"ROLE OF COMPUTED TOMOGRAPHY IN IDENTIFYING THE ANATOMICAL VARIANTS OF NOSE AND PARANASAL SINUSES AND TO ASSESS THEIR RELATION TO PATIENTS HAVING SYMPTOMS OF SINUSITIS: A CROSS SECTIONAL STUDY"

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ABSTRACT

INTRODUCTION –

Acute sinusitis refers to the condition when the sinuses become inflamed. The aetiology includes both environmental and host variables. Additional risk factors for sinusitis includes anatomical variations such as septal abnormalities, uncinate process variants, turbinate variants and ethmoid cell variations. These variations have been associated with the development of inflammatory sinonasal disorders.

Computed Tomography is regarded as the preferred technology for visualizing bony structures because of its superior accuracy and precision. This study was conducted to determine the relation between anatomical variants of nose and paranasal sinuses and symptoms of sinusitis.

AIMS AND OBJECTIVES -

Primary Objective: To determine the prevalence of sinonasal anatomical variants

Secondary Objective: To assess the relation of anatomical variants in patients having symptoms of sinusitis.

MATERIAL AND METHODS - Study was a cross sectional descriptive study with a sample size of 53 patients, done during the 1 year period from January 2023 to December 2023 with patients having symptoms of sinusitis (age > 18 yrs) who were referred to the Department of Radiology, KLEs Dr. Prabhakar Kore Hospital, to get the CT PNS scan.

The study parameters age, gender of the patients and radiological findings of disease and anatomical variants were evaluated and the prevalence of each anatomical variant in patients having symptoms was analyzed.

RESULTS- Out of 53 patients, septal deviations were the most common variant observed in 62% of patients, followed by Concha bullosa (28%), Haller cells (18%), and Agger nasi cells (12%). Patients with septal deviations demonstrated a significantly higher prevalence of symptoms such as nasal obstruction (87%), facial pain (65%), and purulent nasal discharge (53%) compared to those without septal deviations. Significant associations were observed between the maxillary sinusitis and the nasal septum (Chi-square = 0.041) and similarly, significant associations were found between the maxillary sinusitis and ethmoid cells variations (Chi-square = 0.041).

CONCLUSION- This cross-sectional study underscores the crucial role of computed tomography (CT) in thoroughly evaluating anatomical variants of the nose and paranasal sinuses in patients with sinusitis symptoms. It highlights significant correlation between these anatomical variations and clinical symptoms such as nasal obstruction, facial pain, and purulent discharge.

Keywords: CT PNS, sinonasal anatomical variations, sinusitis, septal deviations , nasal obstruction

LIST OF ABBREVIATIONS

SL NO.	ABBREVIATIONS	FULL FORM
1.	CT	COMPUTED TOMOGRAPHY
2.	PNS	PARANASAL SINUSES
3.	CBCT	CONE BEAM COMPUTED TOMOGRAPHY
4.	PSAA	POSTERIOR SUPERIOR ALVEOLAR ARTERY
5.	FESS	FUNCTIONAL ENDOSCOPIC SINUS SURGERY
6.	SSCT	SCREENING SINUS COMPUTED TOMOGRAPHY
7.	MPR	MULTIPLANAR RECONSTRUCTION
8.	DNS	DEVIATED NASAL SEPTUM
9.	BS	BONY SPUR
10.	SSS	SILENT SINUS SYNDROME
11.	RT	RIGHT
12.	LT	LEFT
13.	CL	CONCHA LAMELLA
14.	CB	CONCHA BULLOSA
15.	CRS	CHRONIC RHINOSINUSITIS
16.	ARS	ACUTE RHINOSINUSITIS
17.	OMC	Osteomeatal complex

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INTRODUCTION

Acute sinusitis refers to the condition when the sinuses become inflamed. Rhinosinusitis is a more suitable word since the sinus channels are connected to the nasal passages. It is a frequently diagnosed condition that results in significant healthcare costs each year.[1,2]

The aetiology of acute sinusitis includes both environmental and host variables. The primary cause of acute sinusitis is viral in nature and tends to resolve itself. Around 90% of individuals with colds exhibit viral sinusitis. Individuals with atopy often have sinusitis. The condition arises due to allergies, irritants, viruses, fungus, and bacteria. Anatomical changes such as septal anomalies, polyps, conchae bullosa and ethmoid cell variations are additional risk factors for sinusitis.[3,4,5]

The anatomical features of the nose and paranasal sinuses display significant variability. Many of these variables vary according to age, gender, race, region and ethnicity, however some of the variances are not statistically significant. The emergence of inflammatory sinonasal diseases has been linked to several of these variants. [6,7,8]

There are many different anatomical variations in the sinonasal region. The most prevalent ones are Agger nasi cells, infraorbital ethmoidal (Haller) cells, sphenoethmoidal (Onodi) cells, nasal septal deviation, and concha bullosa.[9,10]

Understanding these variations is not only important for diagnosis, but also plays a crucial role in minimizing the challenges during surgery and problems after endoscopic or open sinus surgery/skull base surgery. [11]

Imaging studies are crucial for evaluating the structural variations of the paranasal sinuses, as they help identify the elements that may contribute to inflammatory changes in the sinuses. The occurrence of sinus variations is often observed in clinical practice. The formation of the paranasal sinuses occurs when the nasal mucosa invaginates into the surrounding facial bones. This process is responsible for the many anatomical variations, including the presence of additional cavities and variations in the shape and location.[12,13]

Computed Tomography is regarded as the preferred technology for visualizing bony structures because of its superior accuracy and precision. The coronal technique is crucial for accurately examining the paranasal structures, with emphasis on the osteo-meatal unit. CT technique allows for precise imaging of the maxillary sinuses, particularly the paranasal cavities, by employing thin and multi-planar cross-sectioning. This approach is highly effective in assessing the position, shape, and variations in inflammatory pathology of these sinuses.[14,15]

A study conducted by Nouarei et al. determined that anatomic variations in bony structures does not increase the chance of developing sinus mucosal illness. However, they could not rule out the possible influence of these variations on the safety of surgery. Therefore, it is important to evaluate the anatomical variations during the preoperative assessment.[15]

In a research done by Roman et al., it was shown that the variations of the paranasal sinuses are not random occurrences. These variations are present in a significant proportion of patients and contribute to the development and recurrence of sinus inflammation. The Cone Beam Computed Tomography (CBCT) technology, because of its excellent multiplanar reconstruction, allows for a very accurate pre-therapeutic evaluation of these predisposing factors.[16]

Anatomical abnormalities may cause osteomeatal blockage, which hinders the outflow of mucus and increases the likelihood of developing chronic rhino sinusitis.

NEED FOR THE STUDY

The anatomical variations induce osteomeatal obstruction, preventing mucus drainage and predisposing to rhino sinusitis.

Though there are various studies on sinusitis and its anatomical variations , due to lack of sufficient research depicting the correlation between anatomical variants and types of sinusitis, especially in the given study area, this study is being conducted to determine the relation between anatomical variants of nose and paranasal sinuses and symptoms of sinusitis.

AIMS & OBJECTIVES

PRIMARY OBJECTIVE :

To determine the prevalence of sinonasal anatomical variants

SECONDARY OBJECTIVE :

To assess the relationship of these variants with patients having sinusitis symptoms

REVIEW OF LITERATURE

THE PARANASAL SINUSES

The paranasal sinuses are air-filled chambers located inside the frontal, ethmoidal, sphenoidal, and maxillary bones of the skull and facial bones around the nose. They are protrusions originating from the nasal cavity and empty into the upper or side part of the nose. The mucosal lining of the sinuses is directly connected to the nasal cavity, allowing diseases from the nasal mucosa to directly transfer to the sinuses.[17,18]

The nasal cavity is a centrally located, tubular pathway for airflow that stretches from the front of the nose to the back. The nasal septum divides the nasal cavity.

The frontal, ethmoid, and sphenoid sinuses border the nasal cavity from anterior to posterior, and the maxillary sinuses border on both sides. Sino nasal architecture and the drainage routes that interconnect the sinuses is complex.

There are four pairs of sinuses, each lined with pseudo stratified columnar epithelium.

1. Maxillary sinuses
2. Frontal sinuses
3. Ethmoid sinuses
4. Sphenoid sinuses

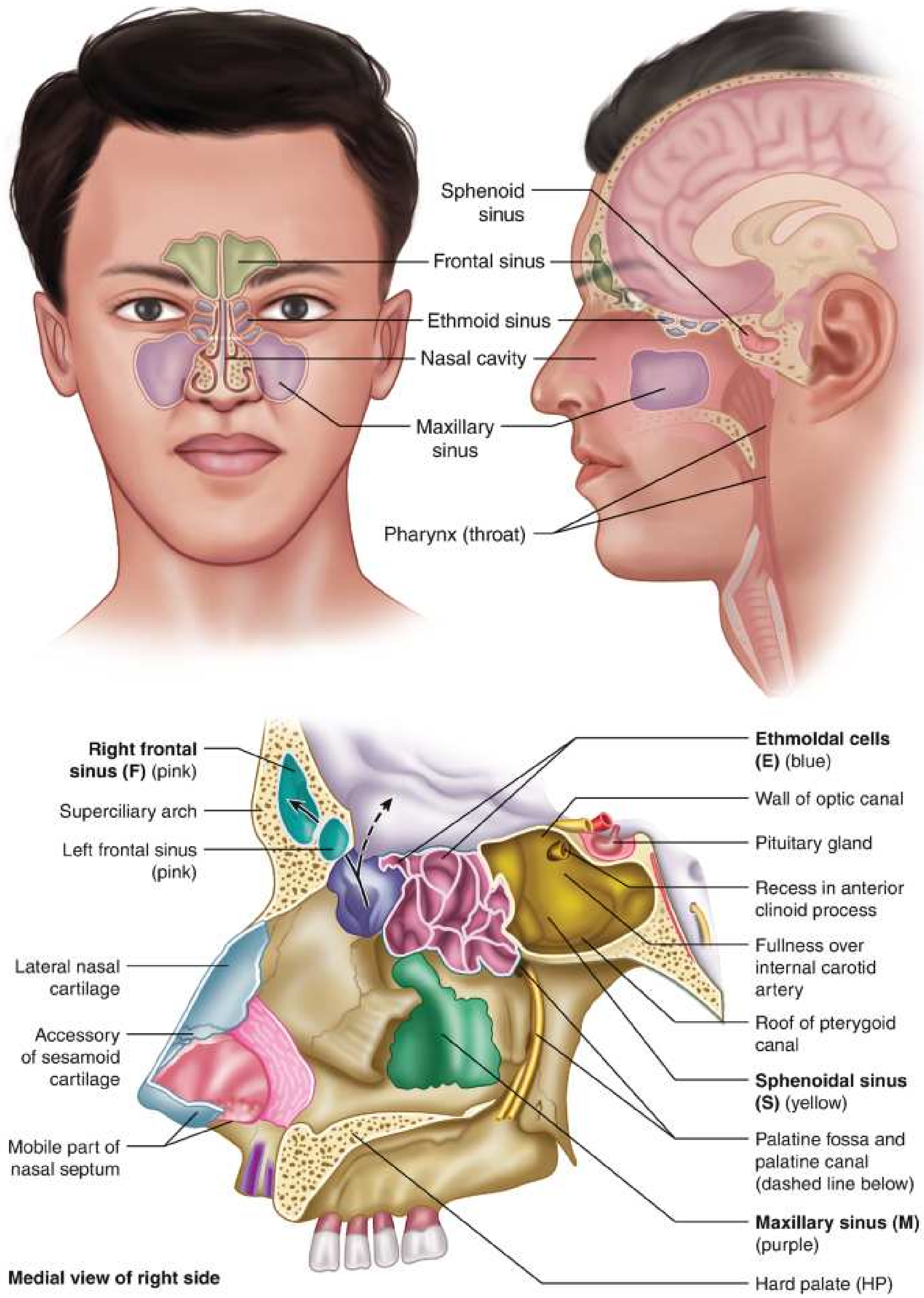
The maxillary sinuses which are the most significant are based beneath the eyes in the maxillary bones.

The frontal sinuses are situated above the eyes within the frontal bone.

The ethmoid sinuses are formed by multiple air cells within the ethmoid bone between the nose and eyes.

The sphenoid sinuses are found inside the body of the sphenoid bone.[19,20]

Figure1: Paranasal Sinuses



STRUCTURE AND FUNCTION

The maxillary sinuses have a pyramid shape and are situated within the maxilla bone. The lateral wall of the nose provides support for the highest point of the sinus as it protrudes into the zygomatic process of the maxilla. Floor of the orbit forms the roof of the sinus and the alveolar process forms the floor. The sinuses are situated bilaterally slightly above the level of the first & second premolars and the third molar. The ostium is positioned at a higher location along the medial wall of the sinus which serves as a point of drainage. Through the hiatus semilunaris, the fluid enters the middle meatus of the nose. [20]

The frontal sinuses are located inside the frontal bone and are divided by a thin bony lamella. These triangular-shaped sinuses extend upward past the medial end of the supraorbital crest and backwards into the medial region of the orbit. Each frontal sinus drains into the middle meatus of the nose through the infundibulum.

There is variation in the size of the ethmoidal sinuses as well as the number of small cavities inside the ethmoid labyrinth. Cluster of 3 to 18 air-filled cavities are located between the nasal cavity and the eye socket. The lamina papyracea, a delicate bony plate of the ethmoid bone, acts as a barrier between the sinuses and the orbit. The ethmoid sinuses are partitioned into three sets of cells by bony basal lamellae. The basal lamellae of the middle turbinate is the most significant of these lamellae and forms a barrier between the anterior and posterior ethmoidal cells, each having distinct drainage pathways.

The sphenoidal sinuses are located furthest toward the back of the skull and are found inside the sphenoid bone in the most posterior position. The sphenoethmoidal recess, which is situated above the superior concha, connects the sinus drainage pathway.[21,22]

The paranasal sinuses have several roles, including reducing the weight of the head, warming breathed air, enhancing the resonance of speech, and acting as protective buffer in case of trauma. The majority of sinuses are either non-existent or in an underdeveloped state in infants. Throughout youth, they progressively enlarge and invade the surrounding bones, reaching their maximum size in the early 20s. Sinuses can vary greatly in shape and size, and they continue to grow slowly.[22]

EMBRYOLOGY

About the eighth week of pregnancy, a series of folds on the side of the nasal wall known as the ethmoturbinals appear. These folds initiate formation of paranasal sinuses. Six or seven folds first appear first , but after regression and fusing, only three or four are left.

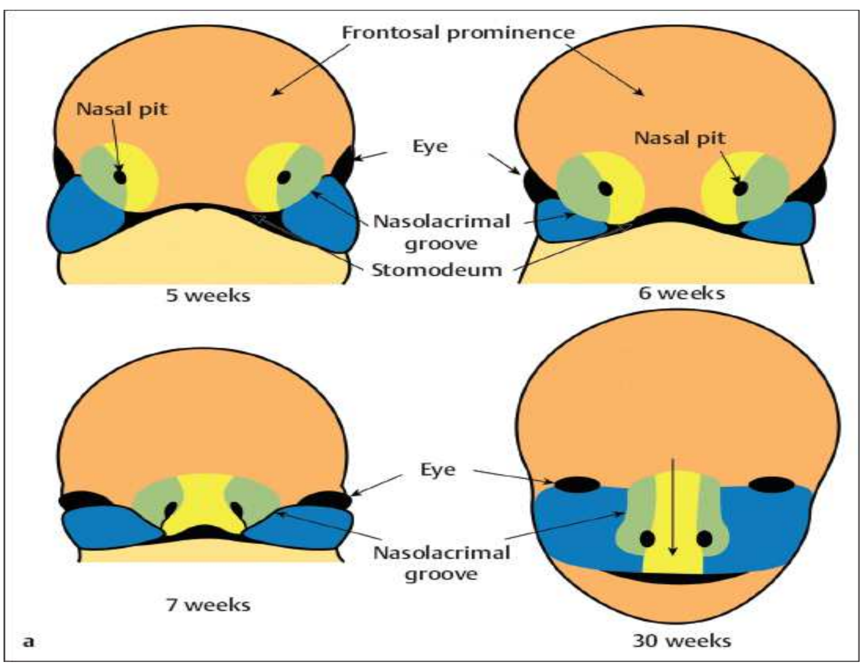
The first ethmoturbinal in humans is weak and incomplete. The upper part of the structure is known as the agger nasi, while the lower part is called the uncinate process. Second is responsible for the formation of middle turbinate. Third is responsible for the formation of superior turbinate. The fourth and fifth ethmoturbinals combine to form the final turbinate. During the course of development, furrows appear between these ethmoturbinals, resulting in the formation of basic nasal passages and recesses.

The anterior pneumatization of the frontal recess within the frontal bone forms the frontal sinus. The frontal sinus normally develops between the ages of five and six. The sphenoid sinus begins to develop in the 3rd month of pregnancy. During this time, the lining of the nose folds inward into the back part of the cartilaginous structure of the nose to create a pouch. The cartilage's surrounding wall undergoes ossification throughout the later stages of fetal growth. The cartilage is then absorbed throughout the second and third years of life, at which point the cavity joins the body of sphenoid.

In the sixth or seventh year of life, the sphenoid sinuses pneumatization continues to progress. Pneumatization of sinuses, including that of the anterior clinoids and pterygoid process, is fully formed at 12 years of age.

Around the tenth week of fetal development, the maxillary sinus starts to develop. The mesenchyme and ethmoid infundibulum invaginations unite during the eleventh week of development to produce a single, oval cavity with smooth sides. This cavity is referred to as the maxillary sinus primordium. The 16th week of development is when sinus ossification starts. The development of the maxillary sinus occurs in two stages between the ages of 3 and 7 to 18. At birth, the ethmoid sinuses have three or four air cells. At adulthood, an individual usually consists of 1–15 aerated cells.[23-25]

Figure 2 : Embryology of Paranasal sinuses



BLOOD SUPPLY

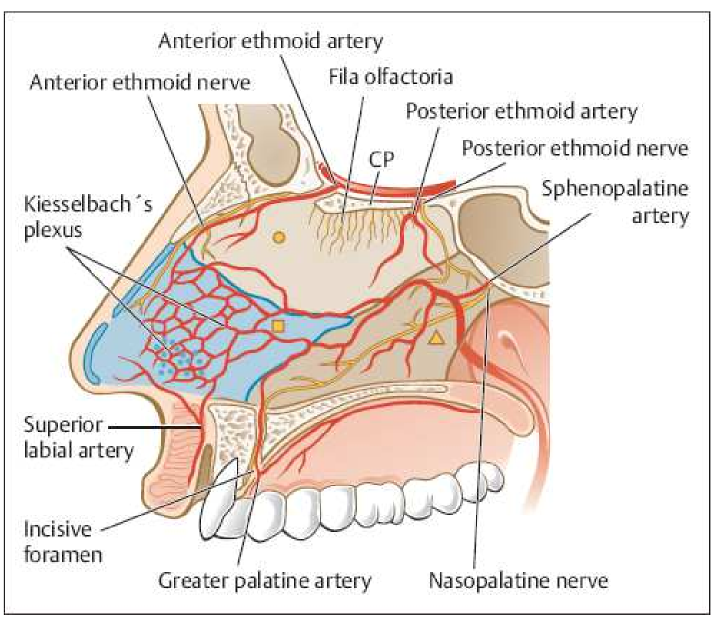
The blood supply of the maxillary sinus is via the branches of the maxillary artery, namely the infraorbital artery, the posterior superior alveolar artery (PSAA), and the posterior lateral nasal artery. Before entering the infraorbital foramen, the infraorbital artery passes via the infraorbital groove and canal. The medial wall of the sinus is next to the posterior superior alveolar artery. The posterior lateral nasal artery is located inside the medial wall of the maxillary sinus.

The blood supply of the frontal sinus is via the supraorbital and supratrochlear arteries, as well as the ophthalmic and supraorbital veins.

The blood supply of the sphenoid sinus is via the sphenopalatine artery, whereas the maxillary vein is responsible for draining the venous blood.

The blood supply of the ethmoid sinuses is via the anterior and posterior ethmoid arteries. These arteries are derived from the ocular artery, which itself is a branch of the internal carotid artery. The venous drainage of the ethmoid sinus is accomplished via the maxillary and ethmoid veins.[26,27]

Figure 3 : Blood supply of sinuses



NERVE SUPPLY

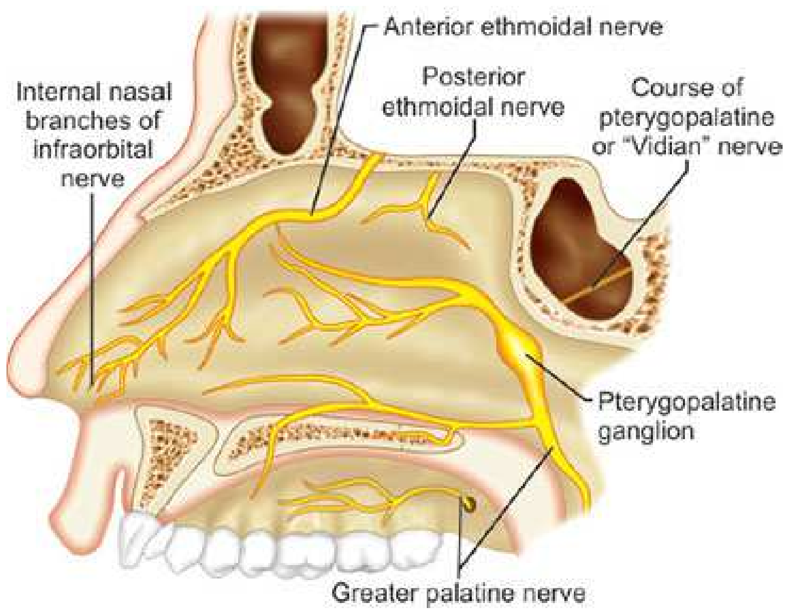
The maxillary sinuses get their neural supply from the infraorbital nerve, as well as the anterior, middle, and posterior superior alveolar nerves.

The frontal sinuses get their nerve supply from the supraorbital nerve.

The ethmoidal cells receive sensory innervation from both the anterior and posterior ethmoidal nerves. The parasympathetic secretomotor fibers of these sinuses originate from orbital branches of the pterygopalatine ganglion.

The sphenoidal sinuses receive their sensory nerve supply from the posterior ethmoidal nerves, and their parasympathetic secretomotor fibers come from orbital branches of the pterygopalatine ganglion.[28,29]

Figure 4 : Nerve supply of sinuses



THE MAXILLARY SINUS

The maxillary sinus is an air-filled space situated inside the maxillary bone, with the base facing the nasal cavity and walls in the anterior, posterior, and superior directions. It has a blunt peak that extends into the zygomatic process of the maxillary bone. The maxillary sinus has a volume of about 15 mL throughout adulthood, making it the biggest among the paranasal sinuses. [20]

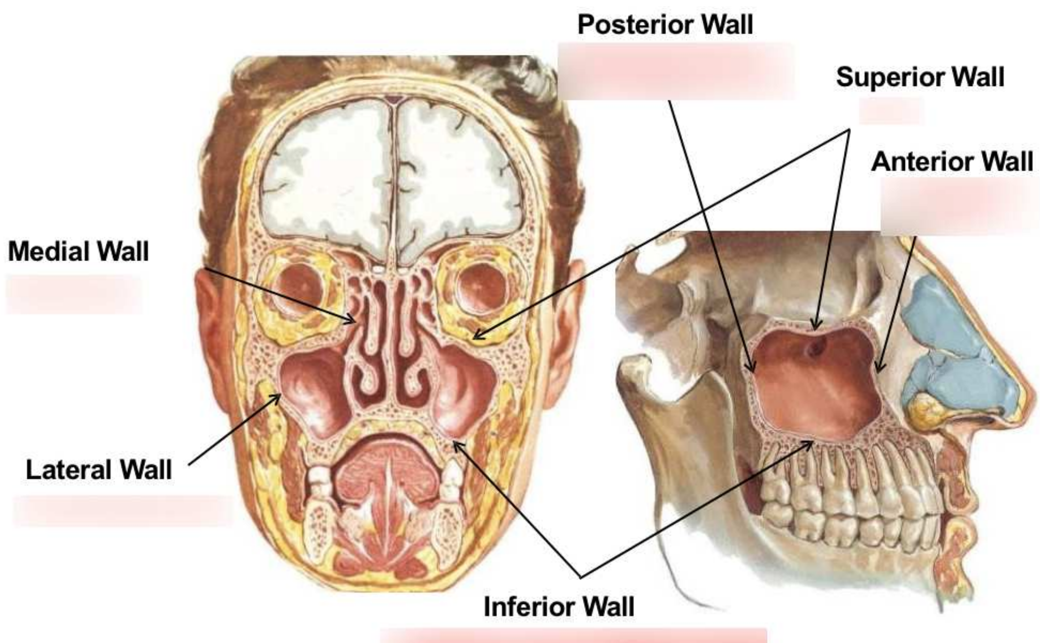
Infraorbital foramen, groove, and canine fossa are the three landmarks that make up the anterior wall, which is formed by the facial aspect of the maxillary bone. The distance between the infraorbital foramen and the lower margin of the orbit is approximately 5 to 8 mm. The maxillary tuberosity forms the posterior wall. It is associated with the contents of the pterygopalatine fossa that is the pterygopalatine ganglion and various branches of the maxillary artery, vein, and nerve. Therefore, the infections of the maxillary sinus and oral cavity can spread to the pterygopalatine fossa. [20,23]

The floor of the orbit forms the roof. The infraorbital artery, which is a branch of the maxillary artery, and the infraorbital nerve, which is a branch of the maxillary division of the trigeminal nerve enters into the infraorbital groove through this wall. The ostium, which is located in the lower portion of the medial wall or at the same level as the orbital floor, connects the maxillary sinus and nasal cavity, but the medial wall acts as a barrier between them.

The inferior wall or the floor of the sinus is in close proximity to the apices of the posterior teeth. The molars are closer to the sinus floor than the premolars, with an average distance of 1.97 mm between the dental apices and the sinus floor.

The buccodistal root of the second molar lies in direct proximity to the floor of the maxillary sinus. [30,31]

Figure 5 : Boundaries of Maxillary Sinus



Maxillary sinuses often include septa, which are thin cortical bone plates that originate from the sinus floor. Cone beam CT scans may provide a clearer image of these septa.

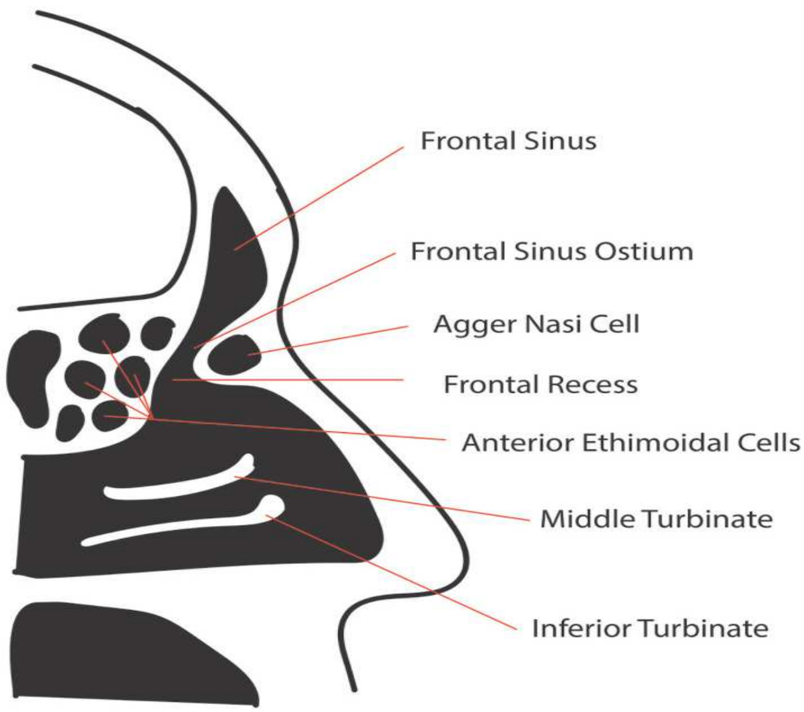
Primary septa form during sinus development, whereas secondary septa form after tooth loss. In addition to septa, tooth loss leads to a localized reduction in the sinus floor and resorption of the alveolar bone.

The maxillary sinus is lined by mucus-producing ciliated pseudo stratified columnar epithelium, and it does not have periosteum. The cilia are responsible for moving the mucous towards the ostium, which is present on the upper part of the medial wall. The cilia are more abundant in the vicinity of the ostium.[32,33]

FRONTAL SINUS

The frontal sinus is a bony structure filled with air that is positioned above the eye socket and inside the frontal bone. The form and size of the sinus vary based on climate and ethnicity. The sinus has a normal capacity ranging from 4 to 7 mL. [34]
The frontal septum divides the frontal sinus into two chambers.

Figure 6 : Frontal sinus anatomy



The frontal infundibulum is a conical narrowing situated in the floor of the frontal sinus, positioned above the agger nasi cells, and serves as a drainage pathway into the frontal recess. The ostium is the narrowest part of the transition zone between the frontal sinus and the frontal recess.

The frontal recess is the area located behind the frontal beak where the frontal sinus empties its contents. The anterior boundary of the sinus is formed by the posterior wall of the agger nasi cell. The lateral boundary is formed by the lamina papyracea. The medial boundary is formed by the middle turbinate.

Infection often occurs in the frontal recess, and the surgical procedure to access it is difficult. In about 50% of the population , the recess opens into the middle meatus, whereas in rest of the individuals, it opens into the ethmoid infundibulum.

FRONTAL CELLS

The International Frontal Sinus Anatomy Classification (IFAC) was developed in 2016 by a group of experts to improve surgeons understanding of the complex and varied frontal sinus recess and frontal sinus anatomy.[35,36]

Figure 7 : The International Frontal Sinus Anatomy Classification (IFAC)

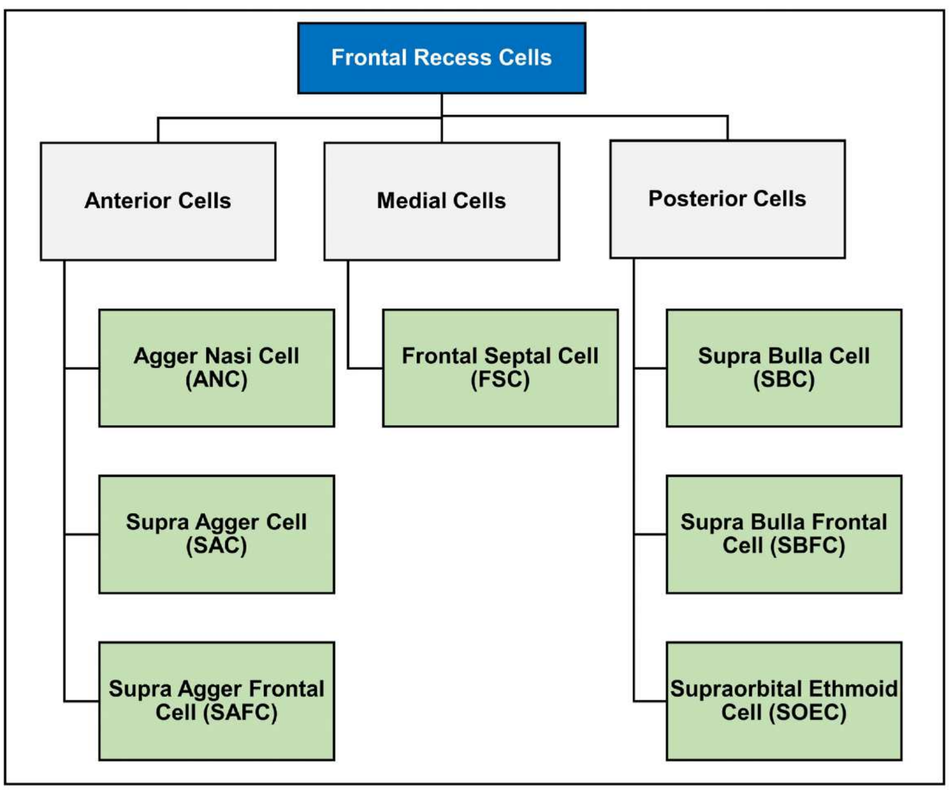


Figure 8 : Kuhn's classification

Kuhn Classification of Frontoethmoidal Cells

Agger nasi cells	
Supraorbital ethmoid cells	
Frontal cells	
Type 1	Single frontal recess cell above agger nasi cell
Type 2	Tier of cells in frontal recess above agger nasi cell
Type 3	Single massive cell pneumatizing cephalad into frontal sinus
Type 4	Isolated cell in the frontal sinus
Frontal bulla cells	
Supra bulla cells	
Interfrontale sinus septal cell	

The anterior cells consist of the agger nasi cell, supra agger cell, and supra agger frontal cell. These cells exert force on the drainage system in a direction that is either towards the middle, towards the back, or towards the back and middle.

The Agger nasi cell is the anterior most ethmoidal cell. Majority of the patients have an ethmoturbinal residual cell, which is be opened to see the frontal recess properly.

The agger nasi cell is found either in front of the origin of the middle turbinate or right above the most anterior insertion of the turbinate into the lateral nasal wall. The Supra Agger Cell is an ethmoidal cell located antero-laterally, positioned above the agger nasi cell which does not extend into the frontal sinus.

The Supra Agger Frontal Cell is an extension of the anterior lateral ethmoidal cell. The extent of extension into the frontal sinus depends upon their size. If the size is tiny, it protrudes into the sinus floor.

Suprabulla cell, suprabulla frontal cell, and supraorbital ethmoid cell are the posterior cells and progress the drainage system in forward direction.

The Supra Bulla Cell is located above the ethmoid bulla and does not extend into the frontal sinus.

The Supra Bulla Frontal Cell originates in the supra bulla region and pneumatizes into the posterior part of the frontal sinus. Posterior wall is formed by the skull base.

The Supraorbital Ethmoid Cell is located at the front of the ethmoid bone and is responsible for air-filled spaces which are found at the front, back or around the anterior ethmoidal artery on the top of the orbit.

Frontal septal cells are medial cells which are located in the middle part of the inferior frontal sinus or in the front part of the ethmoid sinus. The sinuses are connected to the septum of the interfrontal sinus. They exert force on the drainage system, causing it to move in a sideways and backward direction.[36]

THE SPHENOID SINUS

The sphenoid sinus is situated towards the back of the sphenoid bone, lying in the centre and is bordered by the sella turcica superiorly. The sphenoid sinus starts to appear at the age of 2 years in radiographs. The average adult size capacity ranges from 0.5 to 8 mL. The sphenoid sinus has an anatomical connection to significant structures such as the internal carotid artery and optic nerve.

The lateral wall of the sinus is in close proximity to the carotid artery, and artery is exposed in 25% of individuals.

The sphenoid bone has a depression on top caused by the optic nerve, and 4% of people may not have any bone above it.

The hypophyseal gland and cavernous sinus are adjacent to the sphenoid sinus. The sphenoidal sinus pneumatization patterns are based on the extent of pneumatization in relation to the sella turcica : as conchal, pre-sellar, and sellar. [25,37,38]

ETHMOID SINUS

The ethmoid bone is composed of many cells with a complex structure, serving as the drainage pathway for all the paranasal sinuses. At birth, there are 3 to 4 ethmoid air cells which increase in number to 5 to 15 paired cells by maturity. The total volume of these cells is 2 to 3 mL. Their position is situated bilaterally on the septum, in close proximity to the eyes. The middle meatus contains the ethmoid infundibulum, where the frontal ethmoidal cells drain. The superior meatus contains the sphenoethmoidal recess, where the posterior ethmoid cells drain. According to embryologic antecedents, the complex ethmoidal labyrinth is reduced to a sequence of lamellae.

The lamellae are parallel to one other and arranged at an oblique angle.

- The uncinate process represents the first lamella.
- The ethmoid bulla represents the second lamella.
- The anterior and posterior ethmoids are separated by the third lamella, which is also known as the ground or base lamella.
- The superior turbinate represents the fourth lamella.

The largest of the anterior ethmoid cells is the ethmoid bulla which is located above the infundibulum. The anterior ethmoid artery passes the top of this cell.[36,39]

COMPUTED TOMOGRAPHY (CT) SCAN OF PARANASAL SINUSES

The imaging of the paranasal sinuses (PNS) has mostly transitioned from conventional radiography (plain films) to computed tomography (CT). The advancements in technology in these two imaging modalities have yielded more accurate differential diagnosis and comprehensive information on the anatomical scope of PNS disorders. This data provides enough information for diagnosing and strategizing surgical interventions for illnesses affecting the paranasal sinuses.[40]

Computed tomography (CT) has supplanted traditional radiography as the preferred imaging method for evaluating disorders of the paranasal sinuses (PNS). Computed tomography (CT) serves a crucial diagnostic function in patients with sino-nasal illness and is helpful in determining the appropriate therapy. A full axial and coronal CT scan series offers a thorough and extensive assessment of the paranasal sinuses (PNS). Comprehensive information is accessible on the structure, variations, and diseases of the peripheral nervous system (PNS). The correlation of histopathological diagnosis is necessary to confirm the diagnosis.

CT outperforms MRI in assessing intricate bone structures, evaluating fibro-osseous diseases of the peripheral nervous system, and diagnosing face injuries involving the sinuses.[41,42]

In the pre-operative evaluation of patients undergoing functional endoscopic sinus surgery (FESS), computed tomography (CT) is an essential tool, specifically Screening Sinus CT (SSCT). It is now mandatory to evaluate the paranasal sinuses (PNS) prior to functional endoscopic sinus surgery (FESS).

This evaluation acts to assist the otolaryngologist in surgery and directs the surgical strategy.

Computed tomography (CT) is used to assess the distribution and severity of disease and identify anatomical variations (such as septal deviation, spur formation, concha bullosa, and paradoxical curve of the middle turbinate). These variations increase the risk of complications during and after functional endoscopic sinus surgery (FESS). By detecting these variations, CT helps reduce the morbidity and mortality associated with FESS.

With the introduction of multidetector CT, it is possible to capture high-quality MPR imaging in both the coronal and sagittal planes to acquire axial CT data. Direct coronal scanning and sagittal reconstruction have revolutionized the imaging of space-occupying lesions. Precise identification of the illness and microscopic anatomical locations provide a dependable preoperative guide for endoscopic sinus surgery. The integration of CT scanning and diagnostic endoscopy has become the cornerstone in the assessment of Para-nasal sinus illness. Therefore, CT scans have significant importance and provide high-quality imaging of illnesses affecting the para-nasal sinuses.[43,44]

Figure 9 : Indications for CT scan of Para nasal Sinus

- inflammatory disease
  - acute rhinosinusitis
  - gas-fluid levels
  - mucosal disease
  - chronic sinusitis
  - cysts and polyps
  - mucoceles
- foreign body
- malignancy
- preoperative assessment

Figure 10 : CT scan of normal Paranasal sinus- The paranasal sinuses are well ventilated and unobstructed. There is no indication of either recent or long-term sinus inflammation.

ANATOMICAL VARIATIONS

There are substantial differences in nasal architecture across people, and some anatomical variants are more frequent. Rhino sinusitis can arise from obstruction of the osteomeatal complex which is caused by various forms of sinusitis.

Concha bullosa refers to presence of air in the middle turbinate. It can be unilateral or bilateral. When significant in size, it can cause blockage in the middle meatus or infundibulum. It is recognized as a potential cause of nasal obstruction, recurrent sinusitis and headaches.

Superior turbinate pneumatization is infrequent, and its association with sinusitis is less common as compared to middle turbinate pneumatization.

Conversely, the occurrence of pneumatization of the inferior turbinate is quite uncommon. Extensive turbinate pneumatization may lead to swelling of the turbinates and create on going nasal blockage.[45,46]

Figure 11 : CT scan- Superior turbinate pneumatization

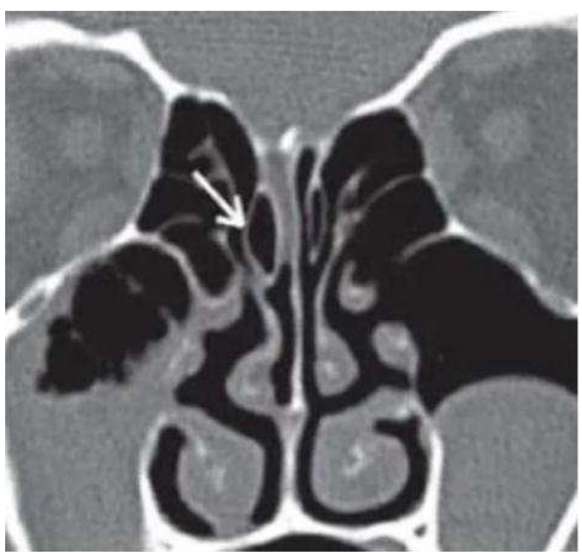


Figure 12 : CT scan- a) Pneumatization of right middle turbinate and b) Pneumatized basal lamella

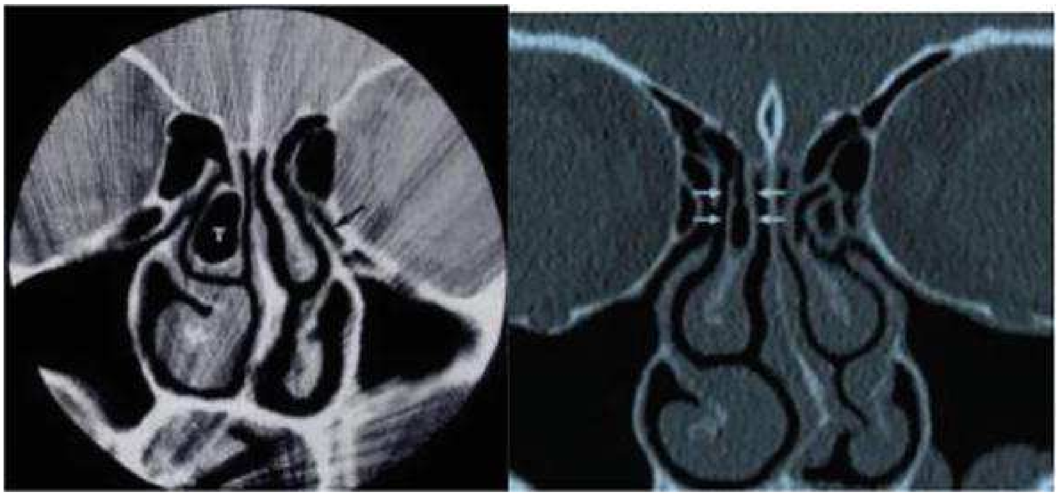


Figure 13: CT scan - Pneumatization of inferior turbinate

NASAL SEPTAL DEVIATION

Defined as non-uniform bending or curving of the cartilaginous septum of the nose. This may result in compression of the middle turbinate resulting in reduction in the width of the middle meatus. This difference is present since birth, but may result from nasal injury.[47]

Figure 14: The CT scan of the paranasal sinus shows a left membranous nasal septum deviation, leading to an underdeveloped left middle turbinate.

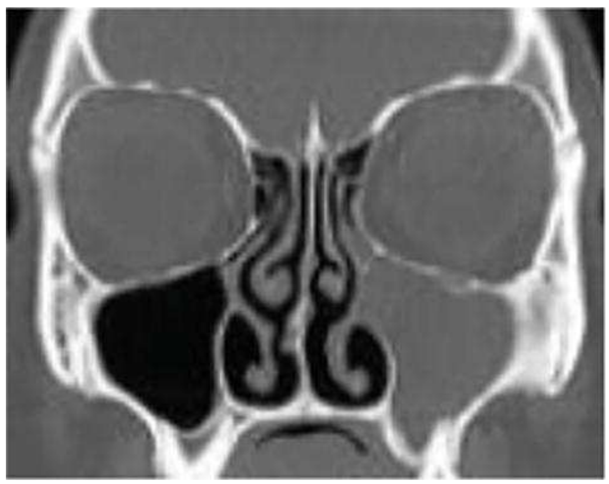
The nasal septum is not aligned with the midline. An anterior deviation refers to the cartilaginous septum, whereas a posterior deviation refers to the bony septum.

Deviation of the nasal septum may lead to the compression and displacement of the middle turbinate on the same side, which commonly results in the ipsilateral blockage osteomeatal complex. This leads to obstruction of the drainage pathways of the frontal, maxillary, and anterior ethmoidal sinuses. [48]

PARADOXICAL MIDDLE TURBINATE

The lateral wall of the nasal cavity contains the superior, middle, and inferior turbinates (conchae). Paradoxical middle turbinate is characterized by the inwardly curled edge of the middle turbinate, with the concave surface facing the nasal septum. Often present bilaterally. [45]

Figure 15: The coronal CT scan of the paranasal sinuses reveals the presence of paradoxical bilateral middle turbinates and opacification of left maxillary sinus.

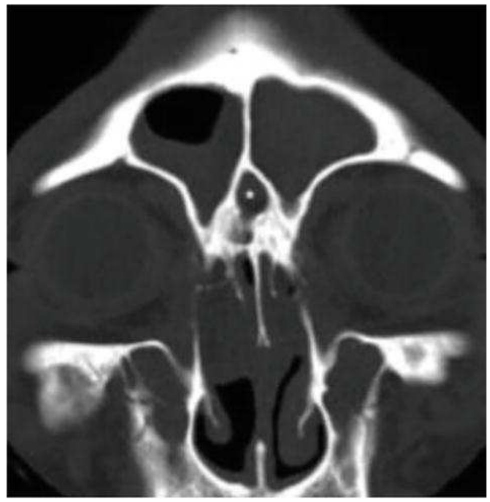


ANATOMICAL VARIATIONS IN FRONTAL SINUS

FRONTAL INTERSINUS SEPTAL CELL

When the cell becomes air filled and may connect with one of the frontal sinuses or exist as a separate air-filled chamber. This might potentially hinder the normal opening of the frontal sinus ostium.

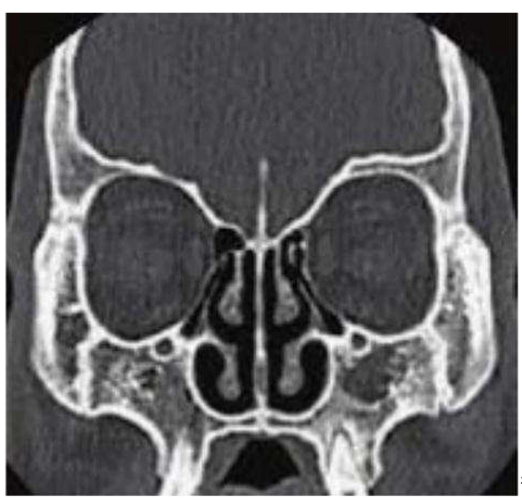
Figure 16: Frontal intersinus septum



ANATOMICAL VARIATIONS IN MAXILLARY SINUS

Maxillary sinus hypoplasia and agenesis are seen, however they do not cause any symptoms. It could be both bilateral and unilateral. In advanced stages of hypoplasia, the uncinate process also undergoes changes. Possible causes of hypoplasia include congenital developmental failure, chronic infection impeding growth, and underdevelopment of the uncinate process which further affects the development of the maxillary sinus.[49]

Figure 17: CT scan showing agenesis of the maxillary sinuses.



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SILENT SINUS SYNDROME (SSS)

It is caused by chronic maxillary sinusitis atelectasis, where the lack of airflow leads to the gradual absorption of the sinus with time.

When the orbital floor is pushed inward, it traps the muscles of the eye socket, causing enophthalmos (sunken eye), sunken orbital sulci, and double vision in some cases. The presence of rhino sinusitis symptoms is uncertain.

Unlike the congenital absence or underdevelopment of the maxillary sinuses, which is present from birth, SSS is an acquired condition which leads to gradual alterations over many months in cases with normally formed maxillary sinuses.

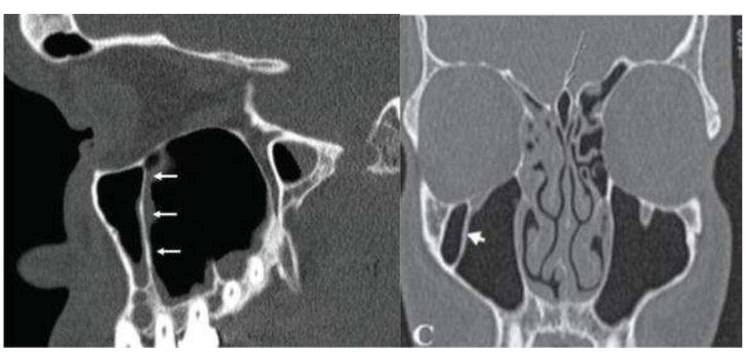
In addition, the criteria for selection also include the absence of significant nasal disease, absence of prior trauma, and absence of congenital abnormality.

Confirmatory and therapeutic imaging requires a Functional Endoscopic Sinus Surgery (FESS) with careful attention to reconstructing the orbital floor.[50]

MAXILLARY INTERSINUS SEPTUM

The occurrence ranges from 21.6% to 66.7% in people. Multiple attempts have been made to categorize it according to the spatial position relative to the premolars and molars. This hinders the passage of mucus and leads to sinusitis. It is found to be more prevalent in people who are missing all of their teeth.[51]

Figure 18 : Maxillary intersinus septum



THE ACCESSORY OSTIUM

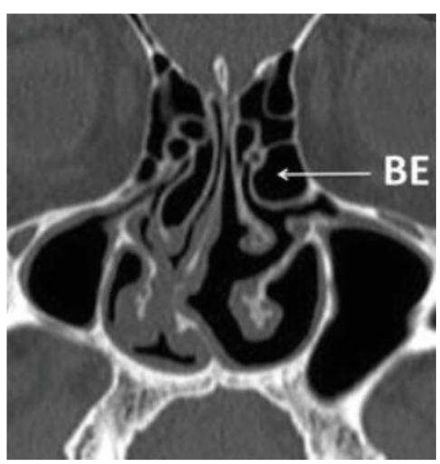
The accessory ostium is an opening that is situated at a distance from the hiatus semilunaris with a prevalence rate of less than 20% among people. It is often seen in the posterior fontanelle, however may also be present in the anterior fontanelle. Commonly, its diameter is less than 1.5 mm. Recirculation syndrome may arise from the development of air loops in both the native and accessory ostium as a result of an accessory ostium. Because of this syndrome, the patient has inadequate ventilation of the maxillary sinus, which leads to the development of maxillary sinusitis. [49]

ANATOMICAL VARIATIONS IN ETHMOID SINUS

The extent of pneumatization of the ethmoidal bulla varies, with 8% of the population having a lack of pneumatization (known as torus ethmoidalis or totus lateralis). A large bulla completely occupies the middle meatus, intruding into the space between the uncinate process and the middle turbinate, with the lateral boundary as the lamina papyracea.

The posterior wall of the frontal recess is formed by the merging of the ethmoidal bulla with the skull base overhead. [52]

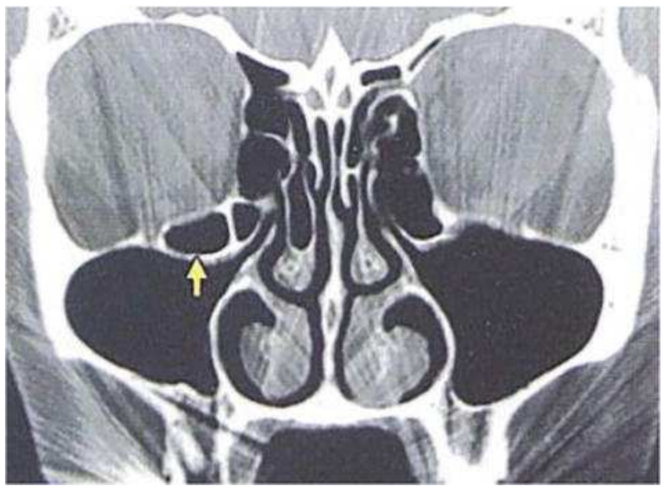
Figure 19 : Bulla Ethmoidalis



HALLER CELL

It is an extension of ethmoidal air sinus which located in the front and lower part of the eye socket. It may result in an obstruction of the infundibulum, impeding the movement of air within the maxillary sinus.[45]

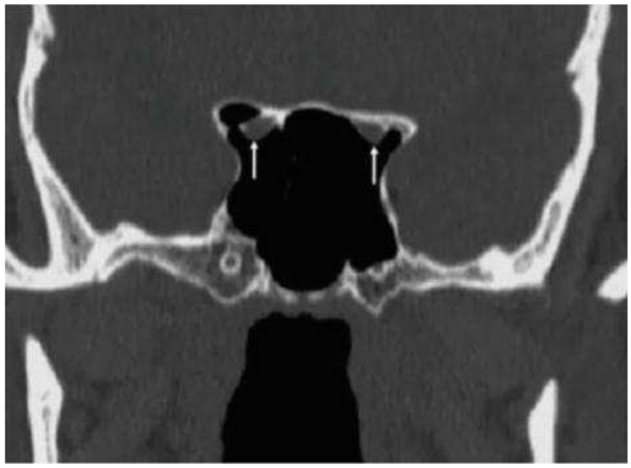
Figure 20 : Haller cell



ONODI CELLS

Onodi cells are anatomical variants that extend laterally and posteriorly from the posterior ethmoid cells. The sphenoid sinus is demarcated by horizontal septations. The optic nerve may be damaged more frequently if these cells manage to enclose the optic nerve tract.[45,54]

Figure 21 : CT scan showing Bilateral Onodi cells

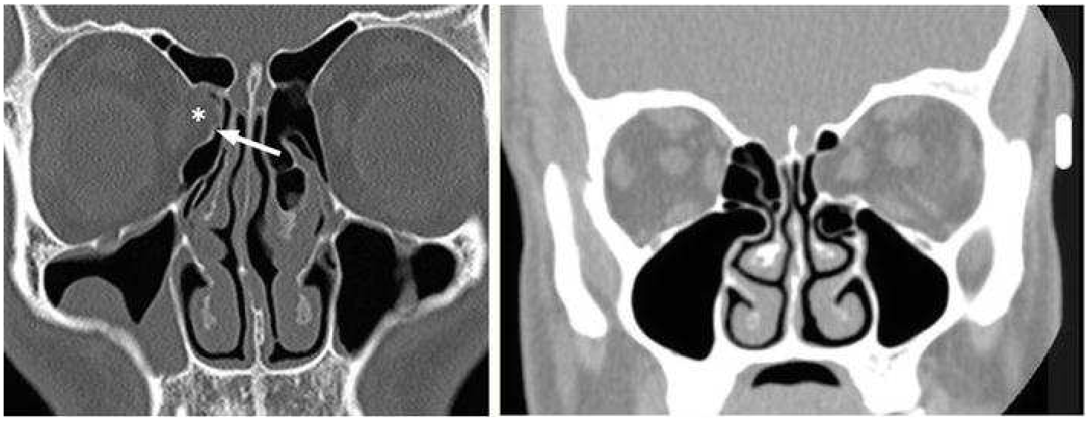


THE LAMINA PAPYRACEA

The thin bone known as the lamina papyracea forms the outer border of the ethmoidal sinus and the inner margin of the eye socket. It is referred to as the orbital lamina of the ethmoidal bone. Trauma, infection, or malignancy can lead to dehiscence of lamina papyracea. The dehiscence can be small or extend upto the basal lamella posteriorly.

Chronic nasal polyposis causes pressure on the delicate bone, resulting in its weakening and culminating in the protrusion and exposure of the contents of the eye socket. The protrusion of the structure may result in the inward folding of the tissue around the eye socket, with or without the involvement of the medial rectus muscle. It is particularly worrisome, especially in the context of endoscopic sinus surgery, as it may lead to potential damage to the periorbital and the medial rectus.[53]

Figure 22 : CT scan lamina papyracea variations



ANATOMICAL VARIATIONS OF SPHENOID SINUS

The inter-sinus sphenoid septum may deviate from the midline which is connected to either the bony canal of the internal carotid artery or the optic canal. To prevent the separation of the bony wall, excessive force should not be applied on the septum, particularly during endoscopic pituitary surgery.

The extension of air from the crista Galli or sphenoid sinus may cause a pneumatized posterior nasal septum. This extension leads to constriction of the sphenoethmoidal area.

SINUSITIS

Sinusitis refers to the inflammation of the sinuses, which are the air-filled cavities located in the skull and face bones. Rhino sinusitis is the most precise term to describe the inflammation of the sinuses, which is associated with inflammation of the nasal passages.

It is prevalent, particularly during the winter and spring seasons. The prevalence of both chronic and acute rhino sinusitis in the population can be as high as 4% and 9.7%, respectively. [55,56]

It should not be assumed that all cases have the same progression and underlying causes. The most frequently found pathogen in viral upper respiratory infections is Rhinovirus and is the leading cause of rhino sinusitis.

Additional implicated viruses include respiratory syncytial virus, adenovirus, coronavirus, and influenza. However, bacterial rhino sinusitis often occurs as a secondary superinfection after a viral infection. The commonly isolated bacteria are H. influenzae, S. pneumoniae, and M. catarrhalis.

The pathophysiology of viral or allergic sinusitis involves three main alterations that disrupt the normal physiology. Inflammation and swelling of the sinus mucosa leads to the obstruction of the sinus ostium and disruption of mucociliary function. These three modifications provide a favourable environment for the proliferation of bacteria.

Chronic rhino sinusitis was formerly seen as a prolonged consequence of the acute episode. Furthermore, the precise pathophysiology of it still remains unknown. A number of theories, including fungal, bacterial, biofilm, microbiome, and immune barrier hypotheses, have been put out to improve our understanding of the disease. Predisposing factors for rhino sinusitis can be divided into two categories: host factors and environmental factors. The risk of developing rhino sinusitis is increased in few hereditary conditions such as cystic fibrosis, primary immunodeficiencies, and primary ciliary dyskinesia.

There is a correlation between gastroesophageal reflux, asthma, and the development of chronic rhino sinusitis. It is believed that the patient's atopic status is directly linked to the presence of CRS, studies have not yet been able to fully explain the extent of this participation. However, clinicians continue to include anti allergic medications in the treatment plan for rhino sinusitis due to their shown effectiveness. [57,58]

SIGNS AND SYMPTOMS

Acute rhino sinusitis symptoms include fever, runny nose, coughing, face discomfort, copious mucus running down the throat, a recent history of upper respiratory tract infection, nasal congestion, and thick discharge with mucus and pus. The location of the discomfort provides clues about which sinus is damaged. Leaning forward often increases facial pain. The symptoms of chronic rhino sinusitis are the same, even though less specific. One of the most common symptoms of chronic rhino sinusitis is headache.

Signs include that both acute and chronic types of nasal congestion with injected hyperemic mucosa result in decreased nasal airflow. Polyposis may be seen in cases of protracted chronic rhino sinusitis; however, the lack of polyposis does not always mean that the illness is not present.

A more thorough examination can be achieved with rhinoscopy using a rigid or flexible endoscope. Any anatomical variations that are found, such as nasal polyps, hypertrophic turbinates, septal spurs, or deviations in the nasal septum, it should be documented as they may affect the therapy options. [59,60,61]

Table 1 : Criteria of diagnosis

Type	Criteria of Diagnosis
Acute rhinosinusitis (ARS)	≥ 4 weeks of purulent nasal drainage (posterior, anterior, or both) and facial pain-pressure-fullness, nasal obstruction, or both Purulent nasal discharge is colored or cloudy, in contrast to clear Secretions in viral upper respiratory infections, either reported or found upon examination Nasal obstruction may be reported by the patient as nasal stuffiness, blockage, congestion, or obstruction, or found upon examination Facial fullness-pressure-pain may involve the periorbital region, anterior face, or manifest with a diffuse or localized headache
Viral rhinosinusitis (VRS)	Presumption of viral rhinosinusitis to be made when signs or symptoms of acute rhinosinusitis are present ≤10 days and are not worsening
Acute bacterial rhinosinusitis (ABRS)	Presumption of bacterial rhinosinusitis to be made when either: a) signs or symptoms of acute rhinosinusitis fail to improve within ≥10 days b) signs or symptoms of acute rhinosinusitis worsen within 10 days after an initial improvement (double worsening)
Chronic rhinosinusitis (CRS)	≥ 12 weeks of ≥2 of the following symptoms and signs: • mucopurulent drainage (posterior, anterior, or both), • nasal obstruction/congestion, • facial pain/pressure/fullness, or • decreased sense of smell. AND inflammation is demonstrated by ≥1 of the following: • purulent mucus or edema in the anterior ethmoid region or middle meatus, • polyps in the middle meatus or nasal cavity, and/or • radiographic image displaying paranasal sinus inflammation

INVESTIGATIONS AND MANAGEMENT

For diagnosis of sinusitis, investigations are typically not advised. On the other hand, it is best to refer the patient to an otorhinolaryngologist if necessary. It would include doing a suitable CT scan of the paranasal sinuses and middle meatal culture under endoscopy guidance in that particular situation.[62]

The treatment approach for rhino sinusitis includes both the symptoms and the root cause. The major therapeutic approach for acute rhino sinusitis (ARS) is a combination of decongestants, nasal corticosteroids, and antibiotics, in case a bacterial infection is detected.

One method of reducing congestion is to apply a topical or oral nasal spray. Compared to the oral option, the topical formulation provides faster relief and a greater effect. But continued use for longer than ten days may cause tachyphylaxis and rebound nasal mucosal edema, or rhinitis medicamentosa. When treating upper respiratory tract infections in their early stages, nasal corticosteroids are recommended because they tend to prevent paranasal sinusitis, especially in patients who test positive for rhinovirus.

Antibiotics should only be provided as either Amoxicillin500 mg, or Amoxicillin/CV625 mg for 5-7 days. Additional alternatives include antihistamine medications, mucolytic medicines, and nasal saline irrigation. In cases of chronic rhino sinusitis, it is common to provide long-term therapy with nasal corticosteroids while only using antibiotics when there is a clear bacterial exacerbation.[63,64]

ASSOCIATION OF ANATOMICAL VARIATIONS OF PARANASAL SINUSES AND SINUSITIS

Anatomical differences have a significant impact in the cause, severity, and degree of sinus involvement in chronic rhinosinusitis (CRS). It assists endoscopic surgeons in determining the sinus physiology during Functional Endoscopic Sinus Surgery (FESS) and mitigates surgical problems.

Understanding the architectural differences of the nose and paranasal sinuses is crucial in clinical practice, as they indicate the likelihood of chronic rhinosinusitis (CRS). Conducting a thorough evaluation of paranasal computed tomography (CT) scans and performing diagnostic endoscopy before surgery significantly reduces the risk of surgical problems.[65]

Several anatomical variations have been shown to be linked with sinusitis, causing inflammation by blocking the drainage routes from the sinuses & the nasal passages. In one research, a strong association was found between the presence of big ethmoidal bullae and maxillary sinusitis.[66]

However, another study revealed a correlation between bent middle turbinates, infraorbital ethmoidal cells, and chronic rhinosinusitis. An empirical correlation has been shown between the existence of sinus mucosal illness and nasal septal deviation, bilateral concha bullosa, infraorbital ethmoidal (Haller) cells, hypertrophic ethmoidal bullae, and Agger nasi cells.[67]

A correlation has also been shown between Agger nasi cells and frontal sinusitis.

A research found that the occurrence of infraorbital ethmoidal (Haller) cells and narrow infundibula was linked to the recurrence of acute rhinosinusitis. Nevertheless, many additional investigations failed to demonstrate a substantial correlation between these anatomical variations and rhinosinusitis. In addition, it has been documented that not identifying specific anatomical variations such as sphenoethmoidal (Onodi) cells, pneumatization of anterior clinoid processes, supraorbital cells, infraorbital ethmoidal (Haller) cells, pneumatization of the dorsum sella, and dehiscence of the lamina papyracea can result in surgical complications due to their close proximity to blood vessels, nerves, the brain, and the orbits. [68, 69,70]

REVIEW OF ARTICLES

- A research done by Puspitasari T et al aimed to assess the incidence of structural alterations in the nose and paranasal sinuses shown on CT Scan images of adult patients with chronic rhinosinusitis (CRS). The CT scans capture pictures of 43 nasal and paranasal sinuses. CT scans were performed on adult patients with chronic rhinosinusitis (CRS). The results indicated that septal deviations, concha hypertrophy, and Agger Nasi cells are the most prevalent morphological changes linked to predisposing factors for chronic rhinosinusitis (CRS). Furthermore, Keros II, sellar sphenoid sinus sellar, and Kuhn I were identified as the most common complicating factors for surgery. These results highlight the need of taking into account these anatomical differences while addressing chronic rhinosinusitis.[71]
- A research conducted by Singh P et al., aimed to assess the prevalence of structural changes in individuals with chronic rhinosinusitis (CRS) and examine their association with these variations. A total of one hundred participants receiving treatment in the outpatient department of ENT were included in the research. These individuals were diagnosed with chronic rhinosinusitis (CRS). The results indicated that the anatomical variation that had a substantial impact on

the development of CRS was a deviated nasal septum and concha bullosa, both of which were extremely significant. The conclusion of the research found a statistically significant link between a deviated nasal septum and concha bullosa with chronic rhinosinusitis (CRS).[72]

- A research undertaken by Shpilberg et al. aimed to establish the prevalence of sinonasal anatomic variations and evaluate their correlation with sinonasal mucosal illness. The research had a total of 192 participants who had a previous medical record of rhinosinusitis. According to the results, the most common normal variations were Agger nasi cells, nasal septal deviation, and sphenoid sinus extension into the posterior nasal septum. Comparing people with mild and those with clinically severe disorders affecting the paranasal sinuses, no statistically significant difference was found in the occurrence of any of the analyzed structural variations. It further stated that routine CT scan study of the paranasal sinuses acquired for sinusitis or rhinitis is of unclear relevance in terms of detecting the existence of distinct anatomic abnormalities unless surgical intervention is planned.[70]
- A prospective research was conducted by Kushwah APS et al., on 50 individuals with symptomatic sinus illness who received CT imaging of the paranasal sinuses. When assessing patients using CT scans of the paranasal sinuses (PNS), the maxillary sinus was shown to be the most frequently affected sinus. The most frequent pattern of inflammation seen was sinonasal polyposis, followed by the osteomeatal unit pattern. This research demonstrated the efficacy of CT scan in diagnosing and planning the care of paranasal sinus disorders, thanks to its high sensitivity and specificity.[73]

- The objective of this study is to examine the structural changes of paranasal sinuses using direct coronal CT-scan and determine the frequency at which they occur. A total of Hundred consecutive patients were referred for a CT-scan of the paranasal sinus (PNS) area. The most prevalent alterations seen was a deviated nasal septum, followed by sphenoid sinus septations. Additional variants identified include middle concha bullosa, paradoxical middle turbinate, horizontal uncinate process, excessively pneumatized ethmoidal bulla or enormous bulla, and frontal sinus septations. Because the structural variations are quite prevalent in the paranasal sinuses (PNS), the study concluded that in order to reduce the risk of complications following surgery, the radiologist performing preoperative CT screening should identify these abnormalities. Computed Tomography (CT) offers a digital representation of the patient's anatomy, serving as a guide for the surgeon and enhancing the effectiveness of treatment plans.[74]
- A retrospective research was done to investigate the anatomical variations in paranasal sinus CT scans of patients with chronic rhinosinusitis (CRS). All patients with CRS who had undergone a CT scan were included in the study. The findings indicated that concha hypertrophy is the prevailing anatomical variant. A preoperative CT scan is crucial as it serves as a useful guide for sinus surgeons during surgery. The timely identification of anatomical differences is crucial for surgical preparation and the avoidance of problems.[75]
- A retrospective research conducted at a tertiary institution. These patients had head CT investigations and agreed to have a coronal section scan of the paranasal sinuses in addition to the axial section of the head. This research aims to investigate the structure of the paranasal air sinus using CT scans and to characterize any variations that may increase the risk of chronic sinusitis and

complications after endoscopic sinonasal surgery. The results indicated that out of a sample group of 250 individuals, a total of 423 incidences of anatomical variations were detected. The predominant anatomical variations observed were pneumatization of the middle nasal turbinates, which occurred in 30.73% of cases. The prevalence rates of agger nasi cells, Haller's cells, septal deviation, and sphenoid sinus septation are 21.64%, 22.91%, 21.91%, and 20.18% respectively. Therefore, it can be determined that CT scans are considered the most reliable and widely accepted method for examining the paranasal sinuses, sinonasal lesions, and inflammatory illness, as well as for assessing patients before and after surgery.[76]

- Parihar P et al. undertook a research to evaluate the congenital anatomical differences in the paranasal sinuses. The research included 477 instances in whom unenhanced CT scans of the brain and paranasal sinuses (PNS) were conducted. Out of all the patients examined, a deviated nasal septum was found to be the most prevalent anatomical variation in 178 (37.3%) patients, followed by concha bullosa in 124 (26%) individuals. The research determined that the existence of structural variations may make individuals more susceptible to sinus-related medical conditions. Radiologists must meticulously observe anatomical variations during the preoperative assessment to prevent potential issues and enhance the effectiveness of treatment approaches.[77]

MATERIALS AND METHODS

Source of Data: Patients with symptoms of sinusitis (age > 18 yrs) coming to the Department of Radiology of KLEs Dr. Prabhakar Kore Hospital, to get the CT PNS scan during the 1 year period from January 2023 to December 2023.

Study Design: A one year based cross sectional study

Study Period: January 2023 to December 2023

Sample Size: 53 subjects

The formula used for sample size calculation is,

$$n = \frac{P\ (100 - P)(Z)^2}{d^2}$$

Where n is the sample size required, p is the percentage occurrence of a state or condition (proportion or prevalence), E is the percentage maximum error required, Z is the value corresponding to level of confidence required. For 5 % level of significance, Z=1.96.

Considering similar result at 95% confidence level and 10% of maximum error.

(P=83.1%)

Hence, minimum sample size required is 53.

As sample size increases, the accuracy increases.

Sampling technique: Convenient sampling.

INCLUSION CRITERIA:

- Symptomatic subjects of sinusitis (nasal obstruction, headache , anosmia , facial pain, and rhinorrhea)
- Age ranges from 18-60 years

EXCLUSION CRITERIA:

- Subjects below 18 years
- Fungal-sinusitis
- Pregnant females
- Previous sinus surgery
- Facial-Trauma

STUDY PROTOCOL:

Institutional ethical clearance from Institutional Ethics committee for Human Subjects Research of Jawaharlal Nehru Medical college , Belagavi, Karnataka was obtained.

The study was conducted using 128 slice Computed Tomography scan machine (Revolution EVO Wipro GE). Unenhanced CT images of the PNS and paranasal region were taken in coronal, complemented by axial and sagittal reconstructions.

In all cases, the existence of the following variants was investigated: (1) Nasal septum: septal deviation; (2) Turbinates: concha bullosa, concha lamella, turbinate hypertrophy; (3) Uncinate process (UP): pneumatization, medialized, lateralized; (4) Ethmoid air cells: agger nasi cells, Haller cells, ethmoid bulla, onodi cells.

DATA COLLECTION PROCEDURE:

An informed consent was obtained from all the study subjects. Anatomical variations of the nose and paranasal sinuses were analysed in the axial , sagittal and coronal views of the CT scan in the bone and soft tissue windows.

The study parameters age, gender, and radiographic findings of disease and anatomical variants were evaluated and the prevalence of each anatomical variant in patients having symptoms was calculated.

OBSERVATION & RESULTS

STATISTICAL METHODS:

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots.

Chi-square test was performed to evaluate the association between two groups.

P-value less than or equal to 0.05 was considered significant.

Data was analysed using 1. SPSS (Statistical Package for Social Sciences) I. IBM SPSS Statistics Version 22 Statistical Software: Core System Users' Guide. SPSS Inc. 2014.

Table 2 : Descriptive analysis of age distribution in study population (N=53)

Parameter	Mean ± SD	Median	Minimum	Maximum
AGE (years)	36.68 ± 12.88	35	18	58

Among the study population, the mean age was 36.68 ± 12.88 (18 to 58)

Table 3 : Descriptive analysis of gender distribution in the study population (N=53)

Gender	Frequency	Percentages
Female	22	41.51%
Male	31	58.49%

Among the study population, 58.49% of them were male and 41.51% of them were female

Graph 1 : Pie chart of Gender distribution in the study population (N=53)

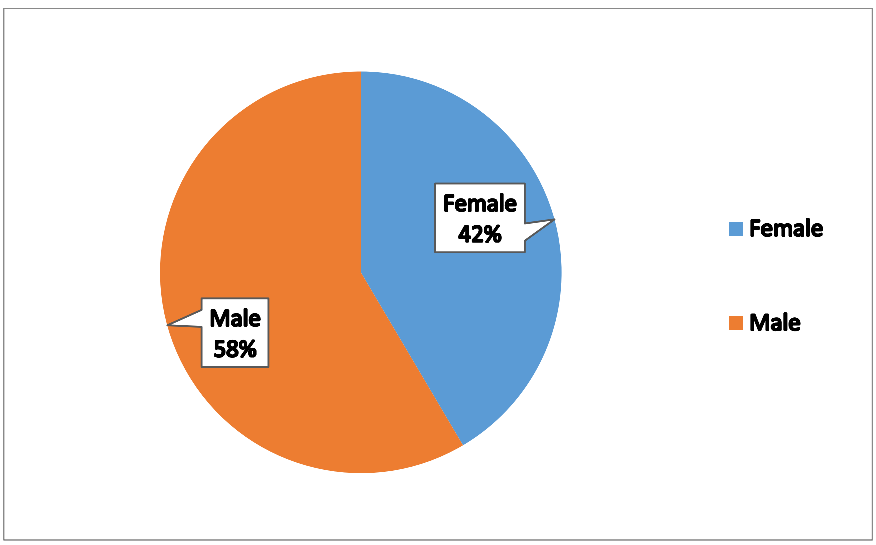


Table 4 : Descriptive analysis of Chief Complaints in the study population (N=53)

Chief Complaints	Frequency	Percentages
Nasal discharge & headache	3	5.66%
Nasal obstruction , discharge , sneezing, anosmia , headache	1	1.89%
Nasal obstruction , sneezing , headache, discharge , anosmia	1	1.89%
Nasal obstruction , discharge	1	1.89%
Nasal obstruction , discharge , anosmia	1	1.89%
Nasal obstruction , discharge , headache	6	11.32%
Nasal obstruction , discharge , headache , anosmia	4	7.55%
Nasal obstruction , discharge , headache , anosmia , facial pain	1	1.89%
Nasal obstruction , discharge , sneezing, headache	8	15.09%
Nasal obstruction , headache	1	1.89%
Nasal obstruction , sneezing , headache	2	3.77%
U/L Nasal obstruction	6	11.32%
U/L Nasal obstruction , discharge	6	11.32%
U/L Nasal obstruction , discharge , anosmia	1	1.89%
U/L Nasal obstruction & facial pain	1	1.89%
U/L Nasal obstruction &headache	7	13.21%
U/L Nasal obstruction, discharge , headache	3	5.66%

Among the study population with the chief complaints, 15.09% of them had Nasal obstruction, discharge, sneezing, headache, 13.21% of them had U/L Nasal obstruction &headache, 11.32% of them had U/L Nasal obstruction, 11.32% of them had U/L Nasal obstruction and nasal discharge ,11.32% of them had Nasal obstruction, discharge, headache.

Table 5 : Descriptive analysis of Duration of symptoms in the study population (N=53)

Duration	Frequency	Percentages
<1 month	16	30.19%
1 month to <2 month	27	50.94%
>=2 months to <3 months	9	16.98%
>=3 months	1	1.89%

Among the study population with duration, 50.94% of them were between 1 month to <2 month, 30.19% of them were <1 month, 16.98% of them were >=2 months to <3 months.

Graph 2: Bar chart of Duration of symptoms in the study population (N=53)

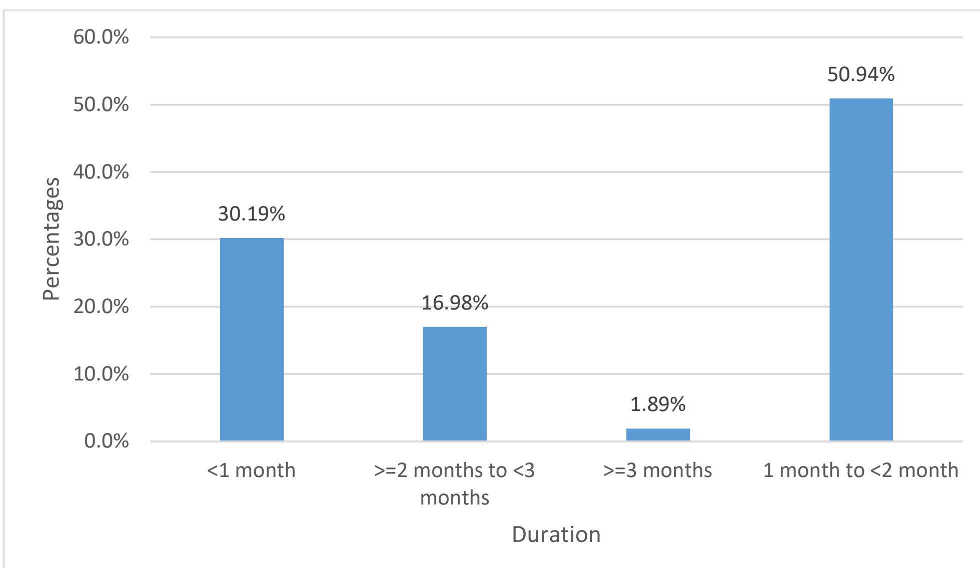


Table 6: Descriptive analysis of Nasal Septum variations in the study population (N=53)

NASAL SEPTUM	FREQUENCY	PERCENTAGES
DNS to right side	14	26.42%
DNS to left side	13	24.53%
DNS to right side with BS	10	18.87%
DNS to left side with BS	8	15.09%
S shaped with bony spur to right side	2	3.77%
S shaped with bony spur to left side	1	1.89%
Nil	5	9.43%

Among the study population with nasal septum assessments, 26.42% had DNS to right side, 24.53% had DNS to left side, and 18.87% had DNS to right side with bone spur, 15.09% exhibited DNS to left side with bone spur, while 3.77% and 1.89% showed S-shaped deviations with bony spur to right and left respectively.

Graph 3 : Bar chart of distribution of Nasal Septum variations in the study population (N=53)

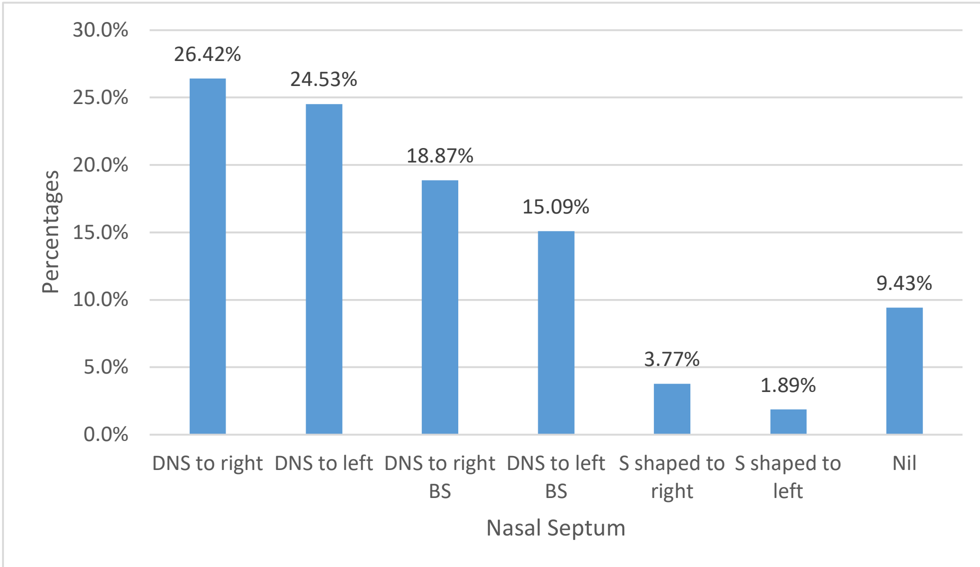


Table 7 : Descriptive analysis of Turbinate variations in the study population (N=53)

TURBINATE	FREQUENCY	PERCENTAGES
CL right	3	5.66%
CL bilateral	2	3.77%
CL right, CB left, Bilateral inferior turbinate hypertrophy	1	1.89%
CL left	5	9.43%
CB right	9	16.98%
CB bilateral	3	5.66%
CB right & left inferior turbinate hypertrophy	1	1.89%
CB left	5	9.43%
Right inferior turbinate hypertrophy	2	3.77%
Bilateral inferior turbinate hypertrophy	1	1.89%
Nil	21	39.62%

A distribution of findings among patients as follows: CL was identified in 12 cases (22.64%), with 3 cases (5.66%) showing involvement of the right side, 2 cases (3.77%) involving both sides, and 5 cases (9.43%) affecting the left side.

CB was more prevalent, identified in 18 cases (33.96%), with 9 cases (16.98%) affecting the right side, 3 cases (5.66%) involving both sides, 5 cases (9.43%) affecting the left side, and 1 case (1.89%) involving the right side along with hypertrophy of the left inferior turbinate. Inferior turbinate hypertrophy alone was found in 4 cases (7.55%), evenly split between right-sided (2 cases, 3.77%) and bilateral (2 cases, 3.77%) involvement.

Table 8 : Descriptive analysis of Uncinate Process variations in the study population (N=53)

UNCINATE PROCESS	FREQUENCY	PERCENTAGES
Lateralisation	1	1.89%
Medialisation	10	18.87%
Nil	42	79.25%

Among the study popoualtion with the findings regarding the uncinate process , it was identified in 11 cases. Among these cases, lateralisation was observed in 1 instance, representing 1.89% of the total. Medialisation was noted more frequently, occurring in 10 cases (18.87%). The majority of cases, 42 in total (79.25%), showed no notable findings related to the uncinate process.

Graph 4 : Bar chart of distribution of Uncinate Process variations in the study population (N=53)

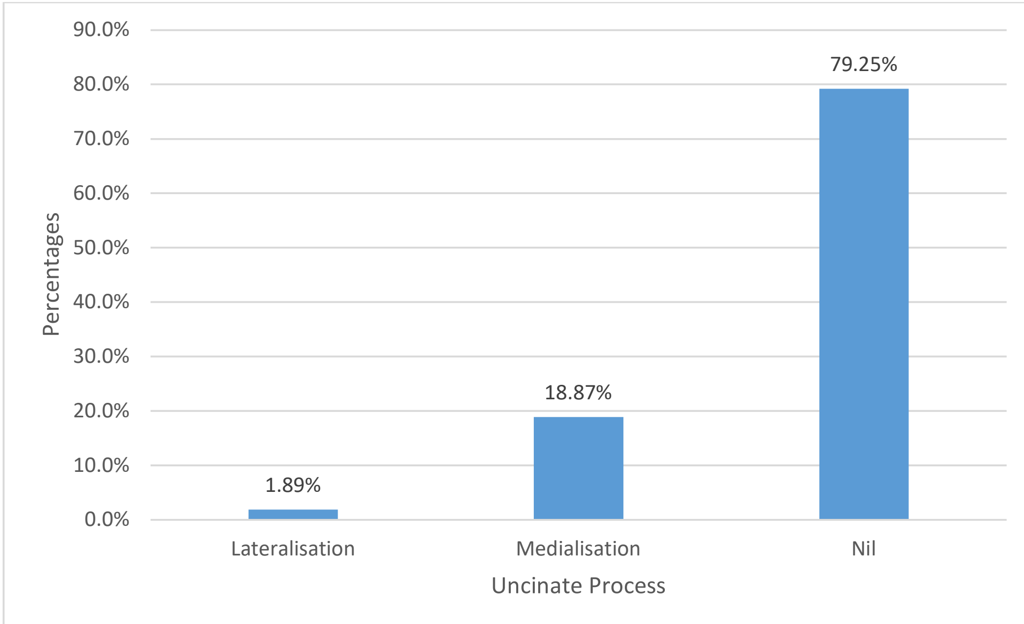


Table 9 : Descriptive analysis of Ethmoid Cells variations in the study population (N=53)

ETHMOID CELLS	FREQUENCY	PERCENTAGES
Onodi right	1	1.89%
Onodi bilateral	2	3.77%
Onodi bilateral, Agger Nasi right	1	1.89%
Onodi left	4	7.55%
Haller right	2	3.77%
Haller left	2	3.77%
Agger Nasi right	1	1.89%
Agger Nasi bilateral	3	5.66%
Agger Nasi left	3	5.66%
Nil	34	64.15%

The findings regarding ethmoid cells reveal various anatomical variations among the study participants. Onodi cells were identified in a total of 8 cases, with 1 case (1.89%) on the right side, 2 cases (3.77%) bilaterally, and an additional case (1.89%) bilaterally along with Agger Nasi involvement on the right side. On the left side, 4 cases (7.55%) exhibited Onodi cells. Haller cells were noted in 4 cases (7.55%), evenly split between the right and left sides (2 cases each, 3.77%). Agger Nasi cells were identified in 7 cases (13.21%), with 1 case (1.89%) on the right side, 3 cases (5.66%) bilaterally, and 3 cases (5.66%) on the left side.

Table 10 : Descriptive analysis of Maxillary Sinusitis in the study population (N=53)

MAXILLARY SINUSITIS	FREQUENCY	PERCENTAGES
Nil	14	26.42%
Right maxillary	11	20.75%
Left maxillary	13	24.53%
Bilateral maxillary	15	28.30%

The maxillary sinusitis indicated varied findings among the participants. A significant proportion, 14 cases (26.42%), showed no abnormalities in either maxillary sinus. Specifically, involvement of the right maxillary sinus was observed in 11 cases (20.75%), while the left maxillary sinus was affected in 13 cases (24.53%). Both the right and left maxillary sinuses were involved concurrently in 15 cases (28.30%).

Graph 5 : Bar chart of distribution of Maxillary Sinusitis in the study population (N=53)

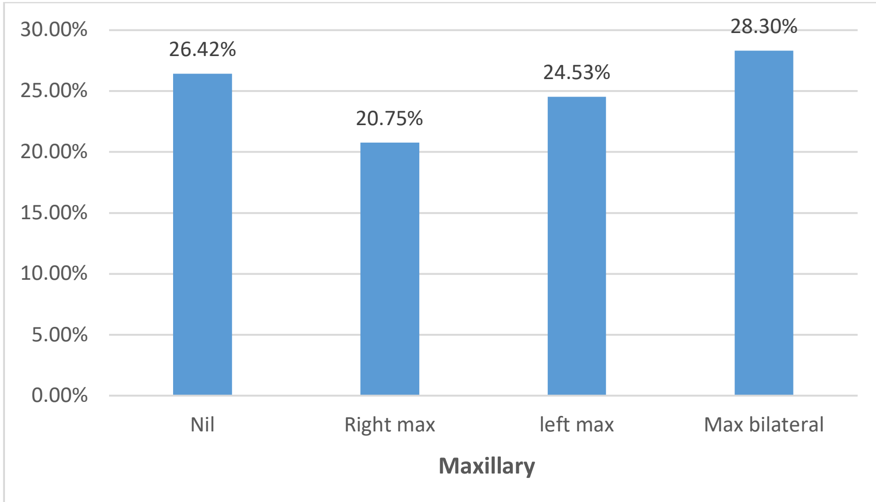


Table 11 : Descriptive analysis of Ethmoid Sinusitis in the study population (N=53)

ETHMOID SINUSITIS	FREQUENCY	PERCENTAGES
Nil	33	62.26%
Ethmoid	20	37.74%

The findings regarding the ethmoid sinusitis indicate that among the participants, 20 cases (37.74%) exhibited ethmoid sinus involvement. In contrast, a majority of cases, totaling 33 (62.26%), showed no abnormalities in the ethmoid sinus.

Graph 6 : Pie chart of distribution of Ethmoid Sinusitis in the study population (N=53)

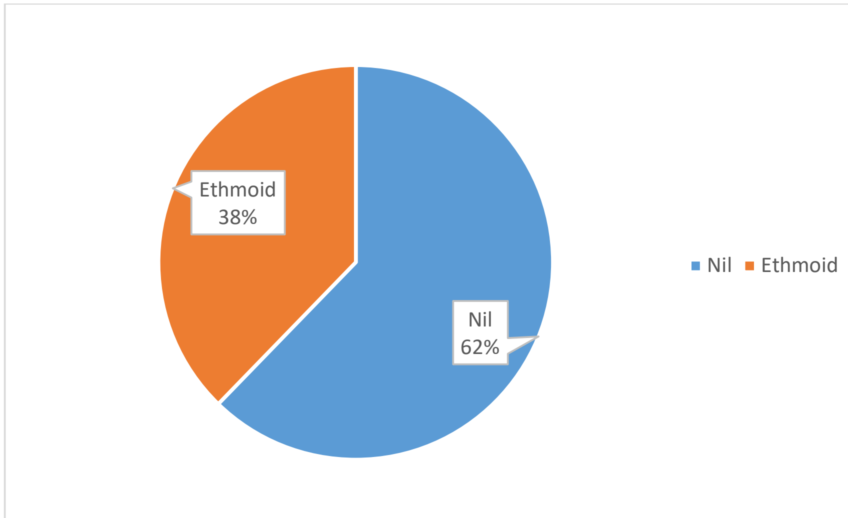


Table 12 : Descriptive analysis of Sphenoid Sinusitis in the study population (N=53)

SPHENOID SINUSITIS	FREQUENCY	PERCENTAGES
Nil	32	60.38%
Right Sphenoid	7	13.21%
Left sphenoid	6	11.32%
Bilateral sphenoid	8	15.09%

The findings regarding the sphenoid sinusitis reveals varied involvement among the study participants. A majority, 32 cases (60.38%), showed no abnormalities in the sphenoid sinus. Among those with identified issues, 7 cases (13.21%) exhibited right sphenoid sinus pathology. Additionally, 6 cases (11.32%) were affected on the left side specifically, while 8 cases (15.09%) showed involvement in both the sphenoid sinuses concurrently.

Graph 7 : Bar chart of distribution of Sphenoid Sinusitis in the study population (N=53)

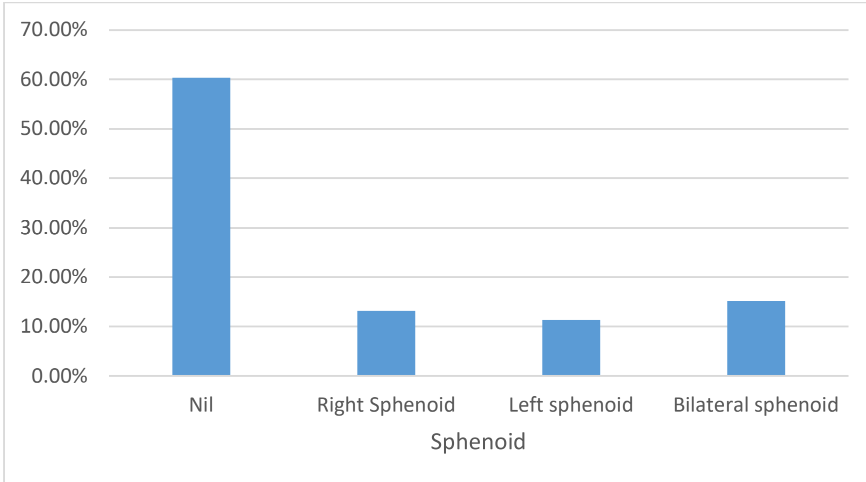


Table 13 : Descriptive analysis of Frontal Sinusitis in the study population (N=53)

FRONTAL SINUSITIS	FREQUENCY	PERCENTAGES
Nil	38	71.70%
Right frontal	3	5.66%
Left frontal	6	11.32%
Bilateral frontal	6	11.32%

The findings regarding the frontal sinusitis indicate varying levels of involvement among the participants. A significant majority, 38 cases (71.70%), showed no abnormalities in the frontal sinus. Among those with identified issues, 3 cases (5.66%) exhibited pathology in the right frontal sinus, while 6 cases (11.32%) were affected on the left side. Additionally, 6 cases (11.32%) showed involvement in both the frontal sinuses simultaneously.

Graph 8 : Bar chart of distribution of Frontal Sinusitis in the study population (N=53)

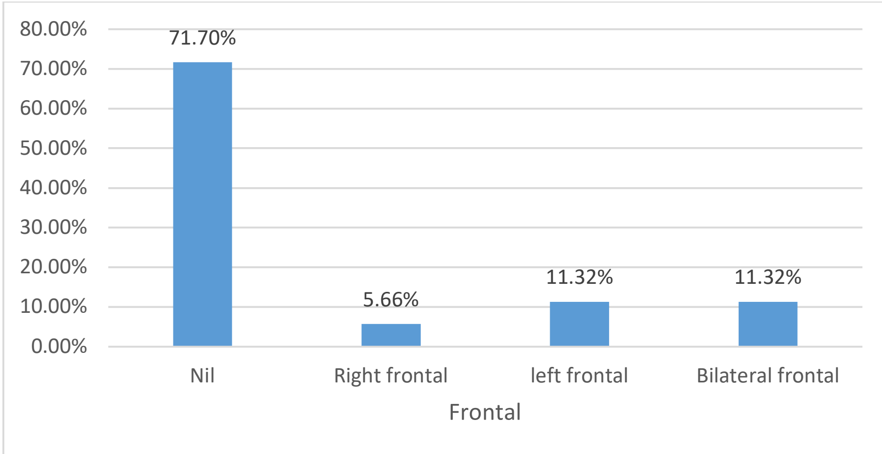


Table 14 : Descriptive analysis of Pansinusitis in the study population (N=53)

Pansinusitis	Frequency	Percentages
Nil	47	88.68%
Pansinusitis	6	11.32%

The results concerning pansinusitis indicate that among the study participants, 6 cases (11.32%) exhibited pansinusitis, a condition where all the sinuses are inflamed. In contrast, a significant majority of 47 cases (88.68%) showed no signs of pansinusitis.

Graph 9 : Pie chart of distribution of Pansinusitis in the study population (N=53)

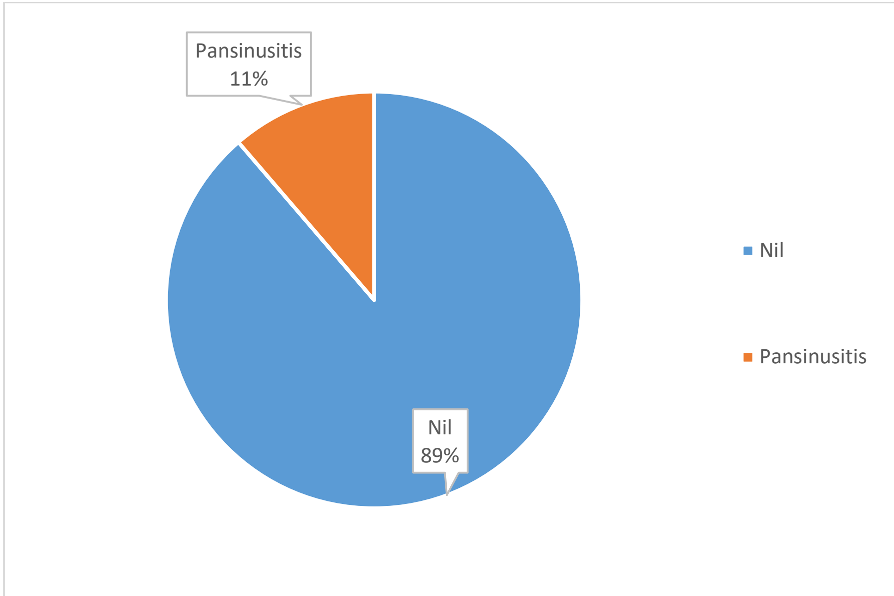


Table 15 : Comparison of anatomical variants across maxillary sinusitis CT findings in the study population (N=53)

Crosstab							Chi-square p value
Parameter		MAXILLARY SINUSITIS				Total	
		Nil	Right max	Left max	Bilateral Max		
NASAL SEPTUM	DNS to right	1	6	2	5	14	0.041
		7.1%	54.5%	15.4%	33.3%	26.4%	
	DNS to left	2	3	6	2	13	
		14.3%	27.3%	46.2%	13.3%	24.5%	
	DNS to right + BS	5	1	0	4	10	
		35.7%	9.1%	0.0%	26.7%	18.9%	
	DNS to left + BS	3	0	4	1	8	
		21.4%	0.0%	30.8%	6.7%	15.1%	
	S shaped to right	0	0	1	1	2	
		0.0%	0.0%	7.7%	6.7%	3.8%	
	S shaped to left	0	0	0	1	1	
		0.0%	0.0%	0.0%	6.7%	1.9%	
	Nil	3	1	0	1	5	
		21.4%	9.1%	0.0%	6.7%	9.4%	

		MAXILLARY SINUSITIS				Total	Chi-square p value
		Nil	Right max	Left max	Bilateral Max		
TURBINATE	CL Right	0	1	2	0	3	0.106
		0.0%	9.1%	15.4%	0.0%	5.7%	
	CL Bilateral	0	0	0	2	2	
		0.0%	0.0%	0.0%	13.3%	3.8%	
	CL Right, CB Left, Bilateral inferior turbinate hypertrophy	0	1	0	0	1	
		0.0%	9.1%	0.0%	0.0%	1.9%	
	CL Left	3	0	2	0	5	
		21.4%	0.0%	15.4%	0.0%	9.4%	
	CB Right	2	1	0	6	9	
		14.3%	9.1%	0.0%	40.0%	17.0%	
	CB Right & Left inferior turbinate hypertrophy	0	0	0	1	1	
		0.0%	0.0%	0.0%	6.7%	1.9%	
	CB Bilateral	1	0	1	1	3	
		7.1%	0.0%	7.7%	6.7%	5.7%	
	CB Left	1	3	1	0	5	
		7.1%	27.3%	7.7%	0.0%	9.4%	
	Right inferior turbinate hypertrophy	0	0	1	1	2	
		0.0%	0.0%	7.7%	6.7%	3.8%	
	Bilateral inferior turbinate hypertrophy	0	0	1	0	1	
		0.0%	0.0%	7.7%	0.0%	1.9%	
	Nil	7	5	5	4	21	
		50.0%	45.5%	45.5%	26.7%	39.6%	

		MAXILLARY SINUSITIS				Total	Chi-square p value
		Nil	Right max	Left max	Bilateral Max		
UNCINATE PROCESS	Lateralisation	0	0	1	0	1	0.156
		0.0%	0.0%	7.7%	0.0%	1.9%	
	Medialisation	4	1	0	5	10	
		28.6%	9.1%	0.0%	33.3%	18.9%	
	Nil	10	10	12	10	42	
		71.4%	90.9%	92.3%	66.7%	79.2%	

		MAXILLARY SINUSITIS				Total	Chi-square p value
		Nil	Right max	Left max	Bilateral Max		
ETHMOID CELLS	Onodi right	1	0	0	0	1	0.041
		7.1%	0.0%	0.0%	0.0%	1.9%	

	Onodi bilateral	0	0	0	2	2	
		0.0%	0.0%	0.0%	13.3%	3.8%	
	Onodi bilateral, Agger Nasi right	0	0	0	1	1	
		0.0%	0.0%	0.0%	6.7%	1.9%	
	Onodi left	1	0	0	3	4	
		7.1%	0.0%	0.0%	20.0%	7.5%	
	Haller right	0	1	0	1	2	
		0.0%	9.1%	0.0%	6.7%	3.8%	
	Haller left	0	0	2	0	2	
		0.0%	0.0%	15.4%	0.0%	3.8%	
	Agger Nasi right	0	1	0	0	1	
		0.0%	9.1%	0.0%	0.0%	1.9%	
	Agger Nasi bilateral	3	0	0	0	3	
		21.4%	0.0%	0.0%	0.0%	5.7%	
	Agger Nasi left	2	1	0	0	3	
		14.3%	9.1%	0.0%	0.0%	5.7%	
	Nil	7	8	11	8	34	
		50.0%	72.7%	84.6%	53.3%	64.2%	

Significant associations are observed between the maxillary sinus involvement and the Nasal Septum (Chi-square = 0.041), indicating a relationship between deviations in nasal septal anatomy (DNS) and various conditions affecting the maxillary sinuses. Similarly, significant associations are found between the maxillary sinus involvement and variants of ethmoid Cells (Chi-square = 0.041), particularly concerning the presence of Onodi cells on the right side. The proportion of the uncinate process and turbinates between the maxillary sinuses was not statistically significant. (P value >0.05)

Table 16 : Comparison of anatomical variants across ethmoid sinusitis CT findings in the study population (N=53)

Crosstab					Chi-square p value
Parameter		ETHMOID SINUSITIS		Total	
		Nil	Ethmoid		
NASAL SEPTUM	DNS to right	8	6	14	0.508
		24.2%	30.0%	26.4%	
	DNS to left	10	3	13	
		30.3%	15.0%	24.5%	
	DNS to right + BS	6	4	10	
		18.2%	20.0%	18.9%	
	DNS to left + BS	5	3	8	
		15.2%	15.0%	15.1%	
	S shaped to right	2	0	2	
		6.1%	0.0%	3.8%	
	S shaped to left	0	1	1	
		0.0%	5.0%	1.9%	
	Nil	2	3	5	
		6.1%	15.0%	9.4%	
		ETHMOID SINUSITIS		Total	Chi-square p value
		Nil	Ethmoid		
TURBINATE	CL right	3	0	3	0.310
		9.1%	0.0%	5.7%	
	CL Bilateral	1	1	2	
		3.0%	5.0%	3.8%	
	CL right, CB left, Bilateral inferior turbinate hypertrophy	0	1	1	
		0.0%	5.0%	1.9%	
	CL left	4	1	5	
		12.1%	5.0%	9.4%	
	CB Right	3	6	9	
		9.1%	30.0%	17.0%	
	CB Right & Left inferior turbinate hypertrophy	0	1	1	
		0.0%	5.0%	1.9%	
	CB bilateral	2	1	3	
		6.1%	5.0%	5.7%	
	CB left	4	1	5	
		12.1%	5.0%	9.4%	

	Right inferior turbinate hypertrophy	2	0	2	
		6.1%	0.0%	3.8%	
	Bilateral inferior turbinate hypertrophy	1	0	1	
		3.0%	0.0%	1.9%	
	Nil	13	8	21	
		39.4%	40.0%	39.6%	

		ETHMOID SINUSITIS		Total	Chi-square p value
		Nil	Ethmoid		
UNCINATE PROCESS	Lateralisation	0	1	1	0.418
		0.0%	5.0%	1.9%	
	Medialisation	6	4	10	
		18.2%	20.0%	18.9%	
	Nil	27	15	42	
		81.8%	75.0%	79.2%	

		ETHMOID SINUSITIS		Total	Chi-square p value
		Nil	Ethmoid		
ETHMOID CELLS	Onodi right	1	0	1	0.32
		3.0%	0.0%	1.9%	
	Onodi bilateral	0	2	2	
		0.0%	10.0%	3.8%	
	Onodi bilateral, Agger Nasi right	0	1	1	
		0.0%	5.0%	1.9%	
	Onodi left	3	1	4	
		9.1%	5.0%	7.5%	
	Haller right	1	1	2	
		3.0%	5.0%	3.8%	
	Haller left	2	0	2	
		6.1%	0.0%	3.8%	
	Agger Nasi right	1	0	1	
		3.0%	0.0%	1.9%	
	Agger Nasi bilateral	1	2	3	
		3.0%	10.0%	5.7%	
	Agger Nasi left	1	2	3	
		3.0%	10.0%	5.7%	
	Nil	23	11	34	
		69.7%	55.0%	64.2%	

No statistically significant associations between ethmoid sinus involvement and variations in the Nasal septum, Turbinates, Uncinate Process, or Specific Ethmoid Cells parameters (all p values > 0.05).

Table 17 : Comparison of anatomical variants across sphenoid sinusitis CT findings in the study population (N=53)

Crosstab							
Parameter		SPHENOID SINUSITIS				Total	Chi-square p value
		Nil	Right Sphenoid	Left Sphenoid	Bilateral Sphenoid		
NASAL SEPTUM	DNS to right	8	3	1	2	14	0.979
		25.0%	42.9%	16.7%	25.0%	26.4%	
	DNS to left	9	1	2	1	13	
		28.1%	14.3%	33.3%	12.5%	24.5%	
	DNS to right BS	5	2	2	1	10	
		15.6%	28.6%	33.3%	12.5%	18.9%	
	DNS to left BS	5	1	0	2	8	
		15.6%	14.3%	0.0%	25.0%	15.1%	
	S shaped to right	2	0	0	0	2	
		6.3%	0.0%	0.0%	0.0%	3.8%	
	S shaped to left	0	0	0	1	1	
		0.0%	0.0%	0.0%	12.5%	1.9%	
	Nil	3	0	1	1	5	
		9.4%	0.0%	16.7%	12.5%	9.4%	
		SPHENOID SINUSITIS				Total	Chi-square p value
		Nil	Right Sphenoid	Left Sphenoid	Bilateral Sphenoid		
TURBINATE	CL Right	3	0	0	0	3	0.608
		9.4%	0.0%	0.0%	0.0%	5.7%	
	CL Bilateral	1	0	1	0	2	
		3.1%	0.0%	16.7%	0.0%	3.8%	
	CL Right, CB Left, Bilateral inferior turbinate hypertrophy	0	0	0	1	1	
		0.0%	0.0%	0.0%	12.5%	1.9%	
	CL left	5	0	0	0	5	
		15.6%	0.0%	0.0%	0.0%	9.4%	
	CB Right	2	3	1	3	9	
		6.3%	42.9%	16.7%	37.5%	17.0%	
	CB Right & Left inferior turbinate hypertrophy	1	0	0	0	1	
		3.1%	0.0%	0.0%	0.0%	1.9%	
	CB bilateral	2	1	0	0	3	
		6.3%	14.3%	0.0%	0.0%	5.7%	
	CB Left	3	1	1	0	5	
		9.4%	14.3%	16.7%	0.0%	9.4%	
	Right inferior turbinate hypertrophy	2	0	0	0	2	
		6.3%	0.0%	0.0%	0.0%	3.8%	

	Bilateral inferior turbinate hypertrophy	1	0	0	0	1	
		3.1%	0.0%	0.0%	0.0%	1.9%	
	Nil	12	2	3	4	21	
		37.5%	28.6%	50.0%	50.0%	39.6%	

		SPHENOID SINUSITIS				Total	Chi-square p value
		Nil	Right Sphenoid	Left Sphenoid	Bilateral Sphenoid		
UNCINATE PROCESS	Lateralisation	0	0	1	0	1	0.076
		0.0%	0.0%	16.7%	0.0%	1.9%	
	Medialisation	5	2	0	3	10	
		15.6%	28.6%	0.0%	37.5%	18.9%	
	Nil	27	5	5	5	42	
		84.4%	71.4%	83.3%	62.5%	79.2%	

		SPHENOID SINUSITIS				Total	Chi-square p value
		Nil	Right Sphenoid	Left Sphenoid	Bilateral Sphenoid		
ETHMOID CELLS	Onodi right	0	0	0	1	1	0.412
		0.0%	0.0%	0.0%	12.5%	1.9%	
	Onodi bilateral	1	0	0	1	2	
		3.1%	0.0%	0.0%	12.5%	3.8%	
	Onodi bilateral, Agger Nasi right	1	0	0	0	1	
		3.1%	0.0%	0.0%	0.0%	1.9%	
	Onodi left	1	1	2	0	4	
		3.1%	14.3%	33.3%	0.0%	7.5%	
	Haller right	2	0	0	0	2	
		6.3%	0.0%	0.0%	0.0%	3.8%	
	Haller left	2	0	0	0	2	
		6.3%	0.0%	0.0%	0.0%	3.8%	
	Agger Nasi right	1	0	0	0	1	
		3.1%	0.0%	0.0%	0.0%	1.9%	
	Agger Nasi bilateral	3	0	0	0	3	
		9.4%	0.0%	0.0%	0.0%	5.7%	
	Agger Nasi left	1	0	0	2	3	
		3.1%	0.0%	0.0%	25.0%	5.7%	
	Nil	20	6	4	4	34	
		62.5%	85.7%	66.7%	50.0%	64.2%	

No statistically significant associations between sphenoid sinus involvement and variations in the Nasal septum, Turbinates, Uncinate Process, or Specific Ethmoid Cells parameters (all p values > 0.05).

Table 18: Comparison of anatomical variants across frontal sinusitis CT findings in the study population (N=53)

Crosstab								Chi-square p value
Parameter		FRONTAL SINUSITIS				Total		
		Nil	Right frontal	Left frontal	Bilateral frontal			
NASAL SEPTUM	DNS to right	9	1	1	3	14		0.978
		23.7%	33.3%	16.7%	50.0%	26.4%		
	DNS to left	9	1	3	0	13		
		23.7%	33.3%	50.0%	0.0%	24.5%		
	DNS to right + BS	7	1	1	1	10		
		18.4%	33.3%	16.7%	16.7%	18.9%		
	DNS to left + BS	6	0	1	1	8		
		15.8%	0.0%	16.7%	16.7%	15.1%		
	S shaped to right	2	0	0	0	2		
		5.3%	0.0%	0.0%	0.0%	3.8%		
	S shaped to left	1	0	0	0	1		
		2.6%	0.0%	0.0%	0.0%	1.9%		
	Nil	4	0	0	1	5		
		10.5%	0.0%	0.0%	16.7%	9.4%		
		FRONTAL SINUSITIS				Total		Chi-square p value
		Nil	Right frontal	Left frontal	Bilateral frontal			
TURBINATE	CL right	3	0	0	0	3		0.124
		7.9%	0.0%	0.0%	0.0%	5.7%		
	Bilateral CL	2	0	0	0	2		
		5.3%	0.0%	0.0%	0.0%	3.8%		
	CL right, CB left, Bilateral inferior turbinate hypertrophy	0	0	1	0	1		
		0.0%	0.0%	16.7%	0.0%	1.9%		

	CL Left	5	0	0	0	5	
		13.2%	0.0%	0.0%	0.0%	9.4%	
	CB Right	8	0	1	0	9	
		21.1%	0.0%	16.7%	0.0%	17.0%	
	CB Right & Left inferior turbinate hypertrophy	0	0	0	1	1	
		0.0%	0.0%	0.0%	16.7%	1.9%	
	CB bilateral	2	0	1	0	3	
		5.3%	0.0%	16.7%	0.0%	5.7%	
	CB left	4	1	0	0	5	
		10.5%	33.3%	0.0%	0.0%	9.4%	
	Right inferior turbinate hypertrophy	2	0	0	0	2	
		5.3%	0.0%	0.0%	0.0%	3.8%	
	Bilateral inferior turbinate hypertrophy	0	0	1	0	1	
		0.0%	0.0%	16.7%	0.0%	1.9%	
	Nil	12	2	2	5	21	
		31.6%	66.7%	33.3%	83.3%	39.6%	

		FRONTAL SINUSITIS				Total	Chi-square p value
		Nil	Right frontal	Left frontal	Bilateral frontal		
UNCINATE PROCESS	Lateralisation	0	0	0	1	1	0.076
		0.0%	0.0%	0.0%	16.7%	1.9%	
	Medialisation	8	0	0	2	10	
		21.1%	0.0%	0.0%	33.3%	18.9%	
	Nil	30	3	6	3	42	
		78.9%	100.0%	100.0%	50.0%	79.2%	

		FRONTAL SINUSITIS				Total	Chi-square p value
		Nil	Right frontal	Left frontal	Bilateral frontal		
ETHMOID CELLS	Onodi right	0	0	0	1	1	0.265
		0.0%	0.0%	0.0%	16.7%	1.9%	
	Onodi bilateral	1	0	0	1	2	
		2.6%	0.0%	0.0%	16.7%	3.8%	
	Onodi bilateral, Agger Nasi right	1	0	0	0	1	
		2.6%	0.0%	0.0%	0.0%	1.9%	
	Onodi left	4	0	0	0	4	
		10.5%	0.0%	0.0%	0.0%	7.5%	
	Haller right	0	1	0	1	2	
		0.0%	33.3%	0.0%	16.7%	3.8%	
	Haller left	2	0	0	0	2	
		5.3%	0.0%	0.0%	0.0%	3.8%	
	Agger Nasi right	1	0	0	0	1	
		2.6%	0.0%	0.0%	0.0%	1.9%	
	Agger Nasi bilateral	3	0	0	0	3	
		7.9%	0.0%	0.0%	0.0%	5.7%	
	Agger Nasi left	1	0	1	1	3	
		2.6%	0.0%	16.7%	16.7%	5.7%	
	Nil	25	2	5	2	34	
		65.8%	66.7%	83.3%	33.3%	64.2%	

No statistically significant associations between frontal sinus involvement and variations in the Nasal septum, Turbinates, Uncinate Process, or Specific Ethmoid Cells parameters (all p values > 0.05).

Table 19 : Comparison of anatomical variants across pansinusitis CT findings in the study population (N=53)

Crosstab					Chi-square p value
Parameters		PANSINUSITIS		Total	
		Nil	Pansinusitis		
NASAL SEPTUM	DNS to right	14	0	14	0.369
		29.8%	0.0%	26.4%	
	DNS to left	11	2	13	
		23.4%	33.3%	24.5%	
	DNS to right + BS	7	3	10	
		14.9%	50.0%	18.9%	
	DNS to left + BS	7	1	8	
		14.9%	16.7%	15.1%	
	S shaped to right	2	0	2	
		4.3%	0.0%	3.8%	
	S shaped to left	1	0	1	
		2.1%	0.0%	1.9%	
	Nil	5	0	5	
		10.6%	0.0%	9.4%	
		PANSINUSITIS		Total	Chi-square p value
		Nil	Pansinusitis		
TURBINATE	CL right	3	0	3	0.681
		6.4%	0.0%	5.7%	
	CL bilateral	2	0	2	
		4.3%	0.0%	3.8%	
	CL right, CB left, Bilateral inferior turbinate hypertrophy	1	0	1	
		2.1%	0.0%	1.9%	
	CL Left	3	2	5	
		6.4%	33.3%	9.4%	
	CB Right	9	0	9	
		19.1%	0.0%	17.0%	
	CB right & Left inferior turbinate hypertrophy	1	0	1	
		2.1%	0.0%	1.9%	
	CB bilateral	3	0	3	
		6.4%	0.0%	5.7%	
	CB left	4	1	5	
		8.5%	16.7%	9.4%	
	Right inferior turbinate hypertrophy	2	0	2	
		4.3%	0.0%	3.8%	

	Bilateral inferior turbinate hypertrophy	1	0	1	
		2.1%	0.0%	1.9%	
	Nil	18	3	21	
		38.3%	50.0%	39.6%	

		PANSINUSITIS		Total	Chi-square p value
		Nil	Pansinusitis		
UNCINATE PROCESS	Lateralisation	1	0	1	0.006
		2.1%	0.0%	1.9%	
	Medialisation	6	4	10	
		12.8%	66.7%	18.9%	
	Nil	40	2	42	
		85.1%	33.3%	79.2%	

		PANSINUSITIS		Total	Chi-square p value
		Nil	Pansinusitis		
ETHMOID CELLS	Onodi right	1	0	1	0.871
		2.1%	0.0%	1.9%	
	Onodi bilateral	2	0	2	
		4.3%	0.0%	3.8%	
	Onodi bilateral, Agger Nasi right	1	0	1	
		2.1%	0.0%	1.9%	
	Onodi left	4	0	4	
		8.5%	0.0%	7.5%	
	Haller right	2	0	2	
		4.3%	0.0%	3.8%	
	Haller left	2	0	2	
		4.3%	0.0%	3.8%	
	Agger Nasi right	1	0	1	
		2.1%	0.0%	1.9%	
	Agger Nasi bilateral	2	1	3	
		4.3%	16.7%	5.7%	
	Agger Nasi left	2	1	3	
		4.3%	16.7%	5.7%	
	Nil	30	4	34	
		63.8%	66.7%	64.2%	

No statistically significant associations between pansinusitis involvement and variations in the Nasal septum, Turbinates, Uncinate Process, or Specific Ethmoid Cells parameters (all p values > 0.05).

DISCUSSION

The anatomy of the nose and paranasal sinuses is highly variable among individuals, with deviations and anomalies often influencing the pathophysiology of sinusitis. Computed tomography (CT) has become indispensable in clinical practice for its ability to provide detailed anatomical imaging, crucial for understanding the impact of these variations on sinusitis symptoms and management strategies. Anatomical variants such as septal deviations, concha bullosa, Haller cells, and agger nasi cells are prevalent findings in CT imaging of the sinonasal region. These variants can disrupt normal sinus ventilation, drainage, and mucociliary clearance mechanisms, thereby predisposing individuals to chronic sinusitis.[78]

CT imaging is essential for its ability to provide high spatial resolution and multiplanar capabilities, which enable precise visualization of sinonasal structures and anatomical variants. Unlike conventional radiography, which offers limited detail and often two-dimensional views, CT scans generate cross-sectional images that can be reconstructed into detailed three-dimensional representations. This capability allows for comprehensive assessment and measurement of anatomical structures such as septal deviations, concha bullosa, Haller cells, and agger nasi cells within the nasal and sinus cavities.

Numerous studies have consistently demonstrated the superiority of CT over conventional radiography in identifying these anatomical variants. Khojastepour conducted a prospective study emphasizing CT's superior visualization and characterization of the osteomeatal complex, critical for diagnosing and managing chronic rhinosinusitis.[79] Similarly, Nautiyal et al. underscored CT's impact on treatment planning by identifying anatomical variants that were challenging to visualize on conventional radiographs.[80]

The multiplanar capabilities of CT imaging allow clinicians to examine structures from various angles, facilitating a comprehensive assessment of complex anatomical relationships. This is particularly advantageous in surgical planning for conditions requiring precise localization of anatomical variants. Vervoorn demonstrated the utility of three-dimensional CT reconstructions in accurately depicting sinus pneumatization patterns and identifying subtle variations that influence surgical outcomes. Furthermore, CT imaging enables quantitative assessment through precise measurements of anatomical dimensions. This aspect is crucial for objectively evaluating variations in osteomeatal complex anatomy and understanding their clinical significance.[81]

Among the study population, the mean age was 36.68 ± 12.88 years. The study enrolled adult patients ranging in age from 18 to 60 years, with a mean age of 42 years. Devaraja etal conducted a study to explore anatomical variations of the nose and paranasal sinuses using a computed tomography. They found that the majority of participants were male, comprising 101 out of the total, resulting in a male-to-female ratio of 2:1. Similarly nearly two thirds of the subjects were males. [82] The examination of patient’s primary complaints in our study identified a number of common symptoms that point to sinonasal problems. The most prevalent complaint, reported by 11.32% of participants, was nasal blockage, often accompanied with discharge and headache. Furthermore, a significant proportion of patients (15.09%) manifested with a confluence of nasal obstruction, discharge, sneezing, and headache, underscoring the intricacy and diversity of symptoms encountered. A notable prevalence of unilateral nasal blockage and headache was also observed, impacting 13.21% of the population. Our study investigated the association between specific anatomical variants identified on CT imaging and symptoms of sinusitis. These results highlight the variety of clinical manifestations of sinonasal diseases and the need for thorough diagnostic methods in order to appropriately diagnose and treat patients presenting with these problems. Comprehending these symptomatology patterns is essential to directing efficacious treatment approaches customized to each patient's requirements and enhancing the results in sinonasal health management. Similarly, Rosenfeld RM etal underscored that three key symptoms that demonstrate high sensitivity and specificity for diagnosing acute rhinosinusitis include purulent nasal drainage coupled with either nasal obstruction or facial pain, pressure, or fullness.[83]

In our study, we observed a diverse range of symptom durations among the study participants affected by sinonasal conditions. A significant proportion, approximately half (50.94%), reported symptoms persisting from 1 month to less than 2 months. A substantial number of patients (30.19%) experienced symptoms lasting less than 1 month, indicative of acute presentations. Additionally, 16.98% of individuals reported symptoms lasting from 2 months to less than 3 months, suggesting a subset with more prolonged or possibly chronic conditions. These findings illustrate the varying temporal patterns of rhinosinusitis symptoms encountered in clinical practice. Recognizing these durations is crucial for tailoring timely and effective treatment approaches to improve patient outcomes and manage sinonasal health effectively. Masood et al found that nasal drainage appears serous but later changes to mucopurulent, typically resolving within 10 days. But, if symptoms increase five days after they initially appear or continue longer than ten days , this frequently points to a subsequent bacterial infection, which is known as acute non-viral rhinosinusitis. All of the symptoms of acute rhinosinusitis are present in chronic rhinosinusitis, but they last longer than 12 weeks.[84]

The distribution of nasal septum deviations in our study population reveals several patterns: 26.42% exhibited a deviation to the right side , while 24.53% had a deviation to the left side. Deviations involving both the septum and the nasal bone were observed in 18.87% for the right side and 15.09% for the left side. Less common findings included an S-shaped deviation to the right side (3.77%) and to the left side (1.89%). Approximately 9.43% of participants showed no septal deviation. Among patients diagnosed with sinusitis in a study by Alsaggaf etal, a majority (43.2%) exhibited a leftward deviation of the nasal septum, while (35.5%) showed deviations to the right. Bilateral deviations were less frequent, observed in 6.1% of cases. These findings emphasize the asymmetry in nasal septum deviations among individuals with sinusitis, suggesting a potential role of nasal anatomy in the development or exacerbation of sinonasal symptoms. These findings underscore the variability in nasal septum anatomy, highlighting the prevalence and distribution of deviations that can potentially impact nasal airflow and predispose individuals to sinonasal symptoms.[85]

In our study, the prevalence and distribution of anatomical variants vary across populations and ethnicities. In our study, septal deviations were the most common variant, observed in 62% of patients, followed by concha bullosa (28%), Haller cells (18%), and agger nasi cells (12%). These variants often exhibit asymmetrical distribution, with the maxillary sinus being the most frequently affected site. The distribution of uncinate process configurations in our study population shows that 18.87% exhibited medialisation, while lateralisation was observed in 1.89% of cases. The majority, comprising 79.25% of participants, showed no notable deviation in their uncinate process configuration. These findings underscore the variability in anatomical presentations of the uncinate process within the sinonasal region.

Gungor etal explored that the uncinate process (UP) is essential within the ostiomeatal complex due to its significant role in regulating mucociliary activity in the nasal and sinus cavities. Variations in the structure of the UP can disrupt normal mucociliary drainage and ventilation, which are critical for maintaining sinus health. These variations may complicate surgical interventions aimed at addressing sinus conditions by altering the anatomy that surgeons must navigate. Therefore, a thorough understanding of UP anatomy and its potential variations is crucial for effective surgical planning and management of sinus disorders.[86]

However, Tuli etal highlighted that the typical uncinate process configuration was the most common overall, observed in 70% of participants, followed by medial deviation, which accounted for 24% of cases. These findings underscore the frequency and clinical relevance of anatomical variations in the uncinate process, highlighting their potential impact on sinonasal anatomy and related surgical considerations.

The distribution of maxillary sinus involvement in our study population shows that bilateral maxillary sinusitis was the most common presentation, affecting 28.30% of participants. This was followed by involvement of the left maxillary sinus in 24.53% of cases and the right maxillary sinus in 20.75%. Approximately 26.42% of individuals showed no apparent maxillary sinus involvement. These findings highlight the variability in unilateral and bilateral maxillary sinusitis presentations among individuals with sinonasal symptoms.[87]

Our study investigated the association between specific anatomical variants identified on CT imaging and symptoms of sinusitis. Patients with septal deviations demonstrated a significantly higher prevalence of symptoms such as nasal obstruction (87%), facial pain (65%), and purulent nasal discharge (53%) compared to those without septal deviations. Michalik etal highlighted that anatomical variants disrupt normal sinus physiology, impairing mucociliary clearance and predisposing to bacterial colonization, which underlies chronic inflammation and symptomatic sinusitis. Recognition of these associations informs clinical decision-making, emphasizing the role of CT in guiding personalized treatment strategies and optimizing outcomes. [88]

Variations in the nasal septum (DNS) are significantly associated with disorders that impact the maxillary sinus. Deviations that specifically affect the right maxillary sinus, left maxillary sinus, or both, such as DNS to right side , DNS to left side, DNS to right side with BS, DNS to left side with BS, and S shaped, demonstrate varied distributions under various circumstances. There are two theories that could account for the connection between sinusitis and DNS. The first theory is that nasal septum deviation results in a narrow osteomeatal complex, which is a mechanical problem. Another idea is that DNS alters the dynamics of airflow within the sinuses, impairing mucociliary function. Both of these may result in sinus infections due to trapped secretions.[89-92]

CONCLUSION

In conclusion, this cross-sectional study underscores the crucial role of computed tomography (CT) in thoroughly evaluating anatomical variants of the nose and paranasal sinuses in patients with sinusitis symptoms. CT imaging provides detailed, three-dimensional anatomical insights that facilitate precise identification of variations such as septal deviations, concha bullosa, and agger nasi cells, commonly implicated in sinonasal pathologies. The study highlights a significant correlation between these anatomical variations and clinical symptoms such as nasal obstruction, facial pain, and purulent discharge, underscoring CT's utility in tailoring treatment strategies.

Moreover, the study emphasizes the variability and prevalence of these anatomical variants, emphasizing the need for personalized diagnostic and therapeutic approaches in managing sinusitis.

SUMMARY

- The study used a cross-sectional design over one year (January to December 2023) at KLEs Dr. Prabhakar Kore Hospital, with 53 subjects aged 18-60 presenting with symptoms of sinusitis.
- The study involved 53 participants (58.49% males, 41.51% females) with an average age of 36.68 years.
- The study was conducted to determine the prevalence of anatomical variants such as septal deviations, concha bullosa, uncinate process variations, and ethmoid air cell configurations.
- To assess the association between these anatomical variants and symptoms of sinusitis (nasal obstruction, facial pain, rhinorrhea, headache).
- The study provides insights into the anatomical variations that may influence the pathophysiology and clinical presentation of sinusitis in the study population.
- Common complaints included nasal obstruction, discharge, sneezing, and headaches. Nasal septum deviations (DNS) were prevalent, with right-sided DNS in 26.42% and left-sided in 24.53% of cases.
- Turbinate abnormalities were predominantly on the right side (39.62%).
- Maxillary sinus abnormalities were found in 71.70% of cases, often bilateral (28.30%). Ethmoid sinus involvement was seen in 37.74%, frontal sinus in 28.30%, sphenoid sinus in 39.62%, and pansinusitis in 11.32%.
- Statistical analysis revealed a significant association between maxillary sinus abnormalities and DNS to the right side (p=0.041).
- Understanding these variations is crucial for diagnosing and treating sinonasal disorders like chronic rhinosinusitis.

- Limitations included a small sample size , suggesting the need for larger studies to validate findings and explore additional factors influencing anatomical variations.
- Overall, the study supports the integral role of CT imaging in optimizing patient outcomes and managing sinonasal health comprehensively.

LIMITATIONS

1. Due to the restricted time of our study to one year and single center setting, all the anatomical variants of the paranasal sinuses could not be evaluated.
2. Functional assessments such as mucociliary clearance and immune status were not directly evaluated in our study.

Future studies should address these limitations to provide a comprehensive understanding of the complex interplay between anatomical variants and sinusitis pathophysiology.

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CONSENT FORM FORMAT

KAHERs JNMC

BELAGAVI

INFORMED CONSENT FORM

Principal Investigator, REGISTRATION NO: BS0121011

Objectives:

PRIMARY OBJECTIVE: To determine the prevalence of sinonasal anatomical variants.

SECONDARY OBJECTIVE: To assess the relation of anatomical variants in patients having symptoms of sinusitis.

Introduction : The paranasal sinuses (PNS) are air-filled cavities present in facial and skull bones. There are four types of paranasal sinuses: maxillary sinus, sphenoid sinus, ethmoid sinus and frontal sinus.

There are many anatomic variants in sinonasal region which are frequently observed on computed tomography (CT) and most frequently observed are agger nasi cells, deviated nasal septum (DNS), infraorbital ethmoidal (Haller) cells, sphenoethmoidal (Onodi) cells, and concha-bullosa (CB).

The vast range of anatomic variants can hinder with mucociliary drainage pathway of osteomeatal complex (OMC) which includes deviated nasal septum, concha bullosa, paradoxical middle turbinate, uncinate process variants, ethmoid bulla and various ethmoidal air-cells.

OMC is the crucial area for spread and pathogenesis of rhinosinusitis. Episodes of rhinosinusitis hinders the movement of cilia that results in collection of mucous within sinuses. However, if there is an anatomical variant, causing narrowing of key area which is OMC, then a minimal amount of mucosal distention may predispose to recurrent infections and may result in severe inflammatory changes in the mucus membrane of sinonasal region.

Explanation of procedure: The patients having symptoms of sinusitis, age more than 18 years who are referred to the Radiology department for the Computed tomography paranasal sinuses will undergo the scan according to the standard protocol.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

If you have any questions about this study, you may contact:

REG NO. BS0121011	**DR.__________________**	**DR. HARSHA HEGDE,**
Post-Graduate, Department of Radio-Diagnosis. J.N. Medical College, Belagavi	Guide, Professor, Department of Radio-Diagnosis J.N. Medical College, Belagavi	CHAIRPERSON, JNMC, IEC & SCIENTIST D, ICMR, NATIONAL INSTITUTE OF TRADITIONAL MEDICINE, BELAGAVI

LEGAL RIGHTS: By signing this consent form, we are not waiving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**ROLE OF COMPUTED TOMOGRAPHY IN IDENTIFYING THE ANATOMICAL VARIANTS OF NOSE AND PARANASAL SINUSES AND TO ASSESS THEIR RELATION IN PATIENTS HAVING SYMPTOMS OF SINUSITIS: A CROSS SECTIONAL STUDY**". My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Participant details:

Name of patient :

____

Signature/Thumb Impression of the patient:

____

Relation to the subject:

Date:

Name of witness:

____

Signature of the witness:

____

Date:

Signature of investigator: ________________________

Date:

ANNEXURE - II

PROFORMA FOR DATA COLLECTION

1. PATIENT NAME:

2. IDENTIFICATION NO:

3. AGE / GENDER:

4. ADDRESS:

5. OCCUPATION:

6. PRESENTING COMPLAINTS:

- **Nasal obstruction**
- **Rhinorrhea**
- **Sneezing**
- **Distorted sense of smell**
- **Headache**
- **Facial pain**
- **Mouth breathing**

7. ALLERGIES:

8. PAST HISTORY:

9. **CT PNS FINDINGS:**

10. ANATOMICAL VARIANTS ON CT PNS:

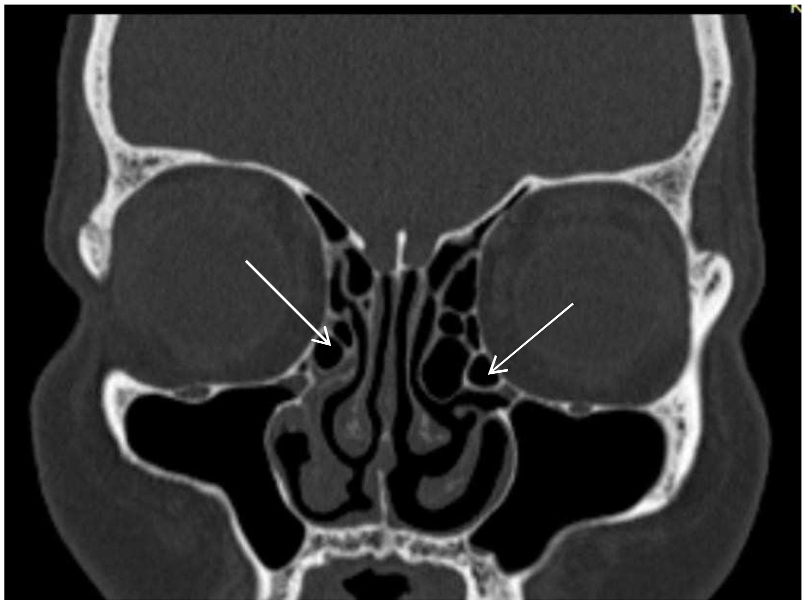
	VARIANTS OF PNS	PRESENT / ABSENT
1. NASAL SEPTUM	NASAL DEVIATION	
2. TURBINATES	CONCHA BULLOSA CONCHA LAMELLA TURBINATE HYPERTROPHY	
3. UNCINATE PROCESS	LATERALISATION MEDIALISATION	
4. ETHMOIDAL AIR CELLS	AGGER NASI AIR CELLS HALLER CELLS ONODI CELLS	

ANNEXURE III – IMAGES

Figure 1. 128 slice Computed Tomography scan machine (Revolution EVO Wipro

CASE 1 – 47 year old female presented with complaints of nasal obstruction, discharge & headache since 2 months.

a)



b)

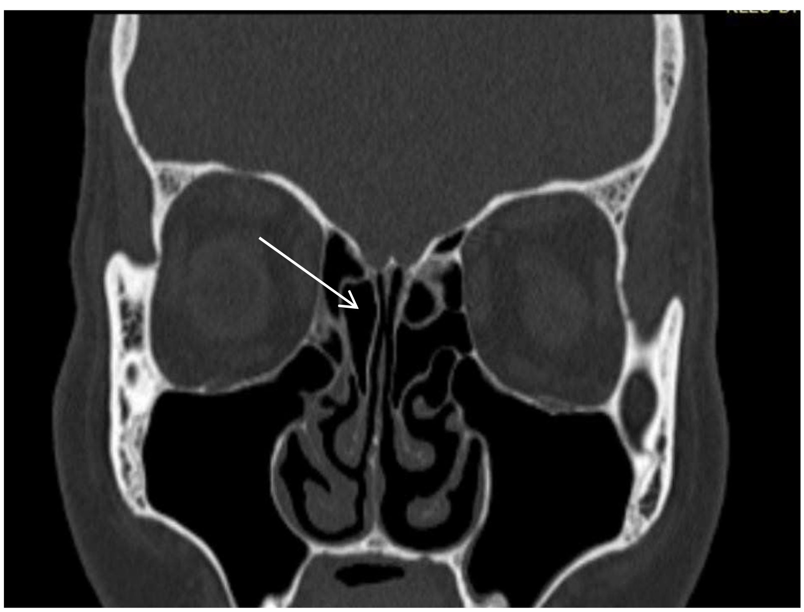
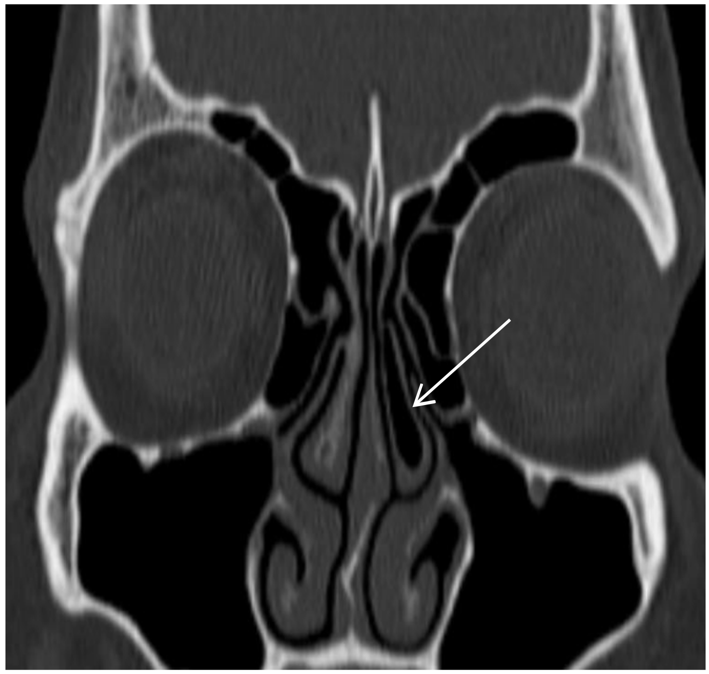


Figure 2. CT PNS Coronal view (Bone window), a) Bilateral Haller Cells and b) Right concha lamella

CASE 2 – 33 year old male presented with complaints of unilateral nasal obstruction & nasal discharge since 15 days.



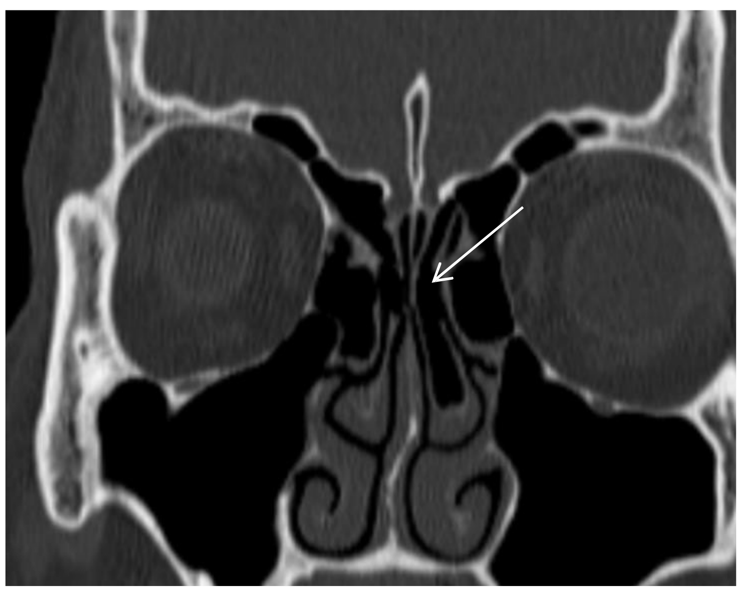


Figure 3. CT PNS Coronal view, (Bone window), Left concha lamella and concha bullosa

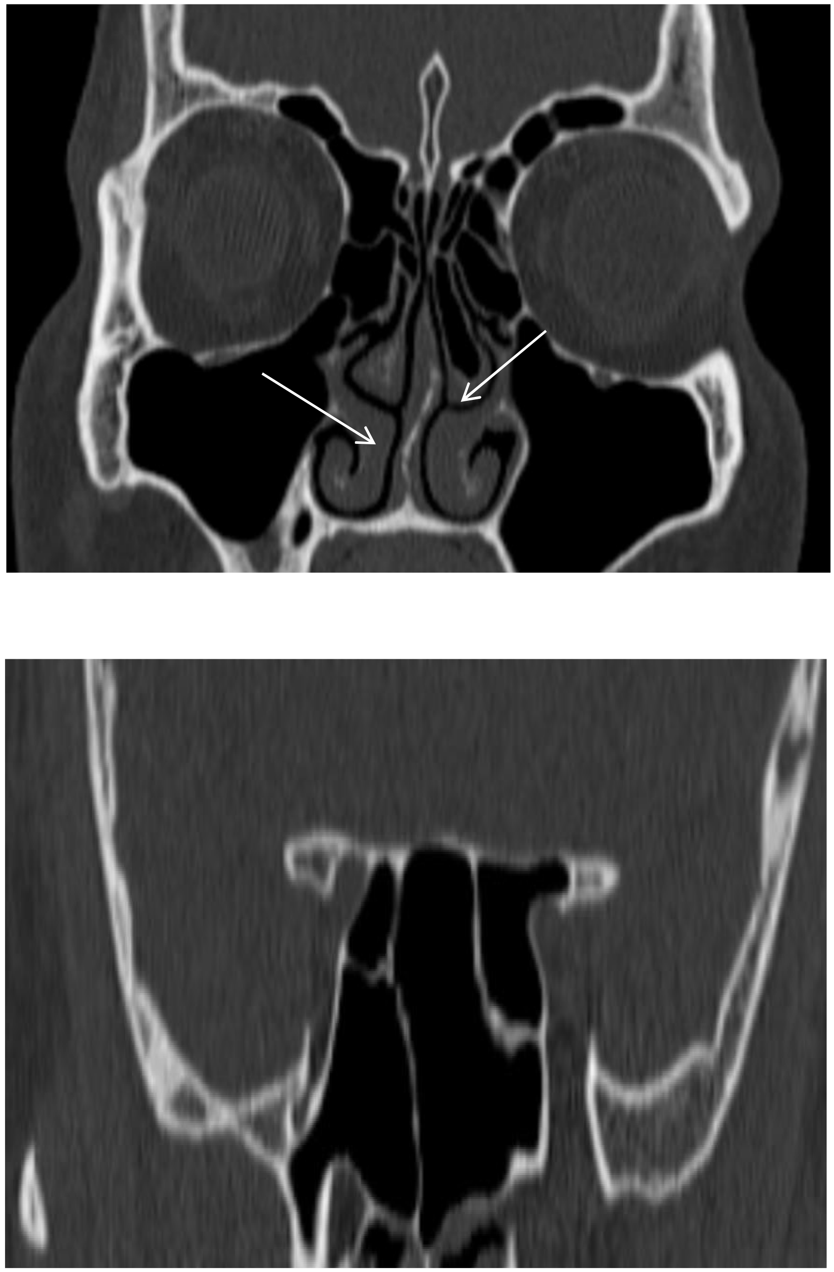


Figure 4–Coronal CT PNS (bone window) showing a) Left concha bullosa, Shaped Deviated nasal septum and b) Left Onodi cell

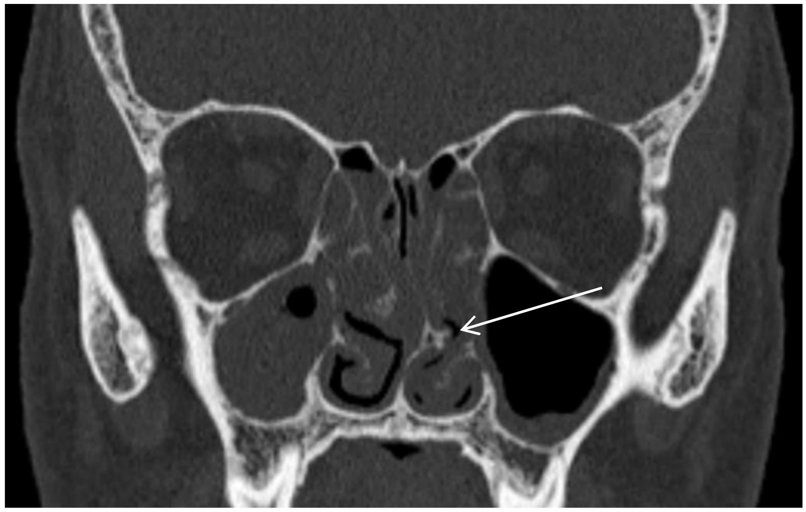
CASE 3 – 41 year old male presented with complaints of nasal obstruction & headache since 4 months. Coronal and axial CT PNS (bone window)showing pansinusitis.

a) Bilateral frontal sinusitis

b) Bilateral maxillary sinusitis

c) Bilateral sphenoid and ethmoid sinusitis

d)



e)

Figure 5 –Coronal CT PNS (bone window) showing a) Deviated nasal septum with convexity & bony spur towards left side and e) Bilateral Onodi cells.

CASE 4 – 24 year old female presented with complaints of nasal obstruction & headache since 15 days.

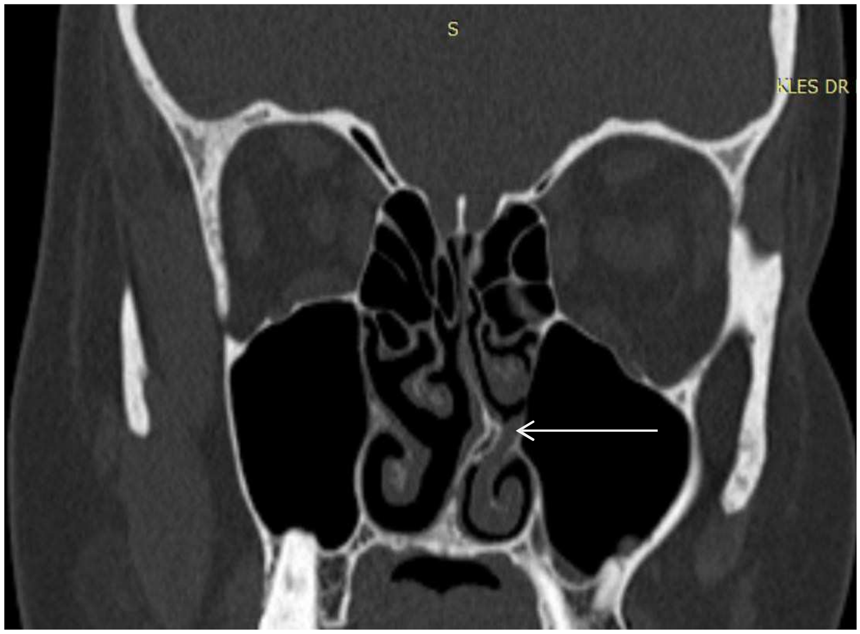


Figure 6– Coronal CT PNS showing Deviated nasal septum with convexity and bony spur towards left side.

ANNEXURE IV

KEY TO MASTER CHART

Equivalents in master chart

GENDER

1. Male=0
2. Female=1

CT PNS SINUSITIS

1. MAXILLARY :
   Right maxillary – 1
   Left maxillary – 2

2. ETHMOID : 3

3. SPHENOID SINUSITIS :
   Right sphenoid – 4
   Left sphenoid – 5

4. FRONTAL SINUSITIS :
   Right frontal – 6
   Left frontal – 7

5. PANSINUSITIS – 8
6. Nil – 0
7. NA – not applicable

ANATOMICAL VARIANTS IN PNS

1. DEVIATED NASAL SEPTUM :

a) DNS to right side - 1
b) DNS to left side - 2
c) DNS to right side with bony spur (BS)- 3
d) DNS to left side with bony spur (BS)- 4
e) S shaped DNS with bony spur to right side-5
f) S shaped DNS with bony spur to left side- 6
g) Nil – 0

2. TURBINATES :

a) Concha Lamella (CL) on right side – 1
b) Concha Lamella (CL) on left side – 2
c) Concha Bullosa (CB) on right side - 3
d) Concha Bullosa (CB) on left side - 4
e) Right inferior turbinate hypertrophy - 5
f) Left inferior turbinate hypertrophy - 6
g) Nil - 0

3. UNCINATE PROCESS :

a) Medialisation – 1
b) Lateralisation – 2
c) Nil -0

4. ETHMOID CELLS :

a) Onodi Cells on right side – 1
b) Onodi cells on left side – 2
c) Haller Cells on right side -3
d) Haller Cells on left side – 4
e) Agger Nasi Cells on right side – 5
f) Agger Nasi Cells on left side – 6
g) Nil – 0

							CT PNS FINDINGS IN TERMS OF SINUSITIS					ANATOMICAL VARIANTS			
S.NO	**AGE**	**SEX**	**CT NO**	**CHIEF COMPLAINTS**	**DURATION**	**CO-MORBIDITIES**	**MAXILLARY**	**ETHMOID**	**SPHENOID**	**FRONTAL**	**PANSINUSITIS**	**DNS**	**TURBINATES**	**UNCINATE PROCESS**	**ETHMOID CELLS**
1	27	0	1196810	U/L Nasal obstruction	1 month	NONE	1	0	0	0	0	2	0	0	0
2	24	0	1190355	Headache , nasal obstrcution & discharge	2 months	NONE	2	3	4	7	0	4	0	0	0
3	26	0	234780	U/L Nasal obstruction	1 month	NONE	1	0	0	0	0	1	1	0	0
4	35	1	251974	U/L Nasal obstruction & facial pain	15 DAYS	NONE	0	3	0	0	0	3	0	0	0
5	42	1	1205821	U/L nasal obstruction, rhinorrhoea	1 month	NONE	0	3	0	0	0	0	2	0	5,6
6	25	1	6981909	Nasal obstruction , sneezing , headache	2 months	NONE	1,2	3	4,5	7	0	1	0	0	0
7	56	1	236953	Nasal obstrcution , sneezing , headache, discharge , anosmia	3months	Pollen allergy	0	3	4	0	0	1	3	0	0
8	32	1	7109768	Nasal obstruction , discharge , anosmia	1 month	NONE	1,2	3	5	0	0	0	1,2	0	2
9	33	0	246503	U/L Nasal obstruction, discharge , headache	2.5 MONTHS	NONE	1,2	0	0	0	0	5	1,2	0	2
10	22	0	6795785	Nasal obstruction , discharge , sneezing, headache	5 MONTHS	NONE	NA	NA	NA	NA	8	3	0	0	0
11	47	1	238351	Nasal obstruction , discharge , headache	2 months	NONE	2	0	0	0	0	1	1	0	4
12	19	0	244999	Nasal obstruction , discharge	1 month	NONE	1,2	3	0	0	0	2	3	0	1,2,5
13	24	0	1200740	U/L Nasal obstruction , discharge	20 days	NONE	1,2	0	0	0	0	1	0	0	0
14	33	0	246503	U/L nasal obstruction, rhinorrhoea	1 month	NONE	2	0	0	0	0	5	1	0	0
15	41	0	1200751	U/L Nasal obstruction &headache	4 MONTHS	NONE	NA	NA	NA	NA	8	4	0	1	0
16	32	0	1178477	U/L nasal obstruction , headache	1 month	NONE	2	0	0	7	0	2	3,4	0	0
17	23	0	10029994	Nasal obstruction , discharge , headache	10 days	NONE	0	3	4,5	6,7	0	4	0	0	6
18	23	1	7043376	Nasal discharge & headache	1 month	NONE	2	0	0	0	0	4	2	0	0
19	36	0	2652255	Nasal obstruction , discharge , headache , anosmia	2 months	NONE	1,2	3	0	6,7	0	3	3, 6	0	1,2
20	18	1	10002646	U/L Nasal obstruction	1.5 months	NONE	1,2	0	0	0	0	4	5	0	0
21	23	1	7185188	u/l nasal obstruction , rhinorrhea	1 month	NONE	1,2	3	5	7	0	3	3	0	0
22	24	1	236114	Nasal obstruction , headache	15 days	NONE	2	0	0	6	0	2	0	0	0
23	47	0	7180080	Nasal obstruction , discharge , headache , anosmia	3 MONTHS	NONE	NA	NA	NA	NA	8	2	2	1	5,6
24	50	1	7135951	Nasal obstruction , discharge , headache , anosmia	2 months	NONE	1,2	3	0	6,7	0	1	0	1	3
25	57	1	10016712	Nasal obstruction , discharge , headache , anosmia , facial pain	1 month	NONE	2	3	5	6,7	0	1	7	2	0
26	48	1	1183020	U/L Nasal obstruction , discharge , anosmia	1 to 1.5 months	NONE	1,2	0	4	0	0	2	3	1	0
27	56	0	10010458	Nasal obstrcution , discharge , sneezing, anosmia , headache	1.5 to 2 months	NONE	1	3	0	0	0	2	0	0	0
28	28	0	257794	U/L nasal obstrcution and headache	15 days	NONE	2	0	0	0	0	4	5	0	0
29	37	1	659312	Nasal obstruction , discharge , headache ,sneezing	2 MONTHS	H/o allergy	1,2	3	4,5	0	0	1	3	1	1,2
30	54	0	1209295	Nasal obstruction , discharge , headache , sneezing	1.5 months	NONE	1,2	3	4,5	0	0	6	3	1	0
31	58	1	4099495	U/L nasal obstruction , discharge , headache	20 days	NONE	0	3	0	0	0	0	3,4	0	5,6
32	50	0	10006596	U/L Nasal obstruction , discharge , headache	25 days	NONE	1	0	0	0	0	0	3	0	0
33	45	0	7211244	Nasal obstruction , headache	2 MONTHS	H/o allergy	NA	NA	NA	NA	8	3	4	1	6
34	29	1	1002376	U/l nasal obstruction, headache	1 month	NONE	2	0	0	0	0	2	2	0	0
35	33	0	254387	Nasal discharge & headache	20 days	NONE	0	0	4,5	6,7	0	0	0	0	1
36	52	0	1007622	Nasal obstruction , discharge , headache , sneezing	2 months	NONE	0	3	4,5	0	0	4	3	0	0
37	46	0	798223	Nasal obstruction , headache , sneezing	1 month	H/o allergy	1,2	0	4,5	0	0	3	0	1	0
38	44	1	1004325	nasal obstruction , discharge , headache , anosmia	2 months	NONE	NA	NA	NA	NA	8	3	0	0	0
39	34	1	786543	u/l nasal obstruction , headache	15 days	NONE	2	0	5	0	0	2	4	0	0
40	55	0	1167667	Nasal obstruction, headache, sneezing, discharge	1 month	NONE	1	0	0	6	0	1	0	0	3
41	36	0	5274483	U/L Nasal obstruction, headache	20 days	NONE	1	0	0	0	0	1	4	0	0
42	28	1	219370	U/l nasal obstruction	15 days	NONE	1	0	0	0	0	1	0	0	5
43	42	0	1173222	Nasal obstruction, headache, sneezing, discharge	2 months	h/o allergy	NA	NA	NA	NA	8	2	2	1	0
44	18	0	10002488	U/l nasal obstruction	25 days	NONE	1	0	0	0	0	1	4	0	0
45	18	1	7160326	U/L Nasal obstruction, headache	15 days	NONE	2	0	0	0	0	4	0	0	4
46	58	0	10007168	U/L Nasal obstruction	1 month	NONE	2	0	5	0	0	2	0	0	0
47	42	0	10003894	Nasal obstruction, headache, sneezing, discharge	1.5 months	NONE	1	3	4	6	0	3	4	0	0
48	53	0	10021654	u/l nasal obstruction and discharge	1 month	H/o allergy	2	0	0	7	0	2	5,6	0	0
49	19	0	257892	Nasal obstruction, headache, sneezing, discharge	1 month	NONE	1	3	4,5	7	0	2	1,4,5,6	0	6
50	22	1	251196	Nasal obstruction , discharge , headache	20 days	NONE	1,2	0	4	0	0	3	3	0	0
51	22	0	6753627	u/l nasal obstruction and discharge	15 days	NONE	0	0	5	0	0	3	0	0	2
52	42	1	799213	Nasal obstruction , discharge , headache	1 month	NONE	1	3	4	6,7	0	1	0	1	0
53	56	0	260468	Nasal obstruction , discharge , headache	1 month	NONE	1,2	0	4	0	0	1	3,4	0	2