS		AE		PE		FS		SS	
SIDE	R	L	R	L	R	L	R	L	R	L
0	19	18	25	24	28	26	30	28	30	30
1	11	15	8	7	7	6	4	4	5	4
2	6	3	3	5	1	4	2	4	1	2

OMC	R	L
0	30	32
2	6	4

DISCUSSION

Numerous normal anatomic variants of structures in nasal cavity or hypertrophied mucosa, can cause obstruction of ostiomeatal complex and cause improper drainage of secretions that may become stagnated and eventually infected[43]. OMC serves as pathway for drainage from maxillary sinus, anterior ethmoids and frontal sinuses.

Deviated septum and/or bony spur cause a significant reduction of critical area in OMC leading to obstruction & complications. This variation was found among 36 of 36 scans, making it maximum amount of variation observed in our present study to 100%. This observation is similar like a study published by Bandyopadhyay et al[44].It was more than 74.1% in study by Aramani et al[6] and 71% reported by Senniappan et al[45]

Incidence of concha bullosa was 50 % in our study, lesser when compared with 57.2% of Senniappan et al's study [45], 53.6% by Bolger [46], and greater than 42.6% by Maru et al [47], 28% by Asruddin et al[48] and 24% by Llyod[49] .

Next variant reported in our study was onodi cells with 22.22% incidence. It is less than 52.7% reported by Senturk et al[36] and more than 5% as reported by Arslan et al [9] and 13% by Meloni[50].

PMT was noted in 4 among our 36, which is 11.11%. It is comparable to study done by Asaruddin et al[48] which is 12% , Aramani et al[6] who reported 14% and Llyod[49] as 15%.

Prominent Bulla ethmoidalis was noted in 3 patients amounting to 8.3% which is much lesser than Aramani et al[6] who reported as 47.1% in ir study and comparable to 12% reported by Sonone[3].

Variations of uncinate are noted in 5 patients out of 36. Of which 3 (8.3%) have medialized uncinate process and 2(5.55%) have pneumatized uncinate. It is comparable to 9.3% of deviated uncinate reported by Aramani[6] and more than 6% reported by Asaruddin et al[48] and less than 26% reported by Senniappan et al[45]. Pneumatised uncinate has been reported by Senniappan et al[45] as 5.7% .

Haller cell seen in only 1 patient among 36 patients in our study which amounts to 2.7%. It is less than 6% reported by Arslan et al[9] and much lower than Bolger et al[46] who had an incidence of over 40%.

We report an incident of 5.55% of pneumatised crista galli in our study , where as Arslan et al[9] report a 24% incidence and Mladina[51] study shows a 66% incidence.

Ostiomeatal unit was involved in 6(16.6%) patients out of which 3(8.3%) had bilateral involvement. Maxillary sinusitis was seen in 24(66.66%) patients out of which 11(30.5%) patients had bilateral involvement. Anterior ethmoids were involved in 16(44.44%) patients. Posterior ethmoids involved in 14(38.88%) patients. 10 (27.77%) patients had frontal sinus involvement and 8(22.22%) had sphenoiditis. Pansinusitis is seen in 2(5.55%) patients. A prospective observational cross sectional study done by Sonone et al[3] comprising of 57 patients showed involvement of maxillary sinuses in 47 (82.4%) , Anterior ethmoids in 21 (36.84%), Posterior ethmoids in 13 (22.81%), FS involvement in 17 (29.82%) , and sphenoid involvement in 16 (28.07%). Ostiomeatal complex in 44 (77.19%). Pansinusitis was seen among 9 (15.79%) patients. Study of 148 patients by Ameri et al. [52] among clinically diagnosed chronic rhinosinusitis also concluded sinus involvement of MS in 61.9%, either of ethmoids in 27.6%, FS in 18.2%, SS in 21.2% with pansinusitis among 13.7%.

CONCLUSION

"CT-PNS" improved visualization and knowledge of PNS anatomy along with better accuracy in terms of evaluation of PNS disease. It also assists in evaluation of OMC anatomy, otherwise not possible to a great extent by plain radiography.

Numerous variations in anatomy of PNS studied using CT Scan are further implicated in blockage of OMC, which further result in impaired drainage and ventilation of sinuses, causing unresolved chronic rhinosinusitis.

Our study reveals:

1. A combination of variations in anatomy of OMC was more commonly found compared to a single variety.
2. Nasal septal deviation was incidentally found as most common abnormality in all the cases.
3. Of all variations seen in ostiomeatal complex, concha bullosa was commonest abnormality noted i.e, 50%.
4. According to our results, Haller cell was the rarest.

SUMMARY

This study was done from the department of Otorhinolaryngology and Head and neck surgery, Jawaharlal Nehru Medical College and KAHER from January 2020 to December 2020. The objective is to compare the radiographic changes in Nasal Septal Body in patients with Chronic Rhinosinusitis and Septal deviation.

We studied a total of 60 CT-PNS, for radiographic changes occurring in nasal septal body. The parameters measured include septal body thickness in right and left nasal cavity, septal body length and height, inferior turbinate medial and lateral mucosa and internal nasal valve area in both nasal cavity.

For analysis of results, we categorized them into three groups. Group 1- DNS, group 2 - CRS, group 3 - CRS+DNS, of which 30 were DNS group, 16 were CRS, 14 were CRS+DNS. The mean age of DNS group was 39.37, CRS group was 38.31, CRS+DNS group was 43.36. In DNS group 15 patients had right deviation and 15 had left septal deviation, in CRS+DNS group, 7 had right deviation and 7 had left septal deviation The mean degree of septal deviation in DNS group were 10.62 and CRS+DNS group were 8.77

It is found in patient with deviated nasal septum (DNS) in addition to contralateral inferior turbinate hypertrophy septal body thickness is also increased. This is found to be similar in case of CRS with DNS. In CRS patients it is found that along with inferior turbinate hypertrophy, the septal body thickness is also increased on the diseased side and values are found to be statistically significant

In literature they are very few studies on septal body, the current study will enlighten us about the importance of septal body and its changes in septal deviation and chronic rhinosinusitis. Thus, it is important to address the septal body hypertrophy for the better symptomatic outcome of the patient.

LIMITATION OF STUDY

Our study had a small sample size and there is need for a study with larger sample size to determine the profile of variations in a particular demographic region.

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ANNEXURE I. ETHICAL CLEARANCE.

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to-be-University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

JAWAHARLAL NEHRU MEDICAL COLLEGE,
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Ref: MDC/DOME/ 432 **Date: 10/10/2020**

To,

REGISTRATION NO: BE0119012

PG student in Otorhinolaryngology and Head & Neck Surgery,
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"STUDY OF VARIATIONS OF OSTIOMEATAL COMPLEX ON COMPUTED TOMOGRAPHY SCAN OF PARANASAL SINUSES: A 1 YEAR OBSERVATIONAL STUDY"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Rooga M Belfad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

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ANNEXURE II

PROFORMA

STUDY OF VARIATIONS OF OSTIOMEATAL COMPLEX ON COMPUTED TOMOGRAPHY SCAN OF PARANASAL SINUSES: A 1 - YEAR OBSERVATIONAL STUDY

Date:

Name:
Age:
Sex:

CT PARANASAL SINUSES

Parameters:

Variation	Right	Left
Deviated nasal septum		
Aggar nasi cell		
Concha Bullosa		
Bulla ethmoidalis		
Paradoxical middle turbinate		
Medialised uncinate process		
Pneumatised uncinate process		
Onodi cell		
Haller cell		
Pneumatised crista galli		

Lund Mackay Scoring:

Sinus	Right	Left
Frontal		
Anterior ethmoidal		
Posterior ethmoidal		
Maxillary		
Sphenoid		
Ostiomeatal complex		

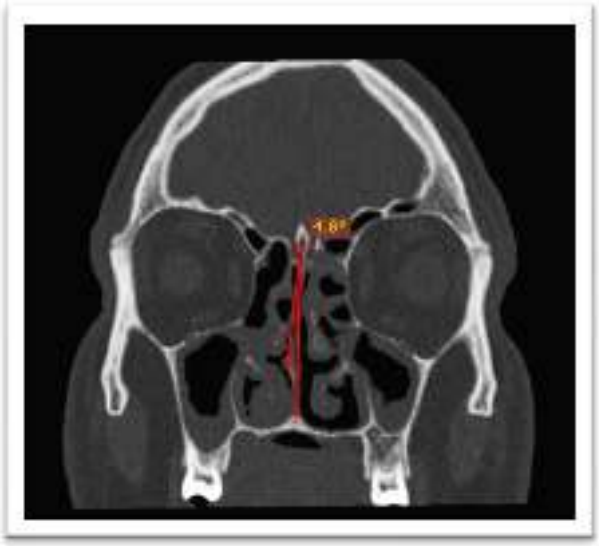
Lund-Mackay CT scan assessment
Paranasal sinuses
Maxillary (0, 1, 2)
Anterior ethmoid (0, 1, 2)
Posterior ethmoid (0, 1, 2)
Sphenoid (0, 1, 2)
Frontal (0, 1, 2)
Ostiomeatal complex (0, 2)*
Total
0 - With no abnormalities
1 - Partial opacification
2 - Total opacification

* 0: Without obstruction; 2: Obstructed.

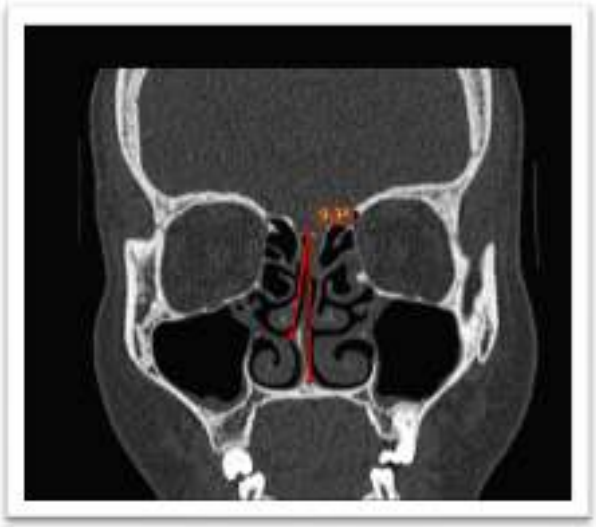
ANNEXURE III

PHOTOGRAPHS

Photograph 1: CT- PNS coronal view showing Grade 1 Deviated nasal septum



Photograph 2: CT- PNS coronal view showing Grade 2 Deviated nasal septum

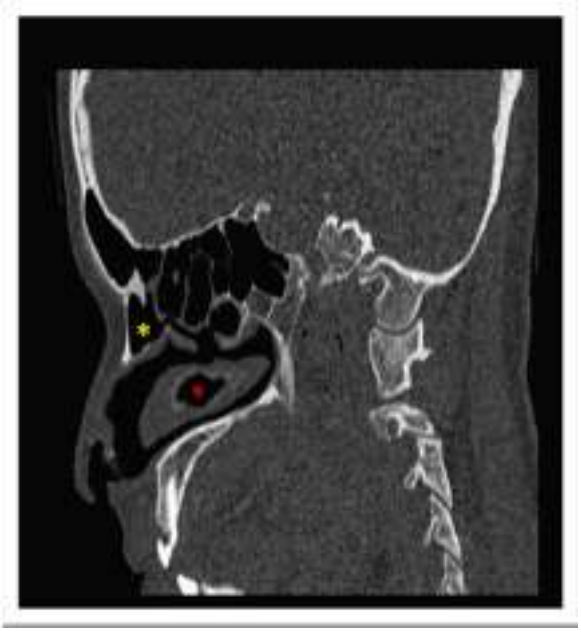


Photograph 3: CT- PNS coronal view showing Grade 3 Deviated nasal septum

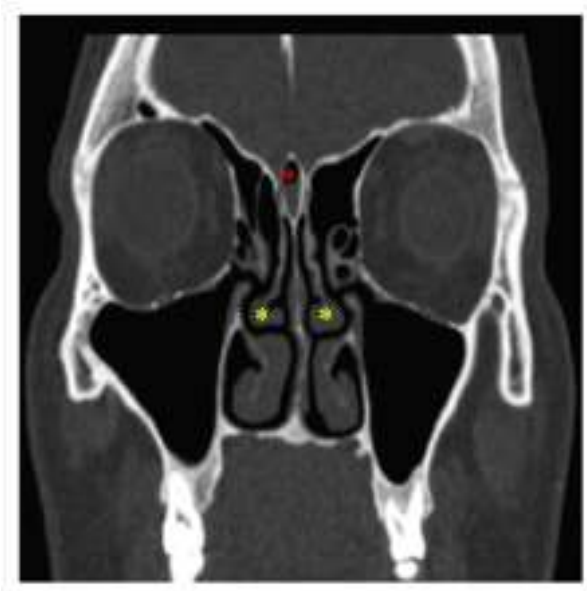
Photograph 4: CT- PNS coronal view showing Bilateral concha bullosa(*)

Photograph 5: CT- PNS coronal view showing Onodi cell (*) with optic nerve within it (*)

Photograph 6: CT- PNS sagittal view showing Large aggar nasi (*) and concha bullosa(*)



Photograph 7: CT- PNS coronal view showing Bilateral paradoxical middle turbinate(*) and partially pneumatized crista galli (*)



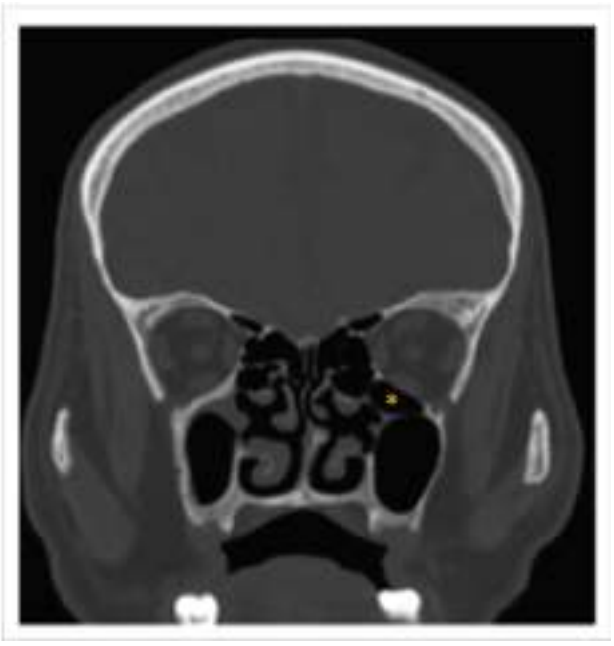
Photograph 8: CT- PNS sagittal view showing Bulla ethmoidalis(*)

Photograph 9: CT- PNS coronal view showing Medialised uncinate(*)

Photograph 10: CT- PNS coronal view showing Pneumatised uncinate(*) and concha bullosa

Photograph 11: CT- PNS coronal view showing Pneumatized crista galli(*) and left concha bullosa(*)

Photograph 12: CT- PNS coronal view showing Haller cell(*)



Photograph 13: CT- PNS coronal view showing left concha bullosa(*)

Photograph 14: CT- PNS coronal view showing uncinate attachment to lamina papyracea on right (*) and cribriform plate on left (*)

Photograph 15: CT- PNS coronal view showing uncinate attachment to Aggar nasi on right (*) and cribriform on left (*) with bilateral concha bullosa(*)

ANNEXURE IV - KEY TO MASTERCHART

DNS	:	Deviated nasal septum
AN	:	Aggar nasi
CB	:	Concha bullosa
BE	:	Bulla ethmoidalis
PMT	:	Paradoxical middle turbinate
MU	:	Medialised uncinate
PU	:	Pneumatized uncinate
OC	:	Onodi cell
HC	:	Haller cell
PCG	:	Pneumatised crista galli
OMC	:	Ostiomeatal complex
N	:	Normal

S.NO	NAME	AGE	SEX	DNS		AN		CB		BE		PMT		MU		PU		OC		HC		PCG	LUND MACKAY SCORING											
																							FRONTAL		ANTERIOR ETHMOID		POSTERIOR ETHMOID		MAXILLARY		SPHENOID		OMC	
				RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	+/-	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
1	RAMAPPA V	36	M	3.7		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	2	0	1	0	1	0	0	1	0	0	0
2	PRASANNA KUMAR	25	M	4.6		N	N	NO	NO	N	N	NO	NO	NO	NO	PRESENT	NO	NO	NO	NO	NO	NO	0	2	1	2	1	2	0	1	0	0	0	2
3	NIRMALA KULKARNI	58	F		13.3	N	N	NO	NO	N	N	NO	PRESENT	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	2	2	2	2	2	2	1	2	2	2	2
4	MADHU KADGONKAR	21	M	4.3		LARGE	LARGE	PRESENT	NO	N	N	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
5	MADHU AKKI	27	F	8.9		LARGE	LARGE	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	0	2	0	0	2	2	1	0	0	2	0
6	KAMALA DESAI	31	F		6.9	N	N	NO	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	2	1	0	0	2	0
7	JAYA VARAL	34	F	8.9		N	N	PRESENT	PRESENT	N	N	NO	NO	NO	PRESENT	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	0	1	2	0	0
8	IRAYYA KEMPAYYA	52	M		4.9	N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	NO	2	2	1	1	0	1	1	1	1	1	2	2
9	GANESH SHETTY	21	M		4.7	N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	PRESENT	NO	0	1	0	0	0	0	0	1	0	0	0	0
10	DURGAPPA PUJARI	65	M	7.5		N	N	NO	NO	SMALL	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	1	0	2	0	0	0	0	0	1	2	0
11	SADIK KHAN	18	M		7.6	N	N	PRESENT	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	1	0	1	0	0	0	0	0
12	VISHAL PATIL	21	M		3.2	N	N	PRESENT	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	1	0	0	0	0
13	SADASHIVAYYA MATHAPATI	62	M	4.8		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	1	2	2	1	1	2	2	0	0	2	2
14	FAKIRAVVA ALAGUDI	46	F		13.7	LARGE	N	PRESENT	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	0	0	0	0	0	0	1	1	0	0	0	0
15	VINAYAK NAYAK	40	M	7.6		N	N	PRESENT	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	1	1	1	1	1	1	0	0
16	VEERAPPA JAGDALE	57	M		6.1	N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
17	TANGEVVA D	36	F	7.1		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
18	RADHIKA NAYAK	18	F	8.6		N	N	NO	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	1	0	0	0	0
19	NAGAPPA NALWAL	65	M		5.7	N	N	NO	NO	N	N	NO	NO	NO	PRESENT	NO	NO	NO	PRESENT	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
20	MAHADEVI RAGE	20	F		5.6	N	N	NO	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	1	0	0	0	0
21	IRAPPA DURGANNAVAR	60	M		8.6	N	N	NO	NO	N	N	PRESENT	PRESENT	NO	NO	NO	NO	PRESENT	NO	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
22	ASHOK CHACHDI	45	M		8	N	N	PRESENT	PRESENT	LARGE	LARGE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	PRESENT	0	0	0	0	0	0	0	0	0	0	0	0
23	VANISHRI MEDAR	21	F	3		N	N	PRESENT	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	PRESENT	0	0	0	0	0	0	0	0	0	1	0	0
24	USHA WALVEKAR	58	F		13.2	N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
25	SUSHILABAI PATIL	65	F	6.7		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	PRESENT	PRESENT	NO	NO	NO	0	0	1	1	0	1	1	1	0	0	0	0
26	PREETHI DHARENNAVAR	18	F	14.5		N	N	NO	NO	N	N	NO	NO	NO	PRESENT	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	0	0	0	0	0
27	KAVERI RAMAPPA	36	F	4.3		LARGE	N	NO	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	1	1	0	0	1	0	0	0	0	0
28	BASAVARAJ KADAGOUDAR	48	M		9.3	N	N	NO	PRESENT	N	LARGE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	1	0	1	0	1	0	2	0	0	0	0
29	NANDAKISHORE PATIL	34	M	8.4		N	N	NO	PRESENT	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	1	0	1	0	2	0	0	0	0	0
30	KALLAVVA DUNDAPPA	60	F		5.6	N	N	PRESENT	NO	N	N	PRESENT	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	0	1	0	0	0	0
31	GALAPPA BANDROLI	40	M	7.2		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	1	0	1	0	1	0	0	0	0	0
32	RAMESH PUJARI	29	M		10.2	N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	2	0	2	1	2	0	0	0	0
33	YALLUBAI PATIL	45	F	6.8		N	N	PRESENT	NO	N	N	NO	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	NO	1	0	1	0	1	0	2	0	0	0	0	0
34	SUNITHA HIRAKI	36	F	5.9		N	LARGE	PRESENT	NO	N	N	NO	NO	NO	NO	NO	NO	NO	PRESENT	NO	NO	NO	0	0	1	1	0	0	1	1	1	0	0	0
35	BASAPPA TALWAR	52	M		9.7	N	N	NO	PRESENT	N	N	NO	PRESENT	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	1	0	0	1	1	0	0	0	0
36	ZEBA JAMEDAR	29	F	4.3		N	N	NO	NO	N	N	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0	0	0	1	0	0	0	0	0