A PROSPECTIVE STUDY ON THE QUALITY OF LIFE OUTCOMES OF PATIENTS WITH CHRONIC RHINOSINUSITIS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY

Dissertation submitted to

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Registration No-221914201

THANJAVUR MEDICAL COLLEGE

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

THANJAVUR – TAMILNADU

MAY 2022

CERTIFICATE

This is to certify that this dissertation titled **A PROSPECTIVE STUDY ON THE QUALITY OF LIFE OUTCOMES OF PATIENTS WITH CHRONIC RHINOSINUSITIS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY" by Dr. ANJU R** is an original work done in the Department of Otorhinolaryngology**, THANJAVUR MEDICAL COLLEGE,** Thanjavur 613004 in partial fulfilment of rules and regulations of **The Tamil Nadu Dr. MGR Medical University for the award of degree of MS (Otorhinolaryngology) Branch IV** under my supervision during the academic period 2019 to 2022

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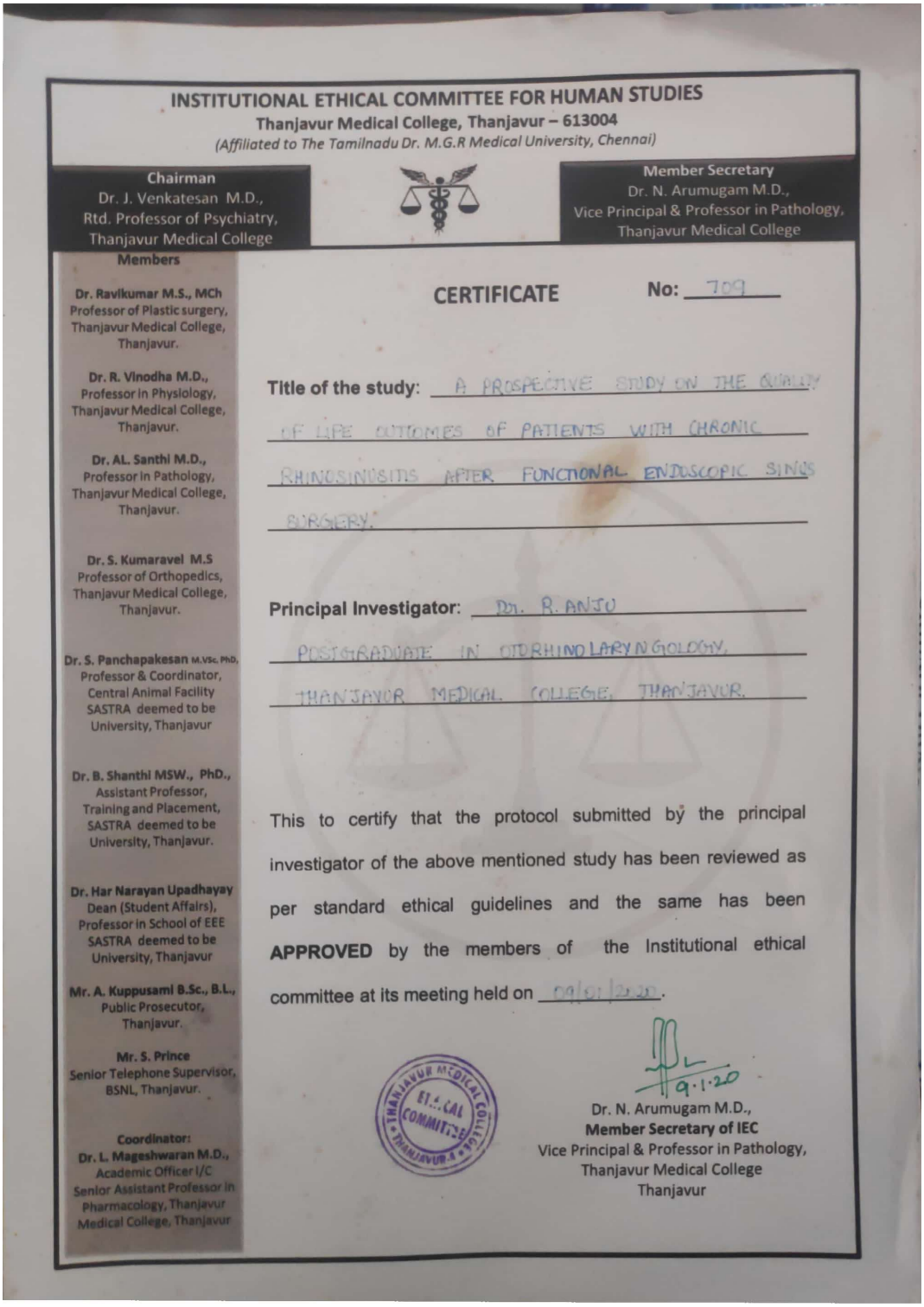

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Title of the study: A PROSPECTIVE STUDY ON THE QUALITY OF LIFE OUTCOMES OF PATIENTS WITH CHRONIC RHINOSINUSITIS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY.

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This to certify that the protocol submitted by the principal investigator of the above mentioned study has been reviewed as per standard ethical guidelines and the same has been **APPROVED** by the members of the Institutional ethical committee at its meeting held on 09/01/2020.

9.1.20

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I solemnly declare that the dissertation entitled "**A PROSPECTIVE STUDY ON THE QUALITY OF LIFE OUTCOMES OF PATIENTS WITH CHRONIC RHINOSINUSITIS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY** " is done by me at **THANJAVUR MEDICAL COLLEGE**, **Thanjavur-613004** during November 2019 to October 2021 under the guidance and supervision of **Prof.C.BALASUBRAMANIAN M.S(ENT)** to be submitted to **The Tamilnadu Dr.M.G.R Medical University** towards the partial fulfillment of requirements for the award of **M.S DEGREE IN OTORHINOLARYNGOLOGY BRANCH-IV**

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INTRODUCTION

The first attempt at nasal endoscopy is largely credited to Hirschman in 1901 who

used a modified cystoscope to examine the nasal cavity. Subsequently, Reichert performed what would be regarded as the first endoscopic procedure; rudimentary maxillary sinus manipulations with a 7 mm endoscope through an oroantral fistula.[1]In 1925, Maltz promoted use of nasal endoscopes for diagnostic evaluation of the sinonasal cavity and coined the term ‘sinuscopy’.[2]The creation of the Hopkins rod system in the 1960s was perhaps the major turning point in the field of sinonasal endoscopy. Professor Harold H. Hopkins developed the rod optic endoscope system as well as several other inventions such as the zoom camera lens and fiberoptic gastroscope. The new telescope design resulted in markedly enhanced light delivery and superior optical quality allowing exceptional detailing of the sinonasal cavity.[3] Using this new innovation, Messerklinger subsequently composed a landmark book in 1978 on diagnostic endoscopy of the nose from his work studying mucociliary clearance in fresh cadavers.[4]

. The concept of FESS is the removal of tissue obstructing the Osteo Metal Complex (OMC) and the facilitation of drainage while conserving the normal non-obstructing anatomy and mucous membrane. The rigid nasal telescope provides superb intra-operative visualization of the OMC, allowing the surgery to be focused precisely on the targeted region. The image can be projected onto a monitor through a camera attached to the eyepiece of the endoscope. Microdebriders remove the

pathologic tissue without damaging normal mucosa[5] .Over the past 20 years, endoscopic sinus surgery has been widely used as a safe and effective treatment for Nose and Para Nasal Sinus (PNS) disorders. Powered instrumentation and stereotactic image-guided surgery have improved efficiency and safety of this procedure.

Modern endoscopic sinus surgery is arbitrarily divided into Messerklinger and Wigand approaches.

Chronic rhinosinusitis is a common disease that has significant impact on quality of life. FESS revolutionised the way of otolaryngologists management of chronic rhinosinusitis. Recent efforts in measuring outcome of FESS have focussed on evaluating not only physical but also the social and emotional consequences of the disease and their treatment.

Functional Endoscopic Sinus Surgery (FESS) is the mainstay of surgical treatment for these patients and improves the quality of their life (QOL) . This subjective assessment of QOL can be measured by disease specific questionnaires.[6] The European position paper on rhinosinusitis and nasal polypi recommends the subjective assessment of symptoms using validated questionnaires.

This has resulted in the development of a number of CRS specific assessment tools such as SF36, RSOM-3, RSUI, RQLQ, SNOT-16, SN-5, SNOT-11, SNOT-20, NOSE, CQ-7, SNOT-20 and SNOT-22 are the two validated patient reported measures of the symptom severity and health related QOL in sino nasal conditions. SNOT-22 (2009) is a modified version of SNOT-20 and RSOM-31. SNOT-22 covers the physical problems, functional

limitations as well as the emotional consequences of patients who suffer from CRS.4

SNOT-22 contains 22 questions on CRS related symptoms. Symptom severity is graded from zero to five - with zero indicating no problem at all and five indicating the worst possible symptom. For each item, scores are added to produce a sum score on a scale ranging from zero to 110 with high scores indicating a large rhinosinusitis related health burden. The patients are also asked to identify which five items are most important to them. At the end of the questionnaire, the patient may state if he or she has had any symptoms that were not included among the 22 items.

This paper aims to assess improvement in QOL after the Functional Endoscopic Sinus Surgery through questionnaire SNOT-22

AIMS AND OBJECTIVES

1. To assses the various symptoms of chronic rhinosinusitis before functional endoscopic sinus surgery
2. To compare the various symptoms of chronic rhinosinusitis before and after functional endoscopic sinus surgery
3. To assess quality of life outcome in patients of chronic rhinosinusitis after functional endoscopic sinus surgery using SNOT22
4. To confirm functional endoscopic sinus surgery as a standard treatment modality in chronic rhino sinusitis patients refractory to medical treatment

REVIEW OF LITERATURE

Endoscopic sinus surgery for the treatment of acute and chronic sinusitis was well established by the first third of this century.[7]It was based on the commendable anatomical studies of Zuckerkandl,[8] Onodi [9] and Grünwald. Transnasal endoscopic sinus surgery was introduced in the mid 1980s. The term FESS was coined by Kennedy.[10] Endoscopic orbital decompression was first described by Kennedy and Michel in the early 1990s. In 1978, Messerklinger documented endoscopic findings in English. He found out that wherever two mucosal layers came in contact, localized disruption of mucociliary clearance occurs which causes stasis of secretions in the area of contact and there by creates an increased potential for infection. . His studies, beginning in the 1950s, demonstrated that in most cases,frontal and maxillary sinuses are involved indirectly by primary disease that originates in the narrow spaces of the lateral wall of the nose and in the anterior ethmoid. This discovery led to the development of an endoscopic diagnostic technique that focused on changes in the lateral wall of the nose and identified and isolated these changes with the aid of the rigid endoscope and tomography. Consequently this resulted in an endoscopic surgical technique that was directed specifically at the primary disease in the ethmoidal region. Messerklinger observed that the removal of this primary anterior ethmoid disease, usually by means of a circumscribed, limited endoscopic procedure, resulted in the recovery of even massive mucosal pathology in the adjacent, large paranasal sinuses.

It has been identified that the main foci of infection for recurrent sinusitis is the ethmoidal infundibulum.With the advent of endoscopes the ethmoidal focus is

cleared, the dependent larger sinuses usually heal without having been touched even if their mucosal pathology seemed almost irreversible .

Functional Endoscopic Sinus Surgery (FESS) is a minimally invasive technique in which sinus air cells and sinus ostia are opened under direct visualization. The goal of this procedure is to restore sinus ventilation and normal function.

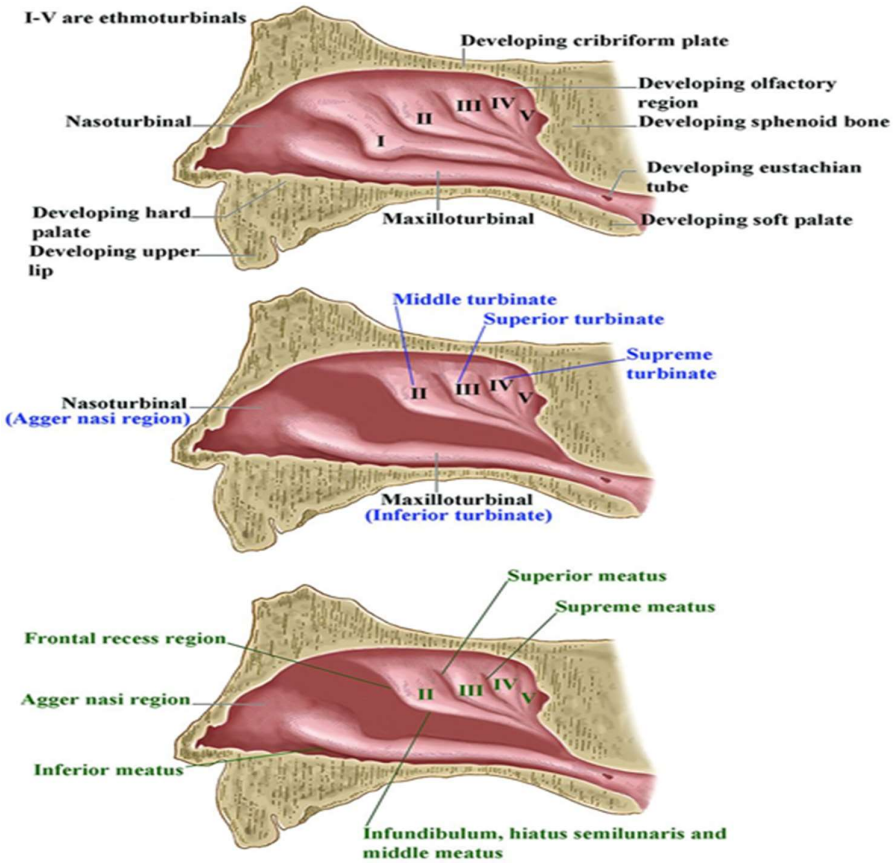
ANATOMY OF LATERAL WALL OF THE NOSE AND PNS

DEVELOPMENTAL ANATOMY

The cartilaginous nasal capsule develops as two separate masses around the forming nasal cavities and the developing nasal septum. While the median mass will become the progenitor of the nasal septum, the lateral masses will become the lateral nasal wall structures. By the third month, the nasal capsule is well-defined cartilage.

All of the turbinates and the paranasal sinuses arise from the cartilaginous nasal capsule. Several soft-tissue folds appear on the lateral wall of each nasal cavity, the preturbinals, which are first supported by cartilage and then by bone. The maxilloturbinal develops first and then is followed by 5 ethmoturbinals (in men, the first ethmoturbinal disappears). An additional rudimentary nasoturbinal arises anteriorly, appearing later as a slight elevation, the agger nasi . By the eighth week, the inferior and middle turbinate anlagen forms, followed by the superior turbinate anlagen. They develop by proliferation of mesenchymal cells and hypertrophy of the

overlying epithelium. During the seventh month, the maxilloturbinal separates from the lateral wall and becomes an independent bone in adult.



The importance of embryology in the functional endoscopic sinus surgery is that they were encountered from anterior to posterior as 4 lamellae. The first basal lamella corresponds to uncinate process, the second basal lamella corresponds to ethmoid bulla, the third basal lamella corresponds to the base of middle turbinate and the fourth basal lamella corresponds to the base of the superior turbinate. By the eighth week, the lateral nasal wall is well-developed. The length of the lower 3 turbinates increases progressively and proportionally in uterine life, while the supreme turbinate remains at an average length of 5 mm from the 14th to 36th week

and is present in only 65% of fetuses. The outpouchings of the nasal mucous membranes that will become the paranasal sinuses are thought to be a secondary phenomenon rather than a primary force in sinonasal development.[11,12]

The uncinate process arises from the cartilaginous capsule at 10 weeks. An air channel then progressively develops lateral to the uncinate process. This will be the primitive infundibulum by 10–11 weeks. The embryonic woven bone of the maxilla can be seen between 9 and 10 weeks, and it then enlarges relative to the nasal cavity. By 13–14 weeks, the expanding maxilla now forms the lateral wall of the inferior meatus as the cartilaginous capsule regresses.9 By the 16th week, the primitive maxillary sinus starts to develop from the inferior margin of the infundibulum.[13]

PARANASAL SINUS

MAXILLARY SINUS-ANTRUM OF HIGHMORE

The maxillary sinus is the first sinus developing in the human fetus as an outpouching structure from the lateral wall of the ethmoidal infundibulum(14,15). At birth, a rudimentary sinus, approximately 7 -8mm in length(anteroposterior diameter), 4-6mm in height (vertical diarneter), and 3-4mm in width (transverse diameter), is present . The growth rate is 2mm vertically and laterally and 3mm anteroposteriorly each year until the ninth year of life . Thereafter, growth is slower but continues in all directions until 15 -18 years, when the sinus reaches the adult size. The average dimensions of the adult maxillary sinuses are 32-34mm in length,

28-33mm in height, and 23-25mm in width, and their volume ranges from 8.5 to 15ml.

ETHMOID SINUS

The initial outpouchings of the ethmoidal cells are evident as early as the fourth fetal month and arise from recesses in the lateral walls of the middle , superior, and supreme meatuses. The ethmoidal cells are always present at birth. They continue to expand until late puberty. Each adult ethmoidal sinus consists of 3 to 15 cells[14] and has an average size of 33, 27, and 14mm in length, height, and width respectively.

FRONTAL SINUS

The frontal sinus begins to develop in the region of the frontal recess during the fourth or fifth month of foetal life [14]. A definitive frontal sinus is rarely seen at birth and is frequently not present until the second or third year of life [15,16]. It is the most variable sinus in development and is said to fail to develop in 4% of the population. Shapiro and Schorr (8) as described the pronounced variability in frontal sinus pneumatization to three factors, i.e., craniofacial configuration, thickness of the frontal bone, and growth hormones. Generally, radiographically the frontal sinus cannot be detected before the age of 5 to 7[16] It continues to grow until puberty, when it reaches the adult size and shape.

SPHENOID SINUS

The sphenoidal sinus emerges in the third or fourth foetal month as invaginations of the posterosuperior part of the sphenoethmoidal recess. The invaginations become pouch-like cavities(concha sinuses) within the sphenoidal concha(ossides of Bertin) which becomes attached inferiorly to the sphenoidal body around three to five years of age postnatally. Following fusion of the sphenoidal concha to the sphenoidal body, pneumatization progresses into the presphenoid and later the basisphenoid parts of the sphenoid bone, with the sphenoidal concha remaining as the anterior sinus wall [17,18]. The patterns of pneumatization of the sphenoidal sinus vary greatly in individuals, and are cIassified into conchal, presphenoidal, basisphenoidal, and occipitosphenoidal[16]. The sinus reaches the adult size in adolescence and its volume ranges from 1 to 6ml.

MACROSCOPIC ANATOMY

I. LATERAL NASAL WALL

The bony elevations in the side walls of the nasal cavity are termed as upper, middle and lower turbinates and spaces inferior and lateral to these turbinates are the meatii named accordingly

INFERIOR TURBINATE

The pair of curved inferior nasal turbinates overhang from the lateral wall on either side as a lateral protuberance. Inferior turbinate ossifies by endochondral ossification . .It has a medial mucosal layer (ML), a lateral mucosal layer(LML),

and a central osseous layer in between (6). The bony layer of inferior turbinate has its attachments to the lateral nasal wall superiorly and laterally while inferiorly it is well circumscribed by an ellipse-shaped mucosa. The lining mucosa is similar to the rest of the nasal cavity – pseudostratified ciliated columnar epithelium and in addition to deeply situated basal 20 cells and superficially ciliated and non-ciliated cells (6). Augusto et al had reported a predominance of mucous glands in the anterior portion of the IT. Between the epithelium and the periosteum of central osseus layer is the lamina propria and forms the major portion of the IT. A rich network of thin-walled venous sinusoids is also present in the lamina propria. While small-calibre venous sinusoids are superficially located, many of the larger venules extend to deeper portions of the lamina propria. The congestion of venous sinusoid is a part of the normal physiological nasal cycle by inducing a temporary enlargement of the IT. The arterial supply of inferior turbinate is by the branches of sphenopalatine artery. One to three large branches of the sphenopalatine artery run along the IT in a posterior–anterior direction and anteriorly anastomose with branches of facial artery

NASOLACRIMAL DUCT

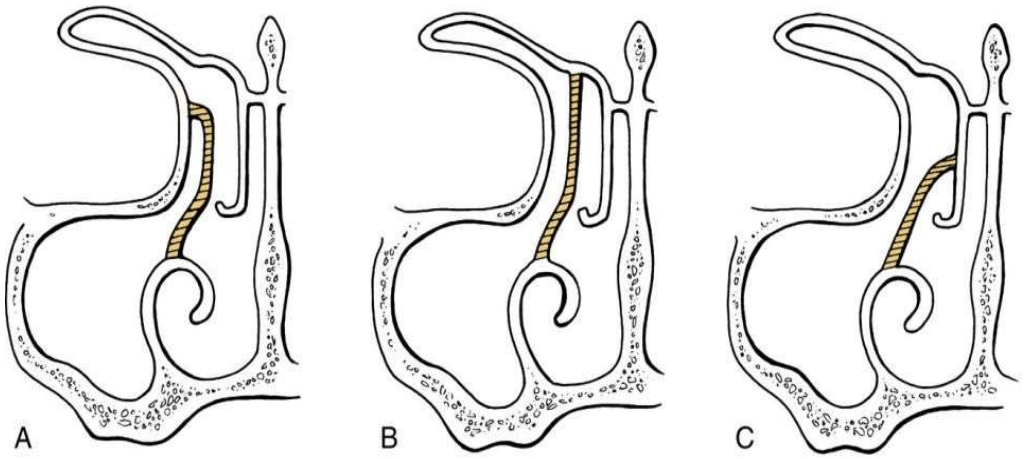
The lacrimal sac drains inferiorly to the nasolacrimal duct, which is bordered medially by palatine bone and the inferior turbinate in the nose and laterally by maxillary bone. The nasolacrimal duct opens at the inferior meatus located underneath the inferior nasal turbinate. The lacrimal sac is approximately 10 to 15 mm in axial dimension and 13 to 20 mm in coronal dimension, and the

nasolacrimal duct is 12 to 18 mm long. Its inferior nasal meatus is partially covered by a mucosal fold known as the valve of Hasner.[19,20,21]

MIDDLE TURBINATE

The middle turbinate is a convoluted structure bending in different planes similar to a dried leaf. It has three parts, depending on its attachment and its orientation in the three-dimensional space. The anterior one-third is in the sagittal plane and is attached above to the cribriform plate at the junction of the medial and lateral lamellae. It also takes a small anterior attachment to the frontonasal process of the maxilla. The middle one-third lies in the coronal plane and is attached to the lamina papyracea. It separates the anterior ethmoidal cells from the posterior ethmoidal cells. Since it stabilizes the middle turbinate, it is called the ground lamella or the basal lamella. The posterior third lies in the horizontal plane and is attached to the lamina papyracea and the perpendicular plate of the palatine bone extending upto the roof of the posterior choana. Middle turbinate overlies the middle meatus. Within middle meatus most anteriorly is a curved ridge called the uncinate process. Behind this is the well pneumatised and most constant anterior ethmoidal cell, namely the ethmoidal bulla. These structures are separated by a semilunar groove called the hiatus semilunaris. The hiatus semilunaris is two-dimensional and leads into a three-dimensional space called the ethmoidal infundibulum. The uncinate process, the bulla and the intervening infundibulum form the key area or the osteomeatal unit into which the frontal, the maxillary and anterior ethmoidal sinuses drain

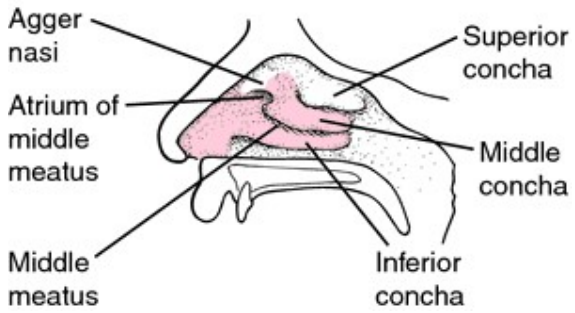
UNCINATE PROCESS



The uncinate process is one of the three downward vertical projections of the ethmoid bone (the other two are the perpendicular plate and the middle turbinate) and articulates inferiorly with the ethmoid process of the inferior turbinate . It may originate from the middle turbinate, the lamina papyracea or the roof of the ethmoid bone. The anterosuperior margin of the uncinate process is in contact with the bony lateral nasal wall. This small, almost sagitally oriented, thin uncinate process runs in an anterosuperior to posteroinferior direction . Posteriorly, the uncinate process is not fused with any other bone. Between this posterior free margin and the ethmoid bulla, there is a sickle-shaped cleft called the hiatus semilunaris inferior , which leads to the ethmoid infundibulum. The use of the Lusk probe facilitates localization of the posterior free margin and the natural maxillary sinus ostium in the ethmoid infundibulum. There are membranous areas of the lateral wall of the middle meatus in which no bone exists. These membranous areas are usually present anterior and

posterior to the uncinate process and are called' anterior and posterior fontanelles. The fontanelles may be sites of accessory ostia of the maxillary sinus.

AGGER NASI



The term comes from the Latin term for nasal mound and refers to the most superior remnant of the first ethmoturbinal, which persists as a mound or crest immediately anterior and superior to the insertion of the middle turbinate. An Aggernasi cell results when this area of the lateral nasal wall undergoes pneumatization. Depending on the degree of pneumatization, Aggernasi cells may reach laterally to the lacrimal fossa and cause narrowing of the frontal recess.

BULLA ETHMOIDALIS

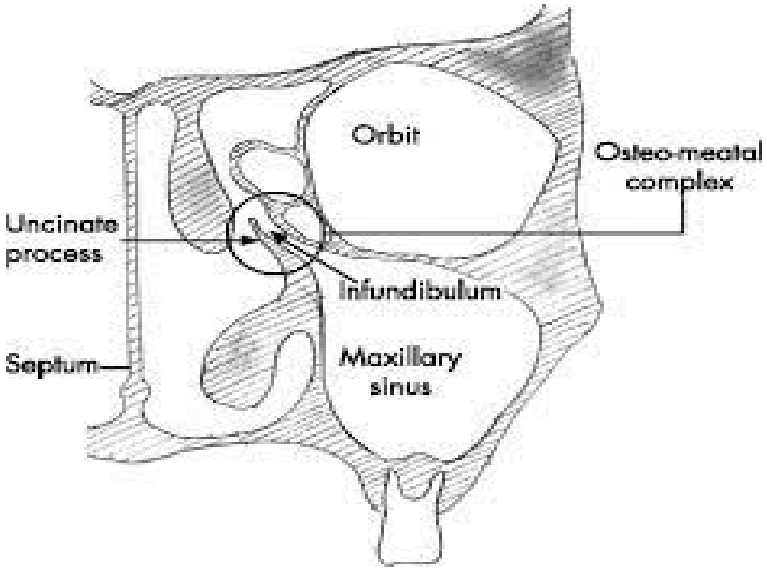
The ethmoid bulla is the largest air cell of anterior ethmoid sinus. It extends from the lamina papyracea laterally and bulges medially into the middle meatus. The ostium of the ethmoid bulla often located on the upper margin of the posterior wall and drains into the middle meatus. Ethmoid bulla can be of variable sizes; however, occasionally “about 8% of the population,” it might be underdeveloped [22].

A rare anatomical variation of the ethmoid bulla, when it is non-pneumatized. In this case, there will be a bony projection from the lamina papyracea known as "torus lateralis." Surgeon must be aware of this anatomical variant during endoscopic sinus surgery to prevent any unintentional orbital penetration [23].

HIATUS SEMILUNARIS AND ETHMOID INFUNDIBULUM

The space between the anterior wall of ethmoid bulla and the free edge of uncinate process is called the hiatus semilunaris; it opens anterosuperiorly into a cavity called the ethmoid infundibulum. The ethmoid infundibulum is the space between the uncinate process and the inferomedial wall of the orbit. Hiatus semilunaris receives drainage from the ethmoid bulla. The maxillary sinus and often the frontal sinus, depending on the superior attachment of the uncinate process, drain into the ethmoid infundibulum.

OSTEOMEATAL UNIT

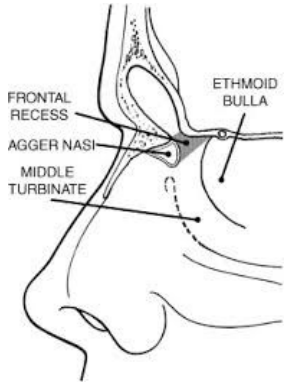


The anterior osteomeatal unit drains the maxillary, anterior ethmoid, and frontal sinuses. It is formed by (1) ethmoid infundibulum, (2) middle meatus, (3) hiatus semilunaris, (4) maxillary ostium, (5) ethmoid bulla, (6) frontal recess, and (7) uncinate process. Occasionally, abnormalities or anatomical variations could affect the patency of this unit. The other draining osteomeatal unit, located posterior in the nasal cavity, is the sphenoethmoidal recess. It drains the posterior ethmoid sinus lateral to the superior turbinate and drains the sphenoid sinus medial to the superior turbinate

NASAL FONTANELLES

Just posterior to maxillary sinus ostium and inferior to lamina papyracea is the membranous wall called nasal fontanelles that separate the maxillary sinus from the nasal cavity. They lie immediately anterior (anterior fontanelle) and posterior (posterior fontanelle) to the inferior aspect of the uncinate process. The posterior fontanelle is much larger and more distinct than its anterior counterpart. The fontanelles, especially the posterior may be perforated creating accessory ostia (20-25%). These accessory ostia are indicative of prior sinus diseases.

FRONTAL RECESS



It is located in the anterosuperior most part of the middle meatus. The frontal sinus natural ostium opening into the recess is of hourglass narrowing. Multiple ostia are found in 10% of patients. The superior attachment of the uncinate process will determine the drainage pattern of the frontal sinus.

SUPERIOR TURBINATE AND MEATUS

Superior turbinate occupies only the upper part of nasal cavity. Occasionally, there is a fourth turbinate called the supreme turbinate, and the corresponding meatus is the supreme meatus.The posterior ethmoid cells drain into the superior meatus. The supreme meatus “if present” drains the most posterior ethmoid cells.

SUPREME TURBINATE

In 60-70% of individuals it lies above the superior meatus which is well developed in only less than 20% through which the posterior ethmoid cells drain into superior meatus.

SPHENOETHMOIDAL RECESS

The space which lies behind & above the superior turbinate where posterior ethmoidal cells and the sphenoid drains into this region.

ANATOMICAL VARIATIONS OF THE TURBINATES

- **CONCHA BULLOSA**

  It is a pneumatization of the inferior bulbous part of middle turbinate. Occurs in approximately 24–55% of the population and often bilateral. Usually pneumatization originates from the frontal recess or the agger nasi cell .

- **INTERLAMELLAR CELL OF GRUNWALD:**

  Also called lamellar bulla or conchal neck air cell. It occurs when the pneumatization is limited to the vertical part of middle turbinate. Usually not causing narrowing of the osteomeatal unit

- **PARADOXIC MIDDLE TURBINATE**

  Present in about 26% of the population. Occasionally, it can affect the patency of the osteomeatal unit

- **PNEUMATIZED BASAL LAMELLA:**

  Can be falsely considered as a posterior ethmoid air cell during endoscopic sinus surgery.

- **MISSED BASAL LAMELLA**

  When the basal lamella does not attach to the lamina papyracea, it attaches to the lateral maxillary sinus wall.

HALLER CELLS

These cells develop along the floor of the orbit and may constrict the posterior aspect of the ethmoid infundibulum.

ONODI CELLS

The posterior ethmoid cells may develop both laterally and superiorly beyond the anterior wall of the sphenoid sinus. These posterolateral cells are called Onodi cells. It is important to recognize Onodi cells since dissecting posteriorly in this plane during surgery may lead to penetration of the skull base or damage the optic nerve.

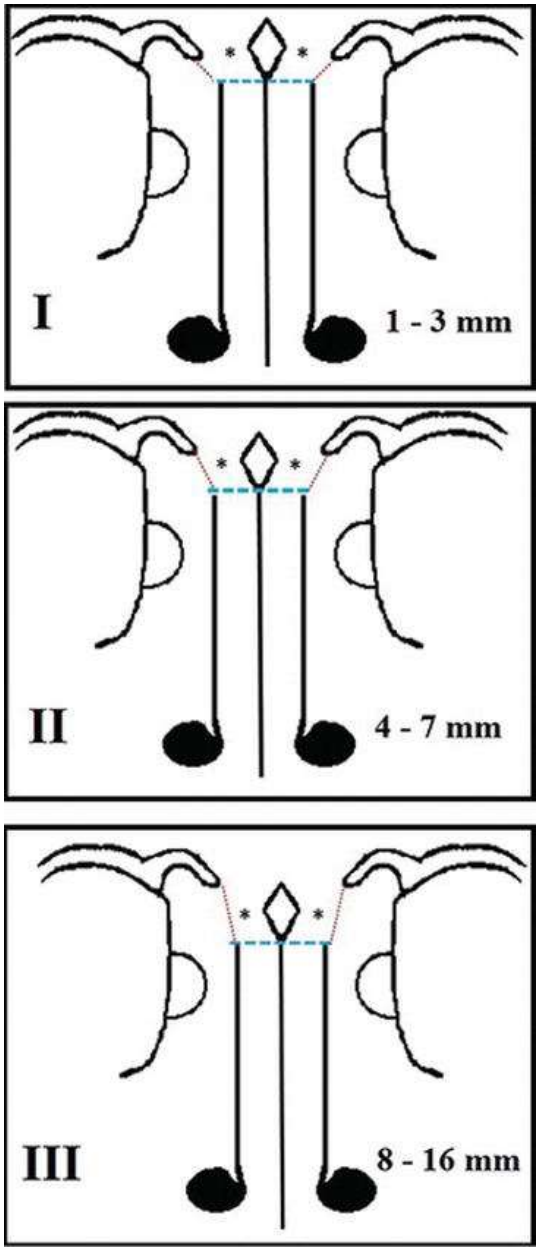
OLFACTORY FOSSA

The olfactory fossa contains olfactory bulbs and blood vessels. Its boundaries are inferiorly the cribriform plate of the ethmoid and medially the crista galli. Laterally it is bounded by the thinnest bone in the anterior skull base "the lateral lamella of the cribriform plate." Superiorly it communicates with the anterior cranial fossa.

Keros in 1962 classified the depth of olfactory fossa into three types based on the length of the lateral lamella :

- **Type 1:** The length of the lateral lamella is 1–3 mm, suggesting a shallow olfactory fossa seen in 12% of the population.
- **Type 2:** The length of the lateral lamella is 4–7 mm, means a moderately deep olfactory fossa seen in 70% of the population.

- **Type 3:** The lateral lamella is longer, measuring 8–16 mm indicating a deep olfactory fossa seen in 18% of the population.An anatomical variation of asymmetry in the depth of olfactory fossa had been reported in literature in upto 10–30% of the population .



Coronal view of the olfactory fossa (asterisks) and its variations of depth. Thick dashed line represents the cribriform plate of the ethmoid. Thin dashed lines represent the thin lateral lamella of the cribriform. The depth of the olfactory fossa classified based on the length of the lateral lamella. Type I: lateral lamella length 1–3 mm; type II: lateral lamella length 4–7 mm; and type III: lateral lamella length 8–16 mm.

Both type 1 and type 3 olfactory fossae are at increased risk for injury during endoscopic sinus surgery because in type 1 the angle between the medial and lateral lamellae of the cribriform plate is greater, and in type 3 the olfactory fossa is lower.

BLOOD SUPPLY, INNERVATION, AND LYMPHATIC DRAINAGE OF THE NASAL CAVITY

The nasal cavity is supplied by circulation derived from the internal and external carotid arteries, namely anterior and posterior ethmoidal arteries, sphenopalatine artery, septal branch of the superior labial artery, and the greater and ascending palatine arteries. Sphenopalatine artery is the main supplier of the nasal cavity.

In the lateral nasal wall, sphenopalatine artery after entering the nasal cavity through the sphenopalatine foramen gives off its posterior lateral nasal branches to supply the lateral wall. And it crosses the face of sphenoid sinus toward the posterior end of nasal septum as the posterior septal artery.

Veins accompany the arteries and drain to pterygoid plexus, facial vein, ophthalmic, and inferior cerebral veins [15].

Lateral nasal wall receives innervation from many nerves. Infraorbital nerves supply the vestibular area. The anterior ethmoidal nerve supplies the superior part of lateral wall. And the anterior superior alveolar nerve innervates the mucosa at the level of the wall of the maxillary sinus. The upper back mucosa is supplied by the lateral posterior superior nasal nerve. And the lower back mucosa innervated by the posterior inferior nasal nerve. The parasympathetic fibers reach the nasal cavity in the Vidian nerve, and sympathetic fibers follow the blood vessels.

Lymphatic drainage of nasal cavity is to the submandibular, deep cervical, and retropharyngeal nodes.

PARANASAL SINUSES

MAXILLARY SINUS

Maxillary sinus occupies the body of the maxillary bone. It is pyramidal in shape, with the base facing medially. The roof of the sinus is the orbital floor, and sinus's floor is formed by the alveolar process of the maxilla.

The medial wall of the maxilla is a large bony defect, known as "the fontanelle," in which the lateral nasal wall mucosa lies directly over the maxillary sinus medial wall mucosa. However, the bony defect is made much smaller by the contribution of the surrounding bones like lacrimal bone, ethmoid bone, inferior

turbinate, and perpendicular plate of the palatine bone. This fontanelle is crossed by the uncinate process which divided it into a small anterior fontanelle and larger posterior fontanelle .

In adult individual, the maxillary sinus may extend from the area of the premolar teeth to the third molar, with a volume of approximately 15–22 ml .

In hyper pneumatized sinus, the apices of the molars or premolars are separated by a thin bone from the floor of the maxillary sinus or even project into the sinus floor. Occasionally, this bone is very thin or even absent, making extraction of such a tooth risky to leave a fistula by tearing of the mucous membrane. However, these types of fistulae often end with spontaneous healing.

Immediately posterior to the maxillary sinus lie the infratemporal fossa laterally and the pterygopalatine fossa medially.

Ostium of the maxillary sinus is located in the upper portion of the medial wall of the sinus, and it opens at the posterior end of the hiatus semilunaris below the ethmoid bulla. The diameter of the ostium is about 2–4 mm, but it can be as wide as 10 mm. Mostly, the ostium existed as a canal with inferolateral orientation toward the sinus; however, it might be only an opening in some cases

The infraorbital nerve, a branch of the maxillary division (V2) of the trigeminal nerve, crosses the roof of maxillary sinus within a bony canal that opens as the infraorbital foramen, about 1 cm below the infraorbital rim. The inferior wall of the infraorbital canal can be extremely thin, with an average thickness of 0.2 mm

or it may be completely dehiscent in between 12 and 16% of cases. It can be abnormally protruded within the maxillary sinus as well.

ANATOMICAL VARIATIONS OF MAXILLARY SINUS

- **Accessory sinus ostium:** Any maxillary sinus opening outside the hiatus semilunaris is considered an accessory ostium. Its incidence is about 10–16%; however, some literature report a higher rate It is located in the posterior fontanelle, posterior to natural ostium . Typically, it is smaller than the natural ostium with an average diameter of 1.5 mm. The clinical significance of the presence of an accessory ostium is that occasionally a circular flow of mucus between the natural and the accessory ostia could occur, leading to recurrent sinusitis. If an accessory ostium is encountered intraoperatively, it should be surgically connected with the natural ostium.

- **Maxillary sinus hypoplasia:** It could be a genuine variant in about 10% of the population . However, it might be secondary to other conditions like Silent Sinus Syndrome, post surgical, or post-traumatic sinus. It carries a higher risk of orbital penetration during endoscopic sinus surgery.

- **Maxillary sinus septum:** Maxillary sinus septum is defined as a ridge that is 2.5 mm or more in height. It can be bony or fibrous septum. Usually extends from the infraorbital canal to the lateral wall of the sinus. Occasionally it can impair the drainage of the sinus.

- **Infraorbital cell (Haller cell):** Any extension of the anterior ethmoid air cells along the orbital floor and lateral to the lamina papyracea is considered as infraorbital cell . The incidence of this variation ranges from 10 to 18% in the literature. It might compromise the patency of the maxillary ostium

BLOOD SUPPLY, INNERVATION, AND LYMPHATIC DRAINAGE

Maxillary sinus receives its blood supply by small arteries from the sphenopalatine, infraorbital, greater palatine, facial, pterygopalatine, posterior lateral nasal, and posterior superior alveolar arteries. Veins accompany these vessels drain to the facial vein and to the pterygoid plexus.

The innervations are from the maxillary division (V2) of trigeminal nerve through various branches, namely superior alveolar (posterior, middle, and anterior), greater palatine, and infraorbital nerves. While the area of the ostium is the most sensitive portion, the main part of the sinus is being relatively insensitive.

The lymphatic drainage is through the infraorbital foramen or the ostium to the submandibular node.

ETHMOID SINUS

The ethmoid bone consists of five components: crista galli, cribriform plate, perpendicular plate, and two ethmoidal labyrinths. Each ethmoid labyrinth projects laterally from the side of the perpendicular plate. Each ethmoidal labyrinth consists of middle and superior turbinates, ethmoid air cells, and a thin paper-like lateral

surface called “the lamina papyracea.” The lamina papyracea forms a large part of the medial orbital wall as well.

The ethmoid air cells are divided by the basal lamella of middle turbinate into anterior and posterior ethmoid sinuses. The ethmoidal labyrinth does not have its own roof, and the roof of the sinus is formed by the orbital plate of frontal bone “Fovea ethmoidalis”

Unlike the other sinuses, ethmoid sinus is not formed by a single air cell, instead it is divided by bony septa into variable number of air cells. Anterior ethmoid contains more air cells than the posterior ethmoid; however, the posterior ethmoid air cells are larger. In adult individual, the average number is 3–7 air cells in the anterior ethmoid sinus, and 2–4 in the posterior ethmoid. Each air cell drains through its own ostium, with anterior ethmoid air cells drain into the middle meatus and the posterior ones drain into the superior meatus

ANTERIOR ETHMOIDAL ARTERY

The anterior ethmoidal artery is one of the critical structures within the ethmoid sinus. After branching from the ophthalmic artery within the orbit, it pierces the upper portion of the lamina, then crosses the roof of anterior ethmoid sinus within a bony canal (approximately 2–3 mm behind the face of the ethmoid bulla). After crossing the sinus, it pierces the lateral lamella to enter the olfactory fossa. Then descends into nasal cavity through a slit on the side of the crista galli

The anterior ethmoidal artery foramen in the lamina papyracea is located about 24 mm posterior to the anterior lacrimal crest. The ophthalmic artery gives

off another branch “the posterior ethmoidal artery” as well, which enters the posterior ethmoidal foramen 36 mm posterior to the anterior lacrimal crest .

Occasionally, the anterior ethmoidal artery bony canal might be dehiscent or totally absent, and the artery is suspended on the mucosa of the sinus. The importance of pre-operative identification of this condition cannot be stressed enough to avoid injuring the artery during operating endoscopically on the ethmoid sinus.

ANATOMICAL VARIATIONS OF THE ETHMOID SINUS

- **Agger nasi cell:** Makes the most anterior ethmoid air cells. Formed by an extension of the ethmoid air cell pneumatization into the lacrimal bone, and it is found as a prominence anterior to the vertical (anterior) attachment of middle turbinate. Their incidence is high, seen in about 93% of the population. Its size has a direct effect on the drainage of frontal sinus .
- **Suprabullar recess and retrobullar recess:** When the upper border of the ethmoid bulla is not reaching the skull base, the space formed between them is referred to as “suprabullar recess.” And when there is a space between the posterior wall of the bulla and the basal lamella, posteriorly, this space is called “retrobullar recess” .
- **Suprabullar cell:** An ethmoid air cell lies above the ethmoid bulla, so the superior border is related to the anterior cranial fossa. This cell is limited to the posterior portion of the frontal recess and does not extend to the frontal sinus (which differentiates it from the frontal bullar cell, the latter does extend

to the frontal sinus). So, the anterior border of the suprabullar cell is made by the frontal recess.

- **Supraorbital cell:** A lateral extension of pneumatization from the suprabullar recess into the orbital plate of frontal bone over the orbit. Literature report 15% as an incidence of the supraorbital cell occurrence in the population.

The anatomical significance of the supraorbital cell is that if it is large it can displace the anterior ethmoidal artery posteriorly. In addition, during endoscopic sinus surgery, it can be mistaken as the frontal sinus.

- Occasionally, small focal corticated defects in the lamina papyracea can be seen in up to 0.5–10% of the population; however, they are not clinically significant.

- **Sphenoethmoidal cell (Onodi's cell):** When the posterior ethmoid air cells pneumatized further posteriorly, and extend superiorly and laterally to sphenoid sinus, it is called the sphenoethmoidal cell or Onodi's cell. This can be explained by the fact that the ethmoid air cells are developed and pneumatized earlier than the sphenoid sinus, so they have a room to extend posteriorly. The incidence of the sphenoethmoidal cell ranges from 3.4 to 14% in the literature The significance of this air cell is that it is closely related to the optic nerve on its superolateral wall, and the nerve can even be engulfed within the air cell as well.

- **Pneumatized crista galli:** Seen in 13% of individuals. The pneumatization extends from the frontal sinuses. Rarely can obstruct the frontal ostium .

BLOOD SUPPLY, INNERVATION, AND LYMPHATIC DRAINAGE

Anterior and posterior ethmoid sinuses receive blood supply by branches from the supraorbital, anterior, and posterior ethmoidal and sphenopalatine arteries. The venous drainage is via the accompanying veins to the superior ophthalmic vein or pterygopalatine plexus.

The innervation is by anterior and posterior ethmoidal nerves of the ophthalmic division (V1) and the posterior nasal branch of the maxillary division (V2) of the trigeminal nerve.

The lymphatic drainage of the anterior ethmoid sinus is to the submandibular nodes, and the posterior ethmoid sinus drains to the retropharyngeal nodes.

FRONTAL SINUS

There are two sinuses extending in the squamous part of the frontal bone. They are separated by bony septum because each sinus (right and left) develops independently; they are expected to be asymmetrically pneumatized. The larger sinus may pass across the midline and overlap the other.

Anterior and posterior walls of sinus are called as outer and inner frontal table, respectively. The inner table is a relative thin bony plate that separates frontal sinus from the anterior cranial fossa posteriorly. On the other hand, the outer table is a considerable thick bony wall [22]. On the posterior wall (inner table) of the

sinus, there are venous drainage channels called “foramina of Breschet.” These foramina have clinical significance in their role in spreading the infection from the sinus toward intracranially. Also, these foramina act as sites of mucosal invagination within the bone, so failing to completely remove the mucosa in these sites during the sinus obliteration procedure may predispose to the development of mucocele. The floor of each frontal sinus forms the anterior roof of the orbit. The floor consisted of a thin bone which can be eroded by the mucocele.

FRONTAL OSTIUM AND FRONTAL RECESS (FRONTAL SINUS DRAINAGE PATHWAY)

Frontal sinus ostium is located at its posteromedial part of the floor. The frontal sinus drainage pathway has an hour-glass shape, with the narrowest point of this pathway corresponds to “the frontal beak” which represents the frontal sinus ostium . Therefore, what lies superior to the frontal beak is frontal sinus, and what lies inferior to the beak is frontal recess[23] . The thickness of the frontal beak (frontonasal process of the maxilla) will determine the size and patency of the frontal sinus ostium. Frontal recess is like an inverted funnel with its apex formed by the frontal sinus ostium. The frontal recess is not a structure by itself, rather it is formed by walls of the surrounding structures. Boundaries of frontal recess are as follows: from the anterior and inferior side, the posterior wall of agger nasi cell; from the posterior side, the face of ethmoid bulla; lateral boundary is formed by the lamina papyracea; medial side formed by the lateral wall of olfactory fossa and the upper portion of middle turbinate; and superiorly, comes the fovea ethmoidalis.

Depending on the superior attachment of the uncinate process, the frontal sinus drainage pathway drains into the middle meatus or the ethmoid infundibulum

The relationship between frontal beak and agger nasi cell size

When agger nasi cell is small, the frontal beak becomes prominent and narrows the ostium. In contrary, the large agger nasi cell results in a small frontal beak which means wider frontal sinus ostium. However, the large agger nasi cell might compromise the frontal sinus drainage pathway at the level of frontal recess, inferiorly[24].

6.3. Anatomical variations of frontal sinus

- Frontal sinus aplasia (totally absent) is found in 5% of the population . And hypoplastic frontal sinus is found in 4%.
- **Frontoethmoidal cells (Frontal cells):** Classification of frontal cells was first described by Kuhn[25] . However, later Wormald modified the frontal cells classification[26] . (This chapter reviews the modified classification by Wormald.) They were classified into four groups as follows:
- Type 1 frontal cell: Single frontal recess cell (above agger nasi cell and below the frontal ostium) .
- Type 2 frontal cells: Two or more cells in frontal recess (above agger nasi cell and below the frontal ostium) .

- Type 3 frontal cell: Single cell above the agger nasi with extension into the frontal sinus through the frontal ostium but not exceeding 50% of the vertical height of the ipsilateral frontal sinus .
- Type 4 frontal cell: Either single cell above the agger nasi with extension into the frontal sinus through the frontal ostium, and exceeding 50% of the vertical height of the ipsilateral frontal sinus, or an isolated cell within the frontal sinus (above the frontal ostium) .
- Frontal bullar cell: Single cell extends from the suprabullar region along the posterior wall of frontal recess and extends into the frontal sinus, superiorly. This differentiates it from the suprabullar cell, which does not extend into the frontal sinus. The posterior wall of the frontal bullar cell is related to anterior cranial fossa, and its anterior wall is related to frontal sinus. Caution must be taken during opening this cell not to cause unintentional trauma to anterior skull base.
- **Frontal intersinus septal cell:** Occasionally, the intersinus septum is pneumatized forming an intersinus air cell, which might be communicating with either one of the frontal sinuses or could be completely an isolated air cell. It might compromise the frontal sinus ostium patency [27]

BLOOD SUPPLY, INNERVATION, AND LYMPHATIC DRAINAGE

- Frontal sinus receives blood supply from the supratrochlear and supraorbital arteries (branching from ophthalmic artery). Venous drainage is by the superior ophthalmic and diploic veins. Lymphatic drainage is across the face

to the submandibular nodes. Frontal sinus receives innervation from the supratrochlear and supraorbital nerves.

SPHENOID SINUS

Sphenoid sinuses occupy the body of sphenoid bone. Classically, there are two asymmetrical cavities separated by off-midline intersphenoid bony septum.

SPHENOID SINUS OSTIUM AND POSTERIOR SEPTAL ARTERY

Sphenoid sinus drains into the sphenoethmoidal recess through a single sphenoid ostium in the sinus's anterior wall, which opens medial to superior turbinate. Typically, the ostium is located in the medial portion of sphenoidal face, about 10–12 mm superior to the upper border of the choana. Also, it can be located be measuring 7 cm from anterior nasal spine at an angle of 30° with the nasal floor. The posteroinferior end (the tail) of superior turbinate can be used to locate the ostium, which typically would be just superomedial to the tail of superior turbinate [28].

Inferior to sphenoid natural ostium, the posterior septal artery (a branch of sphenopalatine artery) crosses the sphenoid face from the lateral nasal wall to the posterior end of nasal septum. Either it bifurcates into superior and inferior branches before crossing (65%) or crosses as main artery then bifurcates (35%). Even if it bifurcates before crossing, both branches pass inferior to the ostium. The average distance between the sphenoid ostium and the posterior septal artery or its superior branch is about 5 mm. Because of that, during widening the ostium, it is safer to dissect and widen the sphenoid ostium horizontally and superiorly.

Alternatively, to the electrocautery if the ostium will be widening more than 5 mm inferiorly [29]

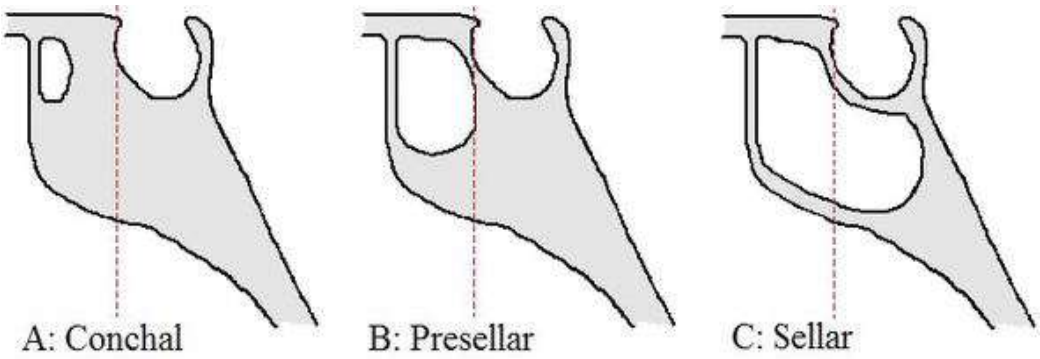
VITAL STRUCTURES SURROUNDING THE SPHENOID SINUS

Vital structures such as pituitary gland, optic nerves, cavernous sinuses and carotid arteries, maxillary divisions (V2) of the trigeminal nerves within the foramina rotundum, and vidian canals are closely related to the sphenoid body. Depending on the degree of pneumatization of the sinus, these structures could be seen as indentations on the sinus's roof and walls, internally.

Roof of the sinus is related to the pituitary gland and middle cranial fossa. Posteriorly lie the pons and the posterior cranial fossa. The optic nerve canal crosses the corner formed by the roof and the lateral wall on the posterior portion of the sinus on each side. On the posterolateral walls, internal carotid artery canals (cavernous segment) will be seen as bony prominences. Within the lateral sphenoid walls, the maxillary division of trigeminal nerves pass through the foramina rotundum toward the pterygopalatine fossae on both sides. Vidian nerves cross the lateral sides of the sinus floor within the vidian canals the "pterygoid canals"

ANATOMICAL VARIATIONS OF SPHENOID SINUS

- **Sphenoid sinus pneumatization:** Depending on the degree of pneumatization, sphenoid sinus is classified into three types[30]



- **Conchal type:** The degree of pneumatization is limited to the anterior portion of the sphenoid body and not reaching the level of the anterior wall of sella turcica. Seen in 1–4% of individuals.
- **Presellar type:** Pneumatization extends up to the vertical level of the anterior wall of sella turcica but not beyond that. Found in 35–40% of the population.
- **Sellar type:** Pneumatization extends beyond the level of the anterior wall of sella turcica below the pituitary fossa and might reach posterior to the sella turcica "occasionally called postsellar type" [31]. The sellar type is the most common one, seen.
- **Sphenoid sinus agenesis**: When non-pneumatized sinus, it is found in less than 0.7% of the population.Sphenoid sinus agenesis or the conchal type are relative contraindications for endoscopic trans-sphenoid skull base approach.

- **Optic nerve canal dehiscence**: In 4% of cases, the bony canal is having a focal dehiscence and only sinus mucosa with neural sheath are separating the nerve from the sinus. In 78% of cases, the thickness of the wall of optic canal that separates it from the sinus is less than 0.5 mm [32]
- **Internal carotid artery canal dehiscence**: When areas of the medial side of bony canal separating the sinus from the artery are defected, putting the internal carotid artery at risk during the endoscopic sphenoid surgery. It was reported in literature a rate between 8 and 25% as the incidence of this variant [33].
- The sphenoid intersinus septum occasionally deviates off the midline and has an insertion on the internal carotid artery bony canal or the optic canal. Excessive traction on the septum should be avoided, in these cases, not to cause avulsion of the bony wall .
- **Pneumatized posterior nasal septum**: Might be from an extension of air from the sphenoid sinus or crista galli. Rarely this cause narrowing of the sphenoethmoidal recess.
- **Supraoptic recess and infraoptic recess**: In hyperpneumatized sphenoid sinus, when pneumatization reaches superiorly and inferiorly to the optic canal, it will result in these two recesses, respectively. Because the infraoptic recess lies between the optic canal and internal carotid artery canal, also known as "opticocarotid recess" In addition, pneumatization can extend from the infraoptic recess to the anterior clinoid process .

- **Lateral recess**: When pneumatization extensively extends inferolaterally between the maxillary (V2) and vidian nerves, it creates this recess ().

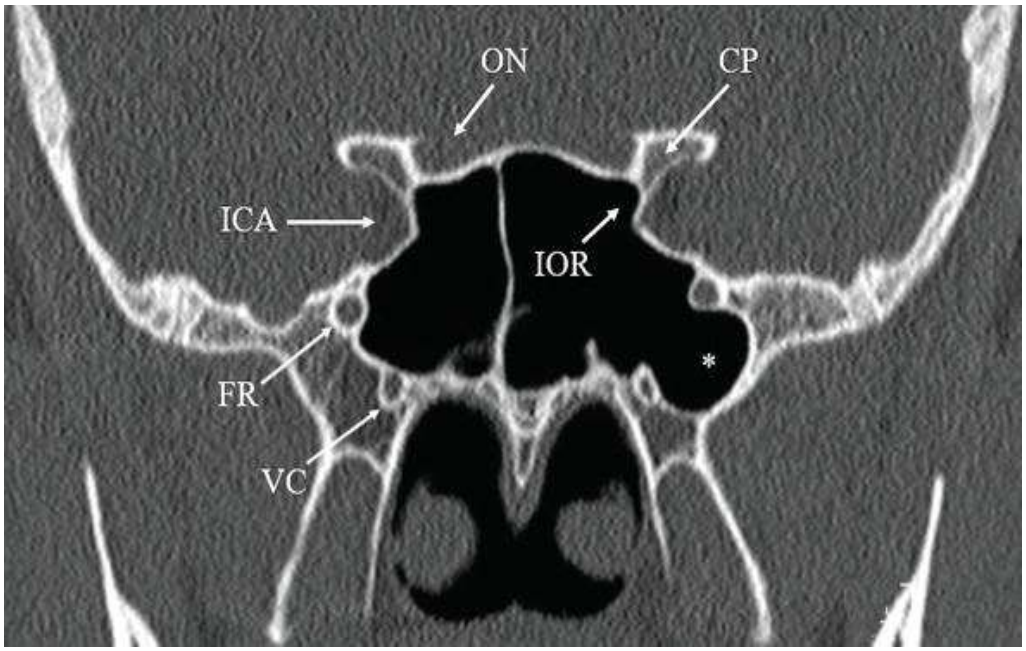


Figure showing *lateral recess

BLOOD SUPPLY, INNERVATION, AND LYMPHATIC DRAINAGE

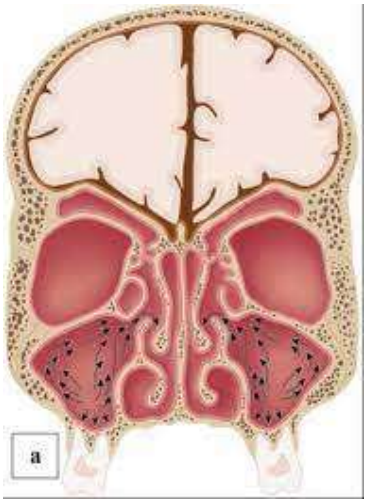
- Arterial supply is from the posterior ethmoidal artery and posterior septal artery. Veins drain via the posterior ethmoidal vein to the superior ophthalmic vein. The sinus mucosa receives innervation from the posterior ethmoidal nerve and the orbital branch of pterygopalatine ganglion. The Lymph drains to the retropharyngeal nodes.

PHYSIOLOGY OF PARANASAL SINUSES

The normal function of the paranasal sinuses and their lining mucous membranes depends primarily on two important factors: ventilation & drainage. The

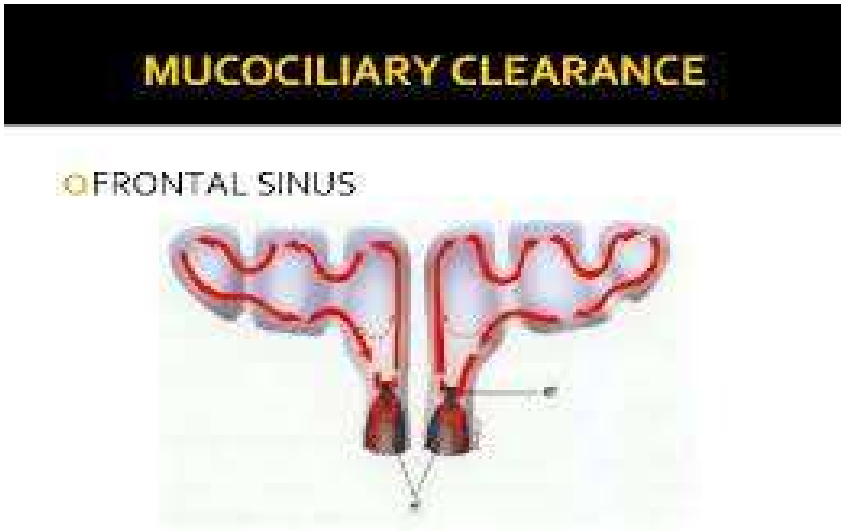
ventilation of the sinuses requires a patent sinus ostium and a patent pathway connecting the ostium to the nasal cavity (prechamber). Normal drainage of the sinuses is a complex function of both mucous secretion and the ciliary mechanisms that transport the mucus through and out of the sinus and into the nasal cavity. The secretions from the sinuses normally form a continuous sheet called mucous blanket over the nasal mucosa. The mucous blanket is made of mucus layer (gel phase) above and a serous layer (sol phase) below, floating over cilia, which are constantly beating towards the nasopharynx. This is called the mucociliary transportation mechanism. An unimpeded flow of air during inspiration through the nose is also important in the transportation of mucus, because the suction or negative pressure created promotes the transportation of mucus out of the sinuses. Messerklinger's studies revealed that the mucus produced in the sinuses follow definite pathways and even if these pathways may be impeded or blocked by various pathologic conditions, their direction is not significantly altered

MUCUS TRANSPORTATION PATHWAYS IN MAXILLARY SINUS



In the maxillary sinus, mucus transportation starts from the floor of the sinus in a stellate pattern. It is transported along the anterior, medial, posterior, lateral walls of the sinuses and along the roof to the natural ostium of the maxillary sinus. The maxillary sinus ostium opens into the floor of the posterior third of the ethmoidal infundibulum, which is bordered by the uncinate process medially and the lamina papyracea of the orbit laterally. The mucus from the maxillary sinus is transported via the infundibulum to the hiatus semilunaris. After leaving the hiatus semilunaris, the mucus is then transported over the medial face of the inferior turbinate posteriorly into the nasopharynx. Secretions from the maxillary sinus are always transported via the natural ostium, even when one or more accessory ostia are present and even in those patients in whom a patent window in the inferior meatus has been surgically created (inferior meatalantrostomy)

MUCUS TRANSPORTATION PATHWAY IN FRONTAL SINUS



The frontal sinus is the only sinus in which there is active inwardly directed transportation of mucus. Mucus is transported into the frontal sinus along the interfrontal septum and then laterally along its roof. From the roof mucus comes medially via the floor and the inferior portions of the posterior and anterior walls of the sinus. The mucus then exits the frontal sinus ostium with some amount getting recycled in the sinus several times. Once the mucus has passed out of the frontal sinus ostium, it is transported through a narrow cleft, the frontal recess. This recess drains either directly into the ethmoidal infundibulum from above or medially to the ethmoidal infundibulum when the infundibulum ends with a superior blind pouch. The frontal recess, depending on anatomical variations, may also collect secretions from other ethmoidal compartments, including secretions from the lateral sinus, from the aggernasi, from a pneumatised middle turbinate and from the most anterior ethmoidal cells. Eventually the secretions from the frontal sinus merge with the secretions from the maxillary sinus and together they are transported back into the nasopharynx

MUCOUS TRANSPORTATION PATHWAYS FROM ANTERIOR , POSTERIOR ETHMOID AND SPHENOIDALSINUSES

In ethmoidal air cells with the ostium located in its floor, the mucus is usually transported directly towards the ostium. If, however, the ostium is located higher in one of the walls, there is usually a spiral transportation pattern directed towards the ostium. The border between the anterior & posterior ethmoidal sinuses is the ground lamella of the middle turbinate. All cells opening anteroinferiorly to the

ground lamella are anterior ethmoidal cells and they drain into the middle meatus. All air cells that open posterosuperiorly to the ground lamella are posterior ethmoid cells and they drain via the superior meatus into the sphenoethmoidal recess. When there is a supreme, or fourth, turbinate with cells in the supreme meatus, these cells also drain into the sphenoethmoidal recess. In the sphenoidal sinus, depending on the location of the ostium, there usually is spiral transportation of mucus toward the ostium, passing subsequently into the spenoethmoidal recess

SPREAD OF INFECTION INTO FRONTAL AND MAXILLARY SINUSES

In the frontal sinus, mucus is actively transported into the sinus along the inter frontal septum on both sides. Apart from being inhaled into the sinuses, pathogens are deposited by the airflow at the entrance to the middle meatus, where they adhere to the mucous blanket. Because of the confluence of the secretion pathways from the entrance to the middle meatus with the pathways of the infundibulum and the frontal recess, these pathogens may be transported into the frontal sinus, where conditions are ideal for growth. If the self-healing capacity of the sinus mucosa or medical treatment is insufficient to clear the sinus, acute or chronic recurring frontal sinusitis will develop. The mucus in the maxillary sinus is transported upward along the natural pathways inside the sinus toward the maxillary sinus ostium, from which it exits the sinus. In some cases these thick secretions can re-enter the maxillary sinus through an accessory ostium and the mucus may continue to circulate. When the natural ostium is patent, this is not of much significance, but if the natural maxillary ostium is blocked by disease or when nasal infection is present, this

inwardly directed route of transportation through an accessory ostium is one way by which pathogens may be transported into the maxillary sinus from the nose. As the natural ostium is blocked, these infected secretions cannot leave the sinus and maxillary sinusitis may result. In many cases, when the patient attempts to blow the nose harder, infected secretions may be forced back into the maxillary sinus from the ethmoidal prechambers. Most of the inflammatory diseases of the frontal & maxillary sinuses are rhinogenic, caused by infection within the nasal cavity and the anterior ethmoidal sinus.

CHRONIC RHINOSINUSITIS

Chronic rhinosinusitis (CRS) is defined as persistent symptomatic inflammation of the nasal and sinus mucosa. Although insights into the pathophysiology of CRS have largely expanded over the last 2 decades. Rhinosinusitis is traditionally classified by duration as acute (<4 wk), subacute (4–12 wk), or chronic (>12 wk), with or without exacerbations) (2). Briefly, the diagnosis of CRS requires that inflammation be documented on physical examination, in addition to persistent symptoms that usually include at least two of the following: nasal obstruction (81–95%), facial congestion/pressure/fullness (70–85%), discolored nasal discharge (51–83%), and hyposmia (61–69%)[34 35]

. Nasal endoscopy is an office procedure used to augment the physical examination to evaluate better the nasal cavity and paranasal sinuses. Endoscopy is used to assess sinonasal mucosal inflammation, polyps, or purulence, and can confirm the diagnosis of CRS when symptoms are nonspecific. CRS often coexists

with other medical conditions, such as allergic rhinitis, asthma, and cystic fibrosis, and with less common conditions, such as sarcoidosis, Churg-Strauss, and Wegener granulomatosis [34].

SYSTEMIC HOST FACTORS	LOCAL HOST FACTORS	ENVIRONMENTAL FACTORS
Allergy Immunodeficiency Genetic/Congenital Mucociliary dysfunction	Anatomic Concha bullosa Enlarged ethmoidal bulla Everted uncinate process Paradoxical middle turbinate Agger nasi cells Haller cells Deviated nasal septum	Microorganisms (bacteria,fungal,viruses) Toxic chemical

CLINICAL FEATURES OF CRS

The criteria for Diagnosis of CRS is the presence of any two of the major factors or any one major factor with any two minor factors. The signs and symptoms must persist for at least 12 consecutive weeks to qualify for CRS.

MAJOR CRITERIA	MINOR CRITERIA
Facial pressure/pain	Headache
Nasal obstruction	Halitosis
Purulent nasal discharge	Dental pain
Post nasal drip	Cough

Anosmia Fever (acute)	Earache Ear fullness Fever(non-acute)

CLINICAL EXAMINATION

External findings: swelling and erythema of the maxillary, ocular and frontal areas.

Anterior rhinoscopy: hyperemia, edema, crusts, purulent discharge, polyps, and changes in appearance after topical decongestion.

INVESTIGATIONS

Routine Blood investigations including CBC with differential count, other metabolic panel including blood glucose, renal and liver function test. In case of cystic fibrosis genetic and sweat chloride testing can be done.

Histopathological analysis of mucosal tissues as well as mucus and debris can be done. Eosinophilic mucin and fungal balls can be readily identified in this.Special stains such as gomorri methanamine silver,calcoflor white can be used in this.Nasal function studies such as olfactory testing,saccharin test can be done.

Diagnostic nasal endoscopy is an important modality of investigation which gives a clear picture about the disease and the condition of mucosa.It can also diagnose polypi ,deviated nasal septum,osteomeatal unit status, uncinate, bulla, turbinates and meati.

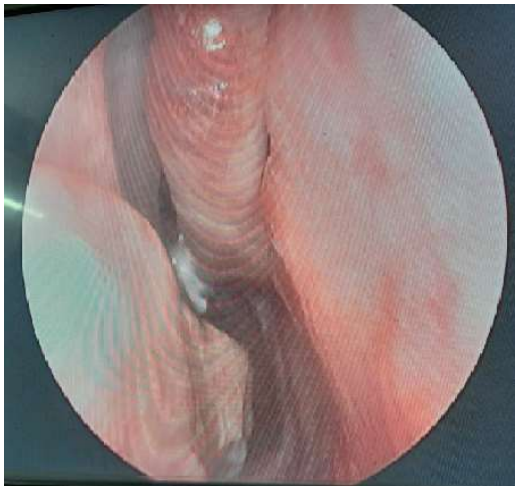
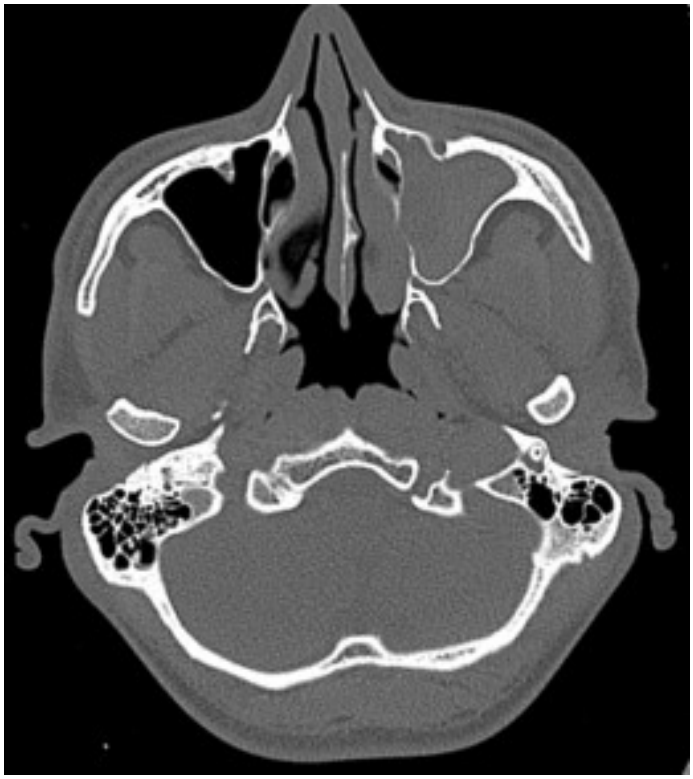


Figure showing DNE image of nasal cavity with discharge in middle meatus with discharge

Computed tomography scan of PNS

CT scan is considered as the gold standard for imaging paranasal sinus and have replaced conventional radiographs.CT scan provide excellent bone detail and when using proper windowing,sensitive in detecting small amounts of mucosal swelling.It also provides anatomical information for operative planning and can be integrated in surgery as part of image guidance. The coronal plane is the best cut in

CT that helps in the approach for surgery depicting both osteomeatal units and the relation of brain with that of the ethmoids and fovea ethmoidalis. The following parameters are used while performing this evaluation: Patient position: Prone with chin hyperextended. Gantry angulation: Perpendicular to bony palate. Extent of examination: From anterior wall of frontal sinus through posterior wall of sphenoid sinus. Slice thickness: 3 mm. Table incrementation: 3 mm Field of view: Adjusted to include only the nasal cavity and PNS. Windowing: For soft tissue and air passages-start with window width of +2000 and a center of –200. Potentiometers are adjusted for best display of uncinate process and bulla ethmoidalis, and the images are recorded at this setting for the entire examination. For bone structures window width of +1500 and a center of +300 is used.



MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) can be a useful adjunct to CT scans, but it is more expensive and time consuming. Soft tissue tumors and impending or actual orbital\intracranial complications of rhinosinusitis are indications for MRI. MRI excels at delineating soft tissues but does not depict fine bone architecture. MRI permits the assessment of various fluid compositions and often allows scar tissue to be more readily distinguished from ther forms of soft tissue disease and recurrent tumors. T1-weighted (T1W) images tend to brighten tissues with fat density and T2-weighted (T2W) brighten those with characteristics of water. Depending on the degree of desiccation of sinus debris, the T1W and T2W signals may be hyperintense or hypointense.

TREATMENT OF CHRONIC RHINOSINUSITIS

Antimicrobials: The aims of antibacterial therapy are to shorten the duration of symptoms, eradicate the causative pathogen, reduce the danger of transmitting the infection to others, and prevent the development of permanent mucosal damage, the progression of disease, or serious complications. Antibiotic therapy is recommended if a patient's symptoms worsen or persist for more than 7 to 10 days and fail conservative therapy such as analgesics, antipyretics, decongestants, and nasal saline irrigation. If no improvement is observed within 3 days of instituting antibiotic therapy, a nonbacterial cause or infection with drug resistant bacteria should be considered.Beta lactams,macrolides,sulphonamides,imipenems can be used.

Mucolytics: Reduce viscosity of thick, tenacious secretions to encourage drainage from sinuses. Guaifenesin 2400 mg by mouth every day for 3 weeks.

Topical intranasal steroid: Reduce edema, congestion, and discharge; encourage drainage of secretions along natural pathways; enhance nasal airflow. 1 to 2 puffs each nostril, once or twice daily, for at least 4 uninterrupted week

Systemic steroid :Reduce proinflammatory cytokines in the sinonasal mucosa of patients with chronic rhinosinusitis; reduce edema and congestion Prednisolone 0.5

mg/kg by mouth every day, tapered over 10 days

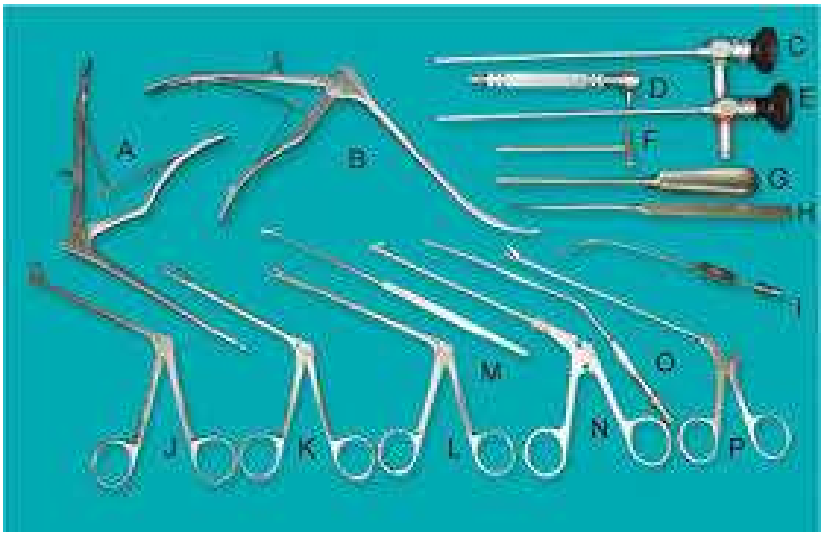
Saline irrigation :Reduce inflammation and thin secretions; pH restoration; humidification Normal/isotonic saline 60 mL each nostril BID

Leukotriene Inhibitors: Cysteinyl-leukotrienes are potent endogenous mediators of inflammation. They have a significant role in contributing to airway inflammation due to their effects of stimulating mucosal edema, mucus hypersecretion, neutrophilendothelial interactions, ingress of eosinophils, and dendritic cell maturation—a prerequisite for future allergic response. Leukotriene inhibitors block type-1 cysteinyl-leukotriene receptors in the smooth muscle and endothelium of respiratory mucosa and in those found on immunocytes. Consequently, leukotriene-receptor antagonists may offer a useful adjunct in the management of rhinosinusitis with a strong allergic pathoetiology. Their efficacy in reducing the symptoms of allergic rhinosinusitis appears to lie somewhere between systemic antihistamines and topical INS.

SURGICAL MANAGEMENT

FUNCTIONAL ENDOSCOPIC SINUS SURGERY

The choice of anesthesia in FESS usually depends on the surgeon. Local anesthesia is safer and associated with less bleeding. Hypotensive general anesthesia has an advantage of controlled ventilation, reduced bleeding and pain. The following are the sites of infiltration of the local anesthetic agent (2% lignocaine with adrenaline 1: 80,000) uncinate process, bulla ethmoidalis, and root, head and posterior end of the middle turbinate. It is important to wait for 10 min after infiltration before surgery is commenced . Instruments for FESS



1. Tilley's Nasal dressing forceps

2. Ball probe

3. Blakesley - straight and 45 degree upturned

4. Stamburgers antrum punch forceps -backward cutting-right and left, upward and downward

5. Power driven microdebrider with blade- used in polypectomy or in turbinoplasty

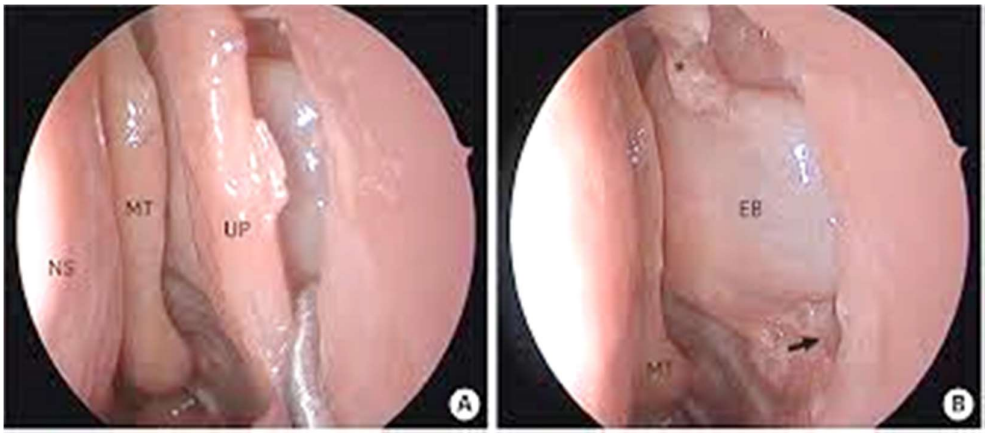
6. Hazeks punch forceps

7. Straight and curved suction tips

Surgical Techniques

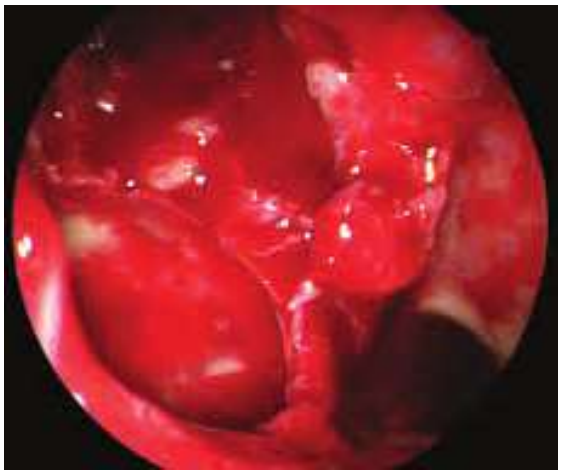
The basic steps of the anterior to posterior technique as formulated by Messerklingler include the following:

Uncinectomy/Infundibulotomy (Fig 15)



The middle turbinate is medialised using a Freer's elevator, the uncinate process is identified and its free margin is palpated with a ball probe. Incision is made in the groove between the uncinate process and the lacrimal crest, starting superiorly at the level of the insertion of the middle turbinate to just above the inferior turbinate. Using Blakesley forceps the uncinate process is grasped and removed with a twisting motion.

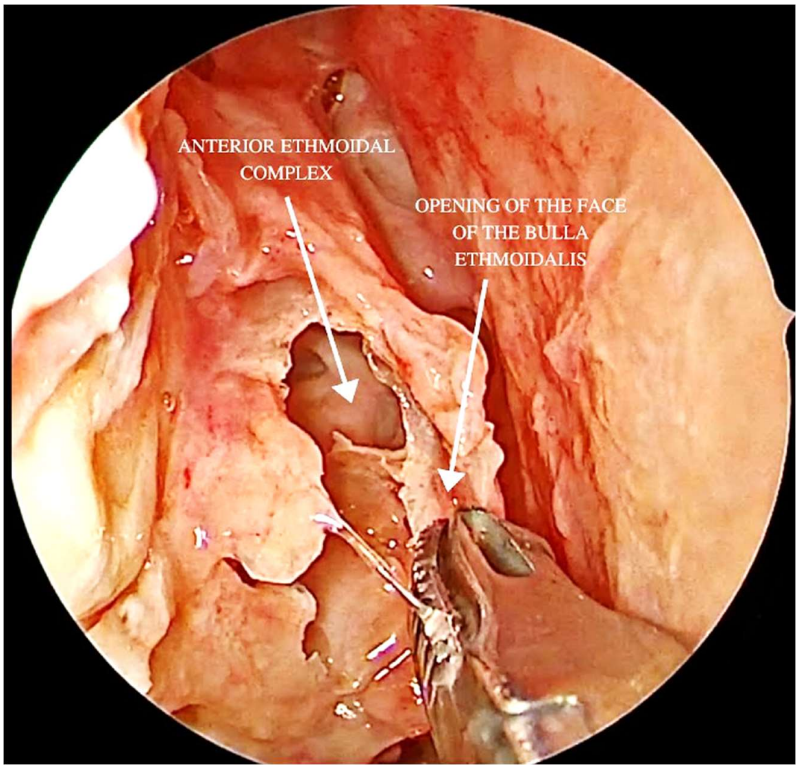
Middle Meatal Antrostomy



Once uncinectomy is done the maxillary sinus ostium can be approached. It is found in the junction of the anterior and inferior walls of the bulla ethmoidalis. If the ostium is incompletely seen, then it is widened with a curette. Posterior fontanelle is noted for any accessory ostium. If present, the natural and the accessory ostia are connected using a backbiting forceps. Otherwise,natural ostium is cut with scissors and joined with the accessory ostia.

Anterior Ethmoidectomy

The anterior face of the ethmoidal bulla is entered with tip of a straight forceps. The inferior and medial wall is removed completely while maintaining the posterior wall intact, the lamina papyracea forms the lateral boundary and skull base the superior boundary of dissection. The posterior wall is most of the time fused with the ground lamella.



Posterior ethmoidectomy

These are entered through the infero-medial part of the ground lamella. The septations in them are removed carefully. The boundaries of dissection are posteriorly the anterior sphenoid wall, lamina papyracea lies laterally, the skull base lies superiorly and the superior turbinate medially.

Sphenoidotomy

After posterior ethmoidectomy, the sphenoid sinus is entered postero-infero-medially of the posterior ethmoidal cells using a suction tip/forceps. The anterior wall of the sphenoid sinus can be ossified in some making it difficult to enter. Upto in 5% of the sphenoid sinuses may not be pneumatized. After entering the sphenoid

sinus the bony anterior wall is gently removed with the Kerrison's punch upto the level of skull base and medial orbital wall. The intersinus septum is later released and the sinus examined.

Frontal Recess Surgery

The frontal sinus opening can be visualized by dissecting upwards between the middle concha medially and the residual uncinate as the lateral limit. Agger nasi cells have to be completely removed. After identifying the frontal opening the, cells around the frontal recess are removed completely. The mucous membrane is preserved as much as possible, otherwise stenosis may occur.

Post Operative Management

After the first 24 hrs the nasal pack is removed and the patient may be discharged in a day or two. Subsequently the patient is followed up at regular intervals, every week for the first one month, every month for the next two months, and at the end of sixth months.

MATERIALS AND METHODS

The study will be conducted in the out-patients and in-patients in the department of Otorhinolaryngology, Thanjavur Medical College Hospital, Thanjavur. The study subjects will be from the patients with chronic sinusitis attending the ENT OPD at Thanjavur Medical College Hospital, Thanjavur during the 19 months period (JANUARY 2020 TO AUGUST 2021).

INCLUSION CRITERIA:-

1. Patients above 18 years of age
2. All cases of CRS, including allergic and infective, with symptoms for at least 12 weeks
3. Patients not responding to 3 weeks of medical therapy like antibiotics, decongestants,antihistaminics and steroid nasal spray

EXCLUSION CRITERIA:-

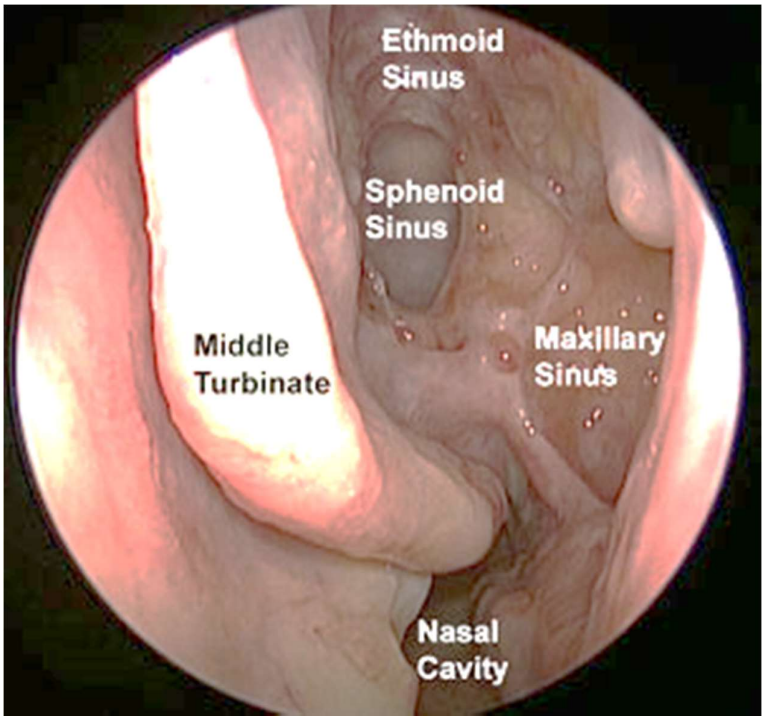
1. Patients with any nasal mass;previous sinus surgery
2. Patients with chronic sinusitis who responded to medical treatment
3. Patients with clinical evidence of sinusitis of dental origin,traumatic origin and fungal sinusitis
4. Patients with chronic disease such as cystic fibrosis,primary ciliary dyskinesia, immune deficiencies and suspected malignancy

Patients with symptoms of chronic rhinosinusitis will be randomly selected from our outpatients attending E.N.T OPD. The patients will be treated with oral antibiotics ,oral as well as topical steroids, nasal decongestants and followed up for a period of 3weeks. Patients having either two major, or one major and two minor criteria/sinus symptoms were considered. Based on the scoring of Sino - Nasal Outcome Test (SNOT-22) scoring the following scoring were considered for individual symptoms of the patient. Ten Chronic rhinosinusitis specific/related symptoms and two non specific or dependant symptoms were considered. Each symptom given the scoring as follows no problem(0), very mild problem(1), mild problem(2), moderate problem(3), severe problem (4) and problem as bad as it can be (5). In form of questionairre scoring was done preoperatively. Thus the scoring ranged from minimum of 0 to maximum of 60

Then the patients will be subjected to DIAGNOSTIC NASAL ENDOSCOPY and COMPUTED TOMOGRAPHY OF PARANASAL SINUSES. . If they had a frequent relapse of symptoms, functional endoscopic sinus surgery will be done and will be followed up post operatively every weeks for a period of 1 month,then monthly upto 3rd month and final at 6th month . The patients will be assessed every weeks by DIAGNOSTIC NASAL ENDOSCOPY .

Data will be entered in MS Excel and analysis will be done using SPSS. Descriptive statistical tools like mean, standard deviation, frequency and percentages will be used to analysis the data For qualitative data's Fishers exact

test and chi square will be applied. For continuous variables student's T test will be applied.



Post op follow up DNE image

ANALYSIS AND RESULTS.

This prospective study on the quality of life outcomes of patients with chronic rhino sinusitis after functional endoscopic sinus surgery .

These 40 chronic rhino sinusitis patients were followed up for 6 months after surgery .

The following observations were made of the data collected from this studies.

Results are divided into two sections :

1) Descriptive statistics using frequency distribution .
2) Inferential statistics using chi square test and fisher exact test .

Descriptive statistics using frequency distribution

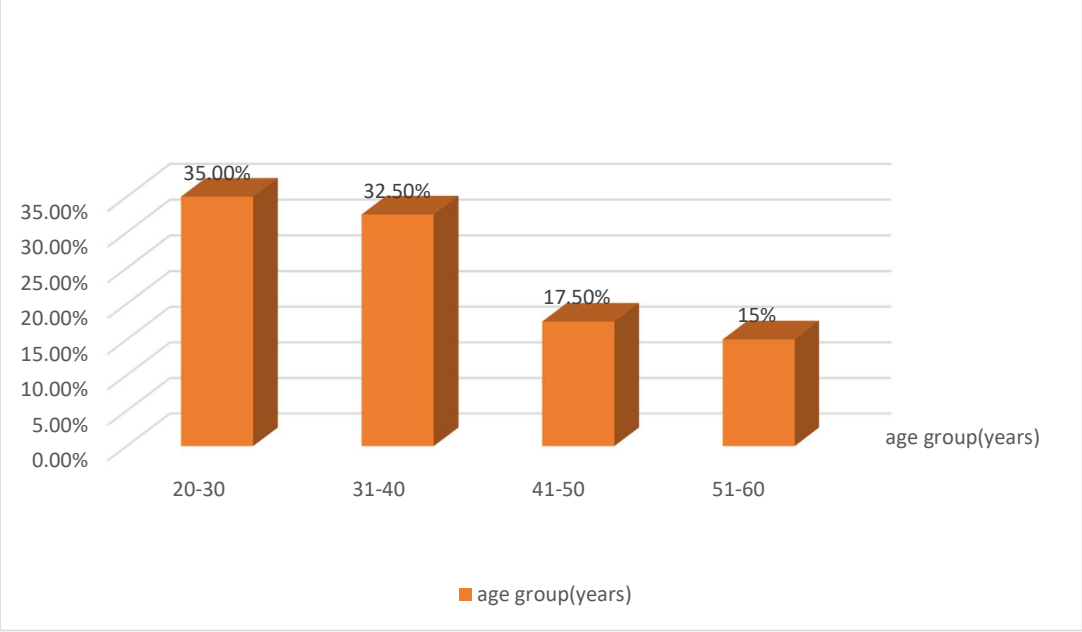
Sociodemographic profile

Table 1.Frequency distribution of sociodemographic profile

S.no	Variables	Frequency (40)	Percent (%)
1.	**Age group(years)**		
	20-30	14	35
	31-40	13	32.5
	41-50	7	17.5
	51-60	6	15
2.	**Gender**		
	Female	17	42.5
	Male	23	57.5

Among the study populations , Age ranged from 24 to 60 years with mean age 37 years of age and SD-10.82 , nearly 70% of the patients were 20 to 40 years of age group .more than 50% of the patients were male .

Chart 1. Frequency distribution of Age group



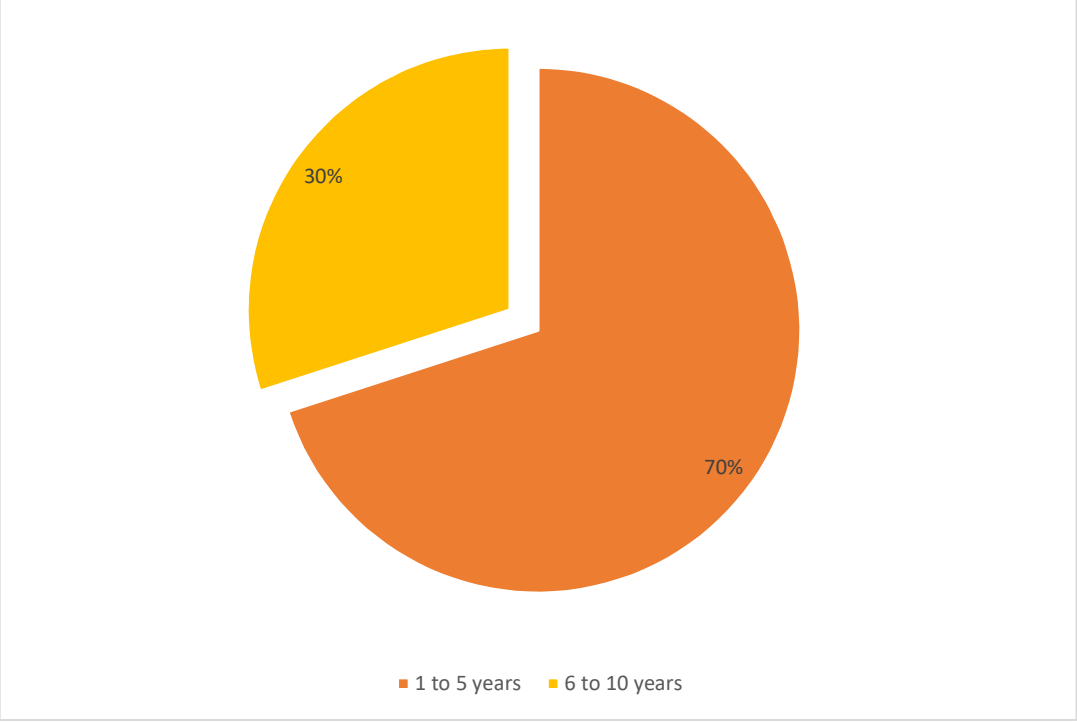
Duration of symptoms

Table 2.Frequency distribution of duration of symptoms

S.no	Variables	Frequency (40)	Percent (%)
	Duration of symptoms(years)		
1.	1 to 5	28	70
2.	6 to 10	12	30

Among the study populations , mean durations of symptoms were 4.75 years ,SD-2.28 years ,ranged from 1 to 10 years.

Chart 2. Frequency distribution of Symptoms



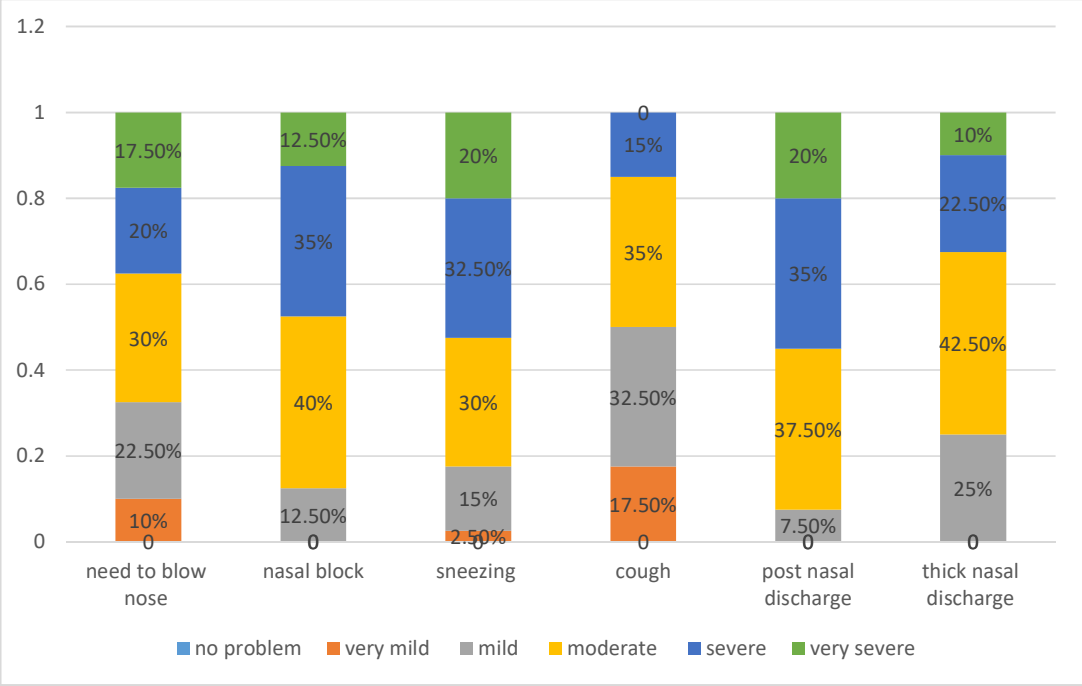
Preoperative nasal symptoms

Table 3.Frequency distribution of preoperative nasal symptoms

S.no	Variables	0-no problem	1-very mild	2-mild	3-moderate	4-severe	5-very severe	Total
1.	Need to blow nose	0	4, 10%	9, 22.5%	12, 30%	8, 20%	7, 17.5%	40, 100%
2.	Nasal block	0	0	5, 12.5%	16, 40%	14, 35%	5, 12.5%	40, 100%
3.	Sneezing	0	1, 2.5%	6, 15%	12, 30%	13, 32.5%	8, 20%	40, 100%
4.	Cough	0	7, 17.5%	13, 32.5%	14, 35%	6, 15%	0	40, 100%
5.	Post nasal Discharge	0	0	3, 7.5%	15, 37.5%	14, 35%	8, 20%	40, 100%
6.	Thick nasal discharge	0	0	10, 25%	17, 42.5%	9, 22.5%	4, 10%	40, 100%

Among the study populations , all the patients had all nasal symptoms with nearly 35 % to 40% of the patients have moderate problem .

Chart 3. Frequency distribution of preoperative nasal symptoms



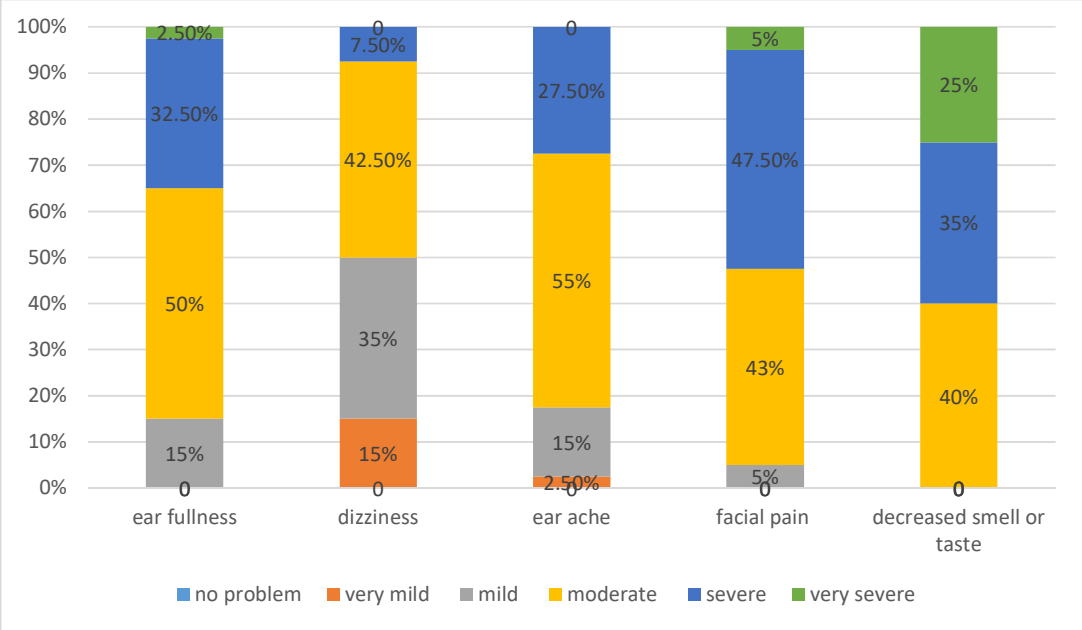
Preoperative symptom profile-extra nasal symptoms

Table 4.frequency distribution of pre operative extra nasal symptoms

S. no	Variables	0-no problem	1-very mild	2-mild	3-moderate	4-severe	5-very severe	Total
1.	Ear fullness	0	0	6, 15%	20, 50%	13, 32.5%	1, 2.5%	40, 100%
2.	Dizziness	0	6, 15%	14, 35%	17, 42.5%	3, 7.5%	0	40, 100%
3.	Ear ache	0	1, 2.5%	6, 15%	22, 55%	11, 27.5%	0	40, 100%
4.	Facial pain	0	0	2, 5%	17, 42.5%	19, 47.5%	2, 5%	40, 100%
5.	Decreased smell or taste	0	0	0	16, 40%	14, 35%	10, 25%	40, 100%

Among the study populations , all the patients had all extra nasal symptoms with nearly 50 % of the patients had moderate problem

Chart 4. Frequency distribution of preoperative extra nasal symptoms



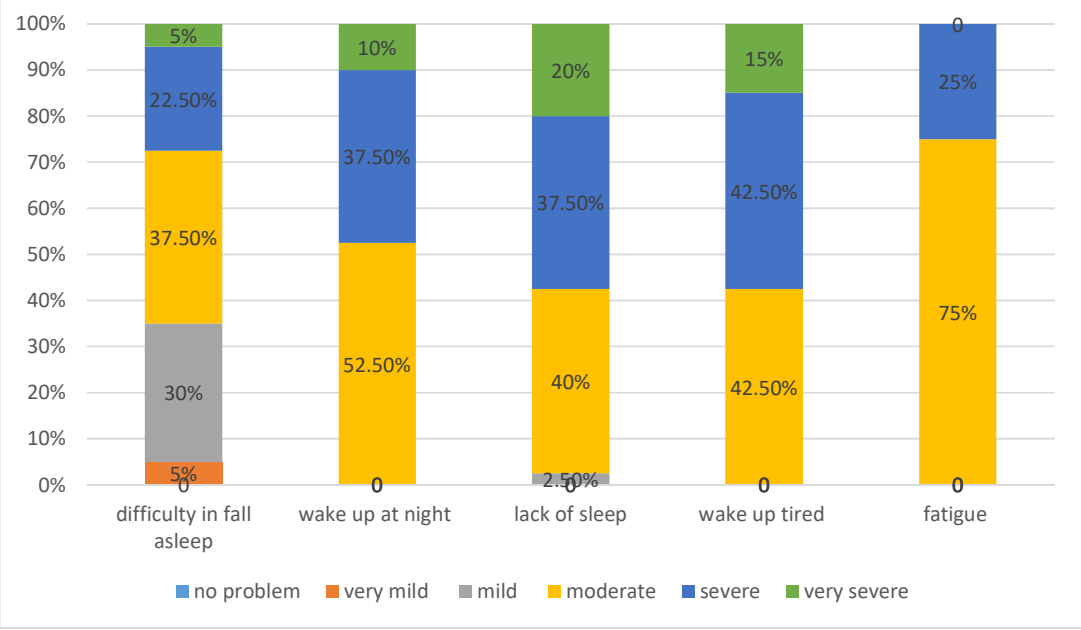
Preoperative symptom profile-sleep disturbances

Table 5.Frequency distribution of pre operative sleep disturbances

S.no	Variables	0-no problem	1-very mild	2-mild	3-moderate	4-severe	5-very severe	Total
1.	Difficulty in fall asleep	0	2, 5%	12, 30%	15, 37.5%	9, 22.5%	2, 5%	40, 100%
2.	Wake up at night	0	0	0	21, 52.5%	15, 37.5%	4, 10%	40, 100%
3.	Lack of sleep	0	0	1, 2.5%	16, 40%	15, 37.5%	8, 20%	40, 100%
4.	Wake up tired	0	0	0	17, 42.5%	17, 42.5%	6, 15%	40, 100%
5.	Fatigue	0	0	0	30, 75%	10, 25%	0	40, 100%

Among the study populations , all the patients had all type of sleep disturbance symptoms

Chart 5. Frequency distribution of preoperative sleep disturbances symptoms



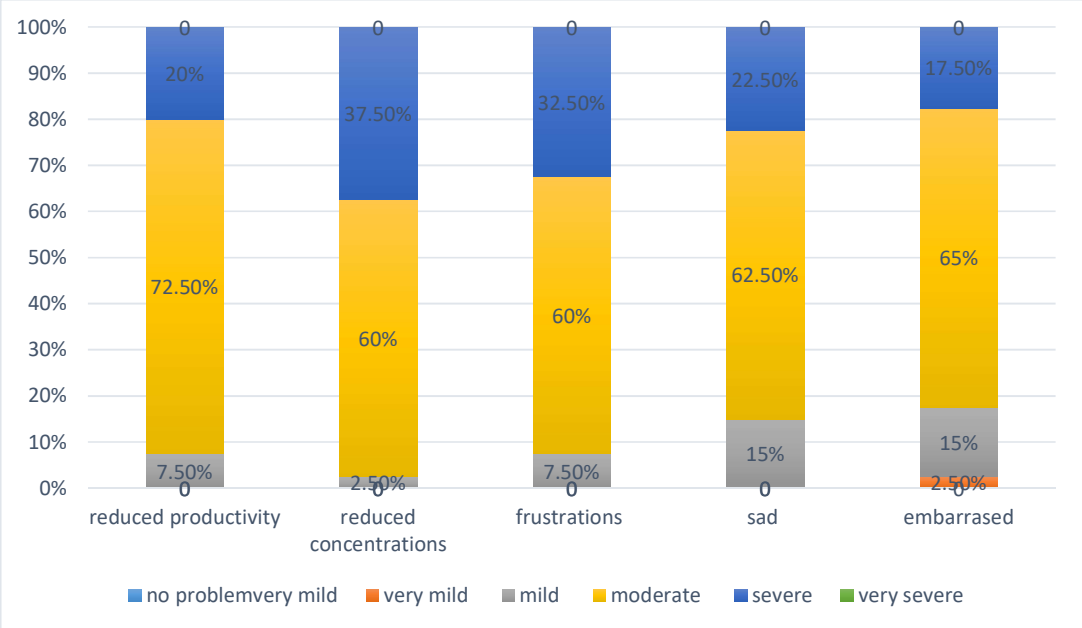
Preoperative symptom profile-psychological and performance related

Table 6.Frequency distribution of pre operative psychological and performance related symptoms

S.no	Variables	0-no problem	1-very mild	2-mild	3-moderate	4-severe	5-very severe	Total
1.	Reduced productivity	0	0	3, 7.5%	29, 72.5%	8, 20%	0	40, 100%
2.	Reduced concentrations	0	0	1, 2.5%	24, 60%	15, 37.5%	0	40, 100%
3.	Frustrations	0	0	3, 7.5%	24, 60%	13, 32.5%	0	40, 100%
4.	Sad	0	0	6, 15%	25, 62.5%	9, 22.5%	0	40, 100%
5.	Embarrassed	0	1, 2.5%	6, 15%	26, 65%	7, 17.5%	0	40, 100%

Among the study populations , more than 60 % of the patients had moderate psychological and performance related problems.

Chart 6. Frequency distribution of preoperative psychological related problems



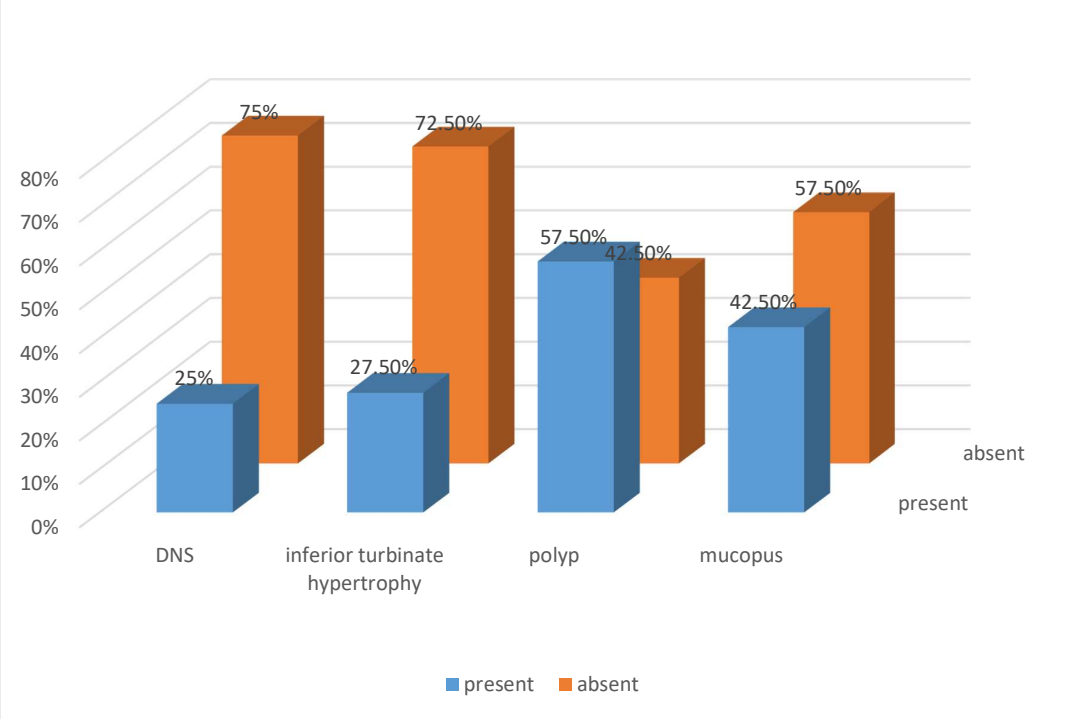
Preoperative symptom profile-anterior rhinoscopy

Table 7.Frequency distribution of pre operative anterior rhinoscopy

S.no	Variables	Present		Absent	
1.	Deviated nasal septum	10,	25%	30,	75%
2.	Inferior turbinate hypertrophy	11,	27.5%	29,	72.5%
3.	polyp	23,	57.5%	17,	42.5%
4.	Mucopus	17,	42.5%	23,	57.5%

Among the study populations , more than 50% of the patients had polyps,next to it were mucopus (42%)

Chart 7. Frequency distribution of preoperative anterior rhinoscopy findings



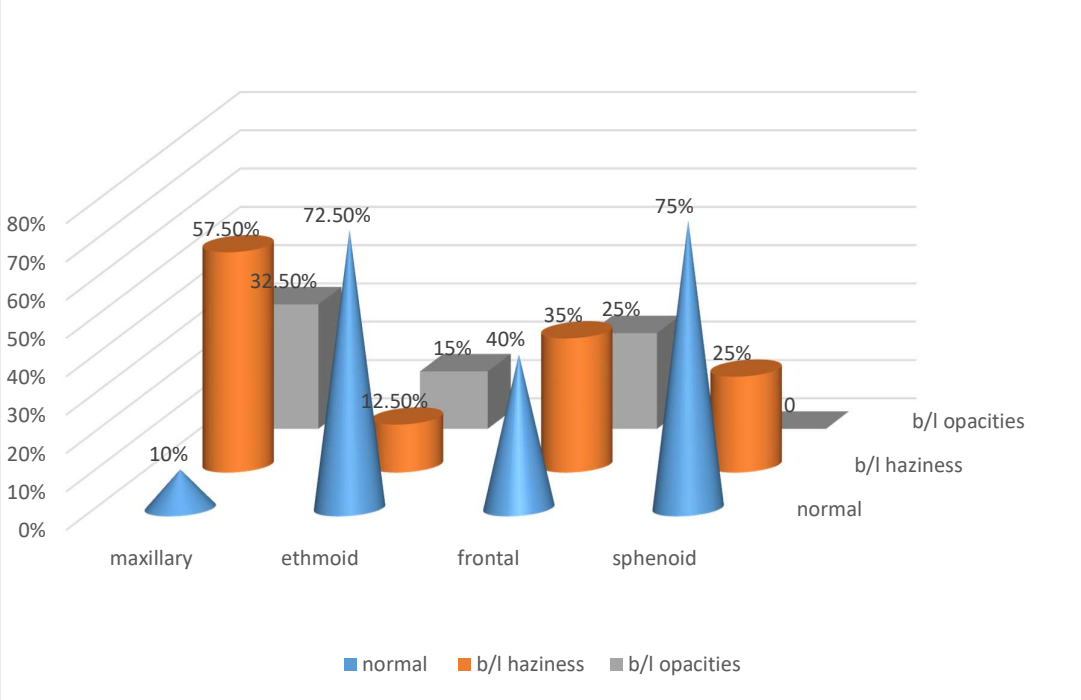
Preoperative x-ray findings

Table 8.Frequency distribution of pre operative x-ray findings

S.no	Variables	Normal	b/l haziness	b/l opacities	Total
1.	Maxillary	4, 10%	23, 57.5%	13, 32.5%	40, 100%
2.	Ethmoid	29, 72.5%	5, 12.5%	6, 15%	40, 100%
3.	Frontal	16, 40%	14, 35%	10, 25%	40, 100%
4.	Sphenoid	30, 75%	10, 25%	0	40, 100%

Among the study populations , maxillary sinuses had more than 50% of b/l haziness, frontal sinuses had 35% b/l haziness, least were ethmoid (12.5%) b/l opacities were seen in 30% of the maxillary ,25% of the frontal sinuses.

Chart 8. Frequency distribution of preoperative x-ray findings



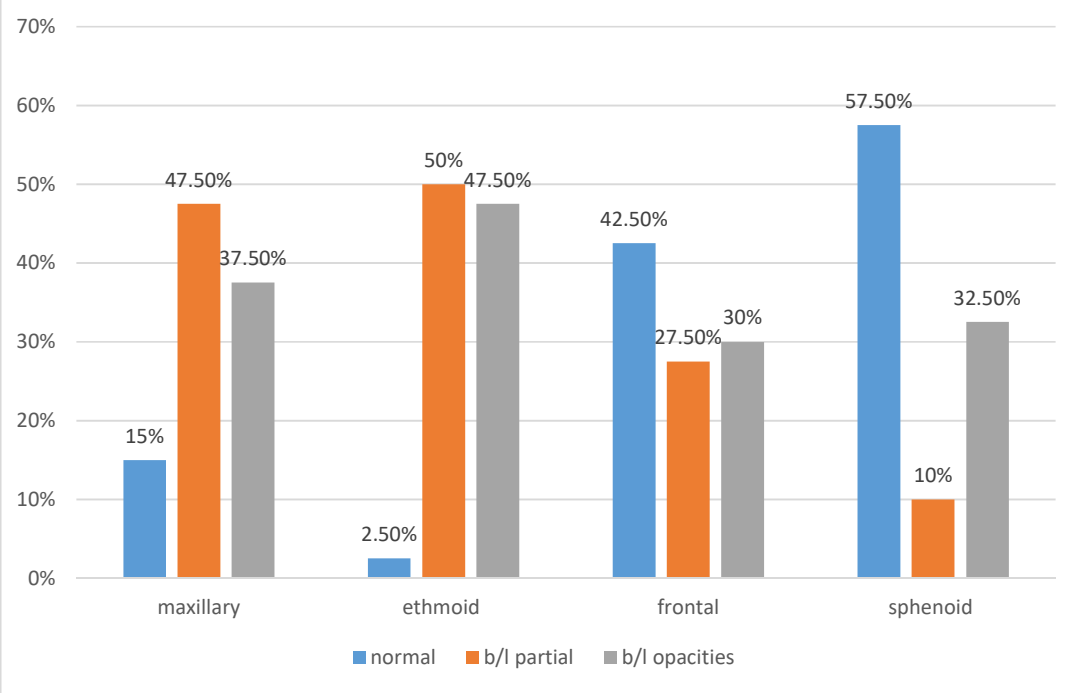
Preoperative –NCCT PNS

Table 9.Frequency distribution of pre operative NCCT PNS

S.no	Variables	Normal	b/l partial	b/l opacities	Total
1.	Maxillary	6, 15%	19, 47.5%	15, 37.5%	40, 100%
2.	Ethmoid	1, 2.5%	20 50%	19, 47.5%	40, 100%
3.	Frontal	17, 42.5%	11, 27.5%	12, 30%	40, 100%
4.	Sphenoid	23, 57.5%	4, 10%	13, 32.5%	40, 100%

Among the study populations , b/l partial opacities were seen in 50% of the ethmoid and maxillary sinuses ,b/l opacities were seen in 47% of the ethmoid sinus,more than 30% were seen in maxillary and sphenoid sinus.

Chart 9. Frequency distribution of preoperative NCCT PNS



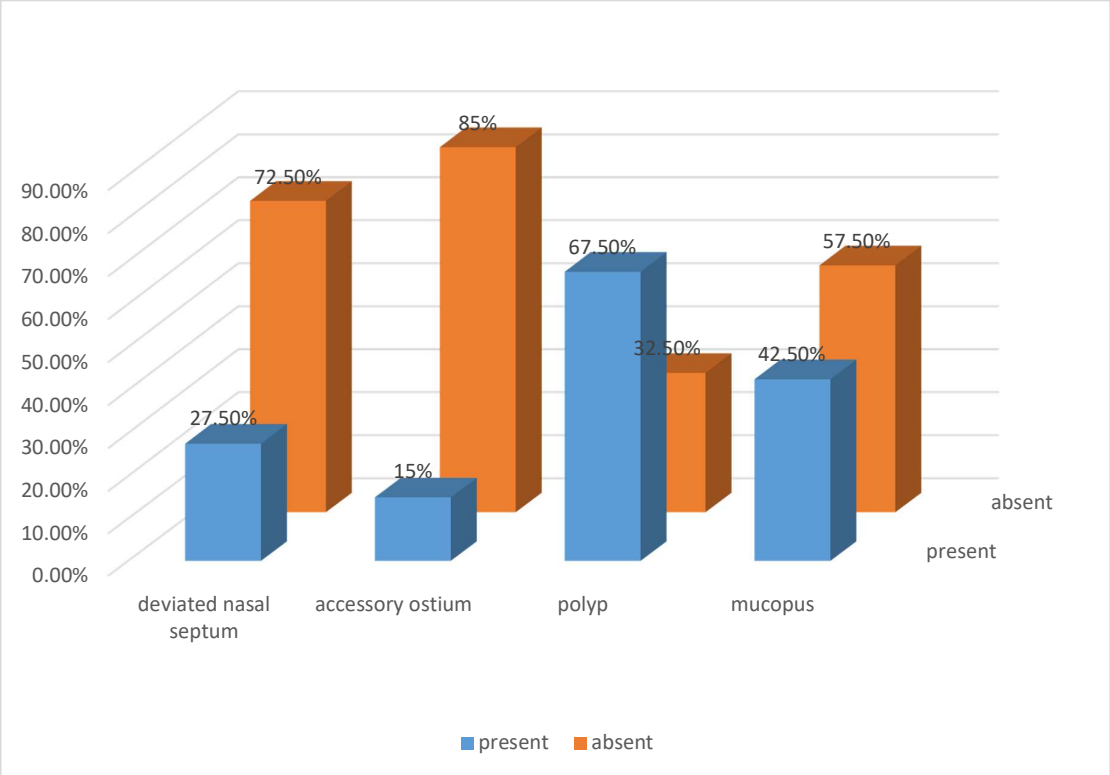
Preoperative- DNE

Table 10.Frequency distribution of pre operative DNE

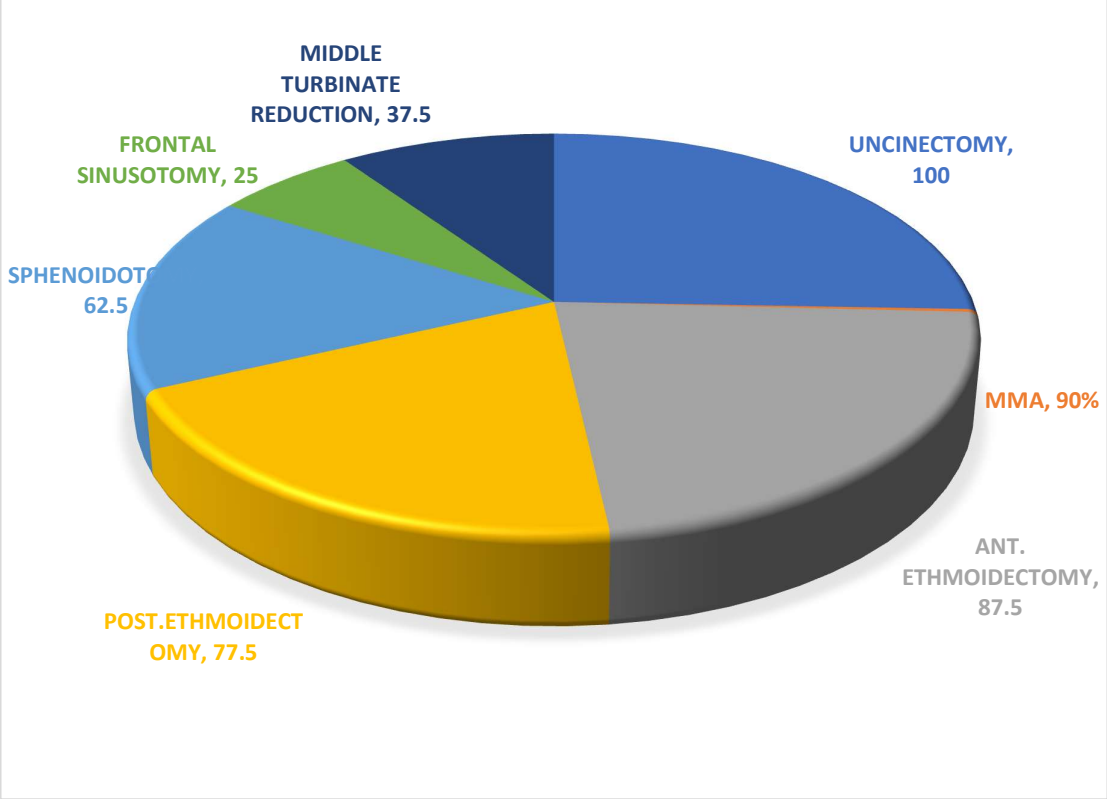
S.no	Variables	Present	Absent
1.	Deviated nasal septum	11, 27.5%	29, 72.5%
2.	Accessory ostium	6, 15%	34, 85%
3.	polyp	27 , 67.5%	13, 32.5%
4.	Mucopus	17, 42.5%	23, 57.5%

Among the study populations , 67.5% had polypoidal changes and 42.5% had mucopus, which are the major findings in preoperative DNE

Chart 10. Frequency distribution of preoperative DNE



PROCEDURES


MIDDLE TURBINATE REDUCTION, 37.5
FRONTAL SINUSOTOMY, 25
UNCINECTOMY, 100
SPHENOIDOT
62.5
MMA, 90%
ANT. ETHMOIDECTOMY, 87.5
POST.ETHMOIDECT OMY, 77.5

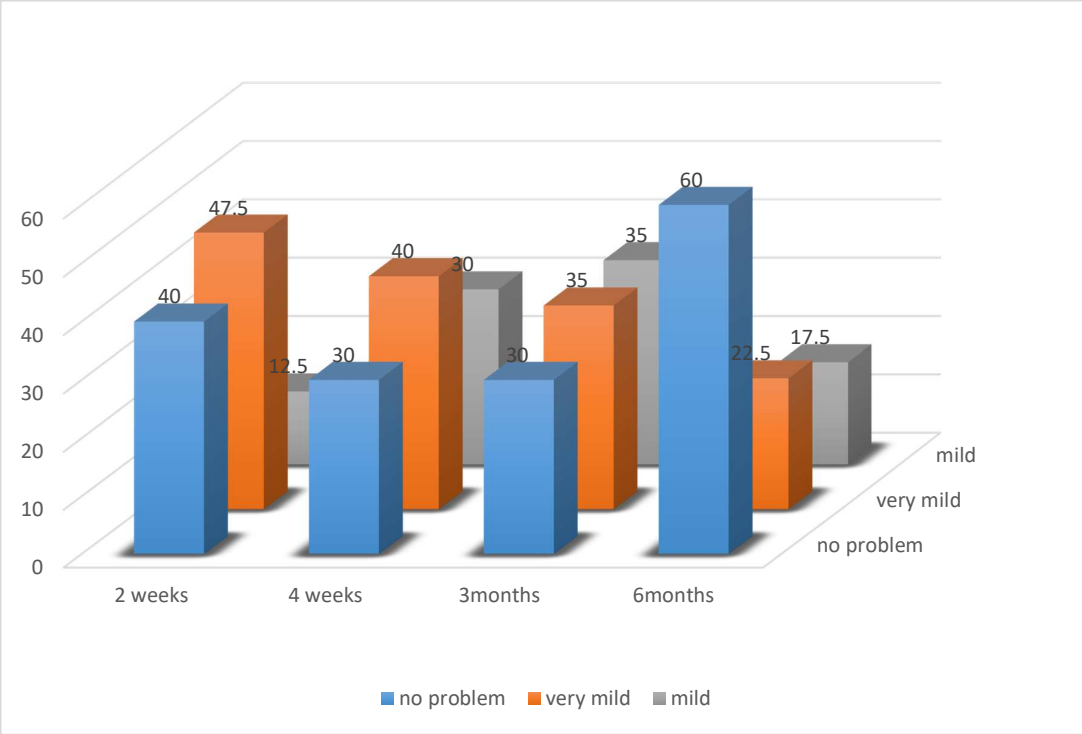
Post operative symptom profile- nasal symptoms

Table 12.Frequency distribution of post operative running nose

S.no	Running nose	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	16, 40%	12, 30%	12, 30%	21 52.5%
2.	1-very mild	19, 47.5%	16, 40%	14, 35%	9 22.5%
3.	2-mild	5, 12.5%	12, 30%	14, 35%	7 17.5%

Among the study populations , at the end of 6 months review 52.5% of the patients had no running nose symptoms post operatively.

Chart 12.frequency distribution of post operative running nose



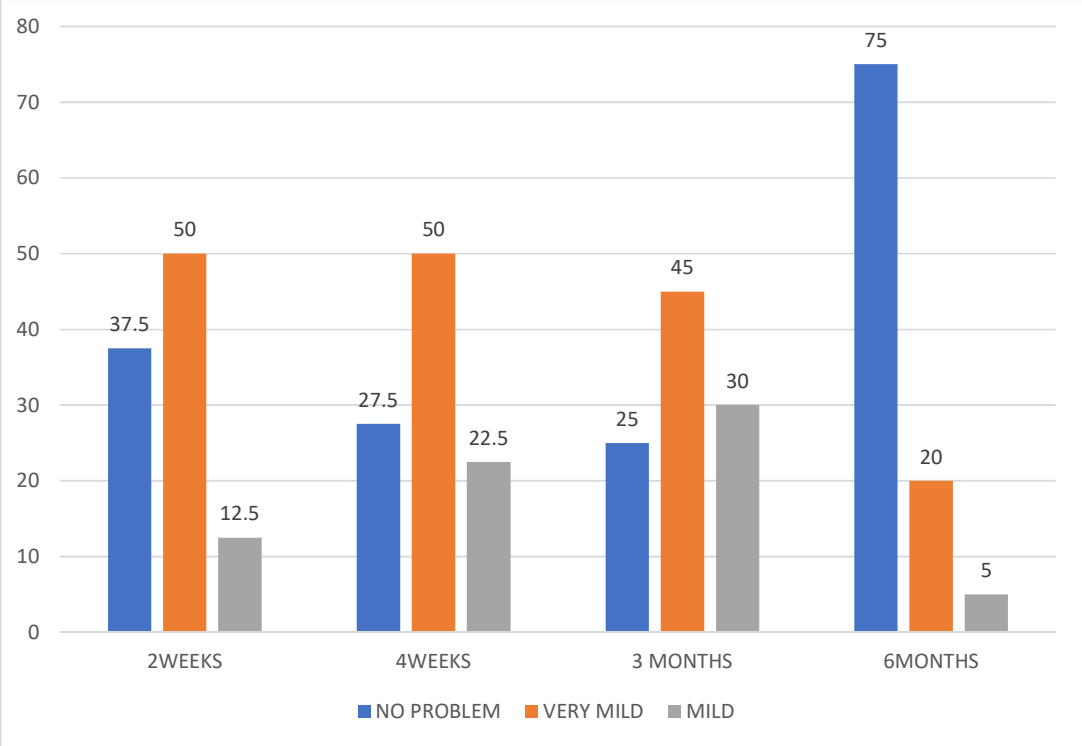
Post operative symptom profile- post nasal discharge

Table 13.Frequency distribution of post operative symptoms-postnasal discharge

S.no	Post nasal discharge	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	15, 37.5%	11, 27.5%	10, 25%	30 75%
2.	1-very mild	20, 50%	20, 50%	18, 45%	8 20%
3.	2-mild	5, 12.5%	9, 22.5%	12, 30%	2, 5%

Among the study populations , at the end of 6 months review 75% of the patients had no post nasal discharge symptoms post operatively.

Chart 13.Frequency distribution of post operative symptoms-postnasal discharge



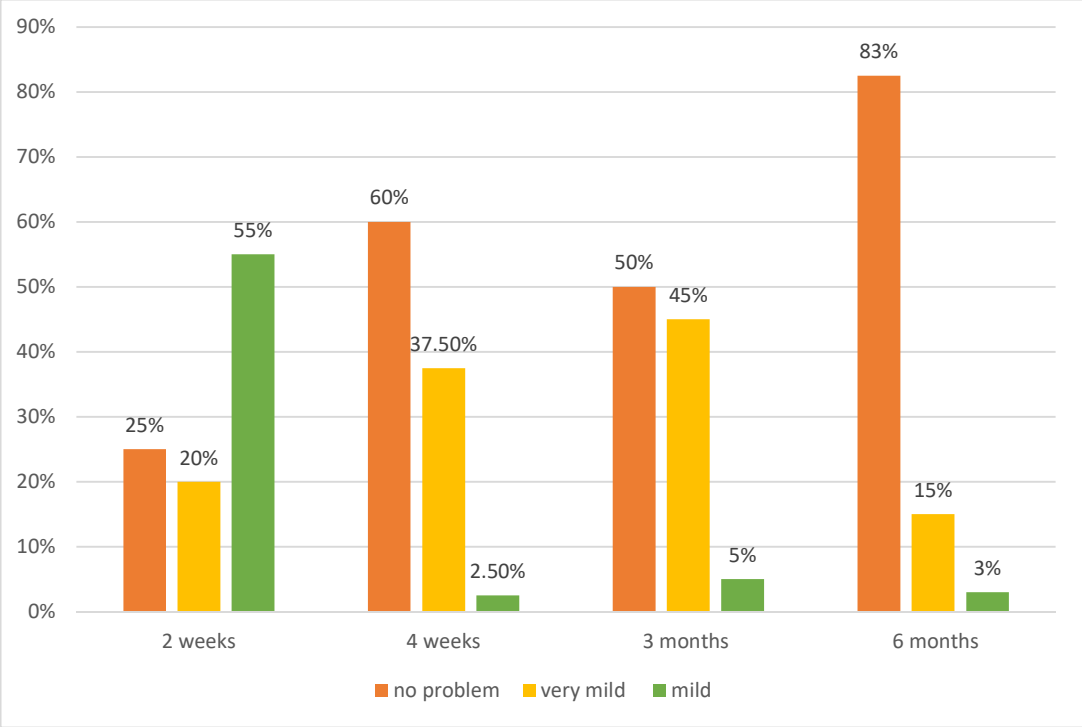
Post operative symptom profile-extra nasal symptoms

Table 14.Frequency distribution of post operative symptoms-ear fullness

S.no	Ear fullness	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	10, 25%	24, 60%	20, 50%	33, 82.5%
2.	1-very mild	8, 20%	15, 37.5%	18, 45%	6 15%
3.	2-mild	22, 55%	1, 2.5%	2, 5%	1 2.5%

Among the study populations , at the end of 6 months review 82. 50% of the patients had no ear fullness post operatively.

Chart 14.Frequency distribution of post operative symptoms-ear fullness



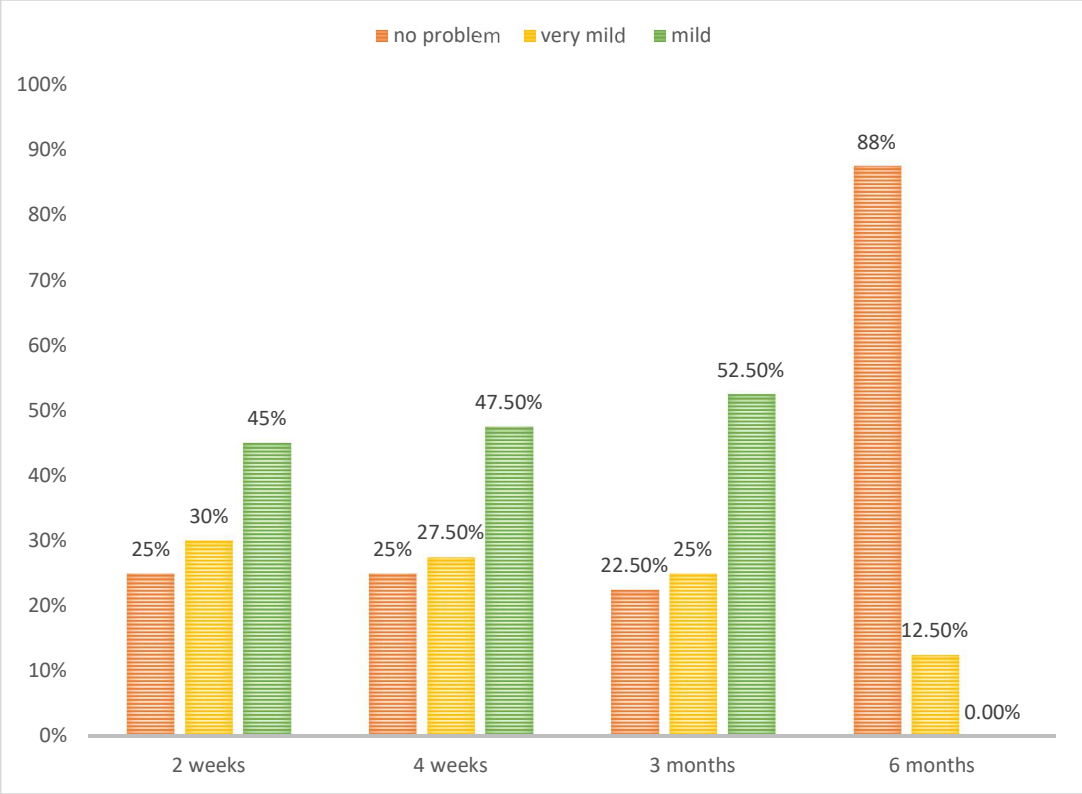
Post operative symptom profile-extra nasal symptoms

Table 15.Frequency distribution of post operative symptoms- facial pain

S.no	Facial pain	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	10, 25%	10, 25%	9, 22.5%	35, 87.5
2.	1-very mild	12, 30%	11, 27.5%	10, 25%	5, 12.5%
3.	2-mild	18, 45%	19, 47.5%	21, 52.5%	0 0

Among the study populations , at the end of 6 months review 87.50% of the patients had no facial pain post operatively.

Chart 15. Frequency distribution of post operative symptoms-facial pain



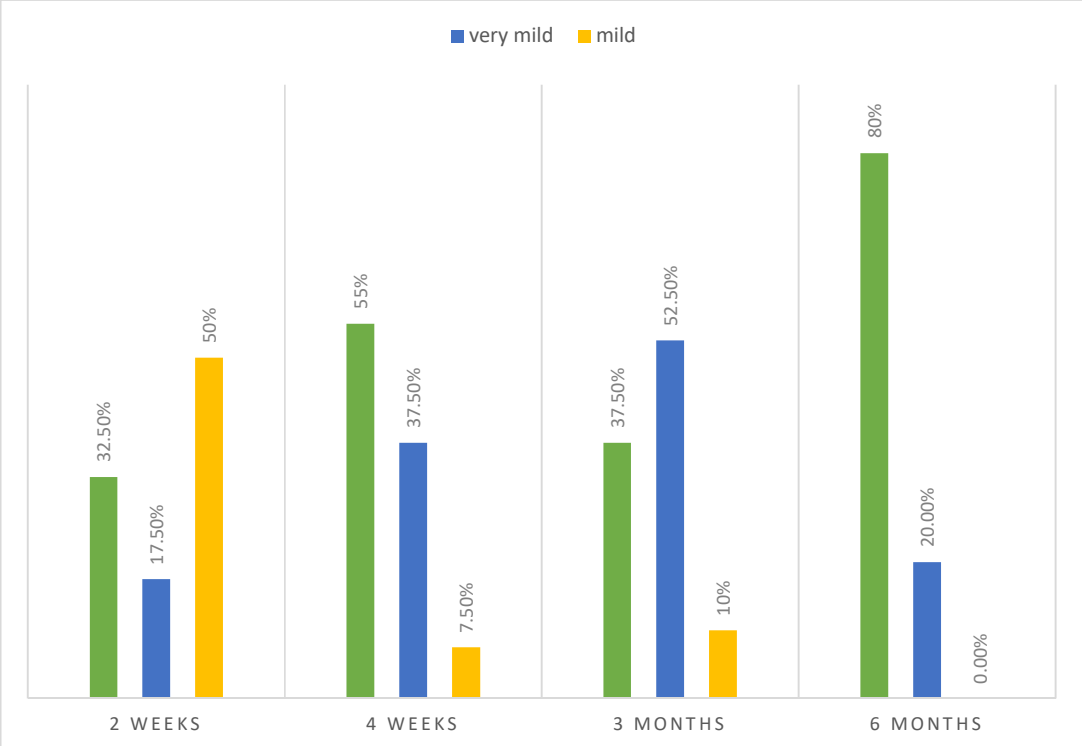
Post operative symptom profile-extra nasal symptoms

Table 16.Frequency distribution of post operative symptoms- decreased smell or taste

S.no	Decreased smell or taste	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	13, 32.5%	22, 55%	15, 37.5%	32, 80%
2.	1-very mild	7, 17.5%	15, 37.5%	21, 52.5%	8, 20%
3.	2-mild	20, 50%	3, 7.5%	4, 10%	0, 0

Among the study populations , at the end of 6 months review 70% of the patients had decreased smell or taste post operatively.

Chart 16.Frequency distribution of post operative symptoms- decreased smell or taste



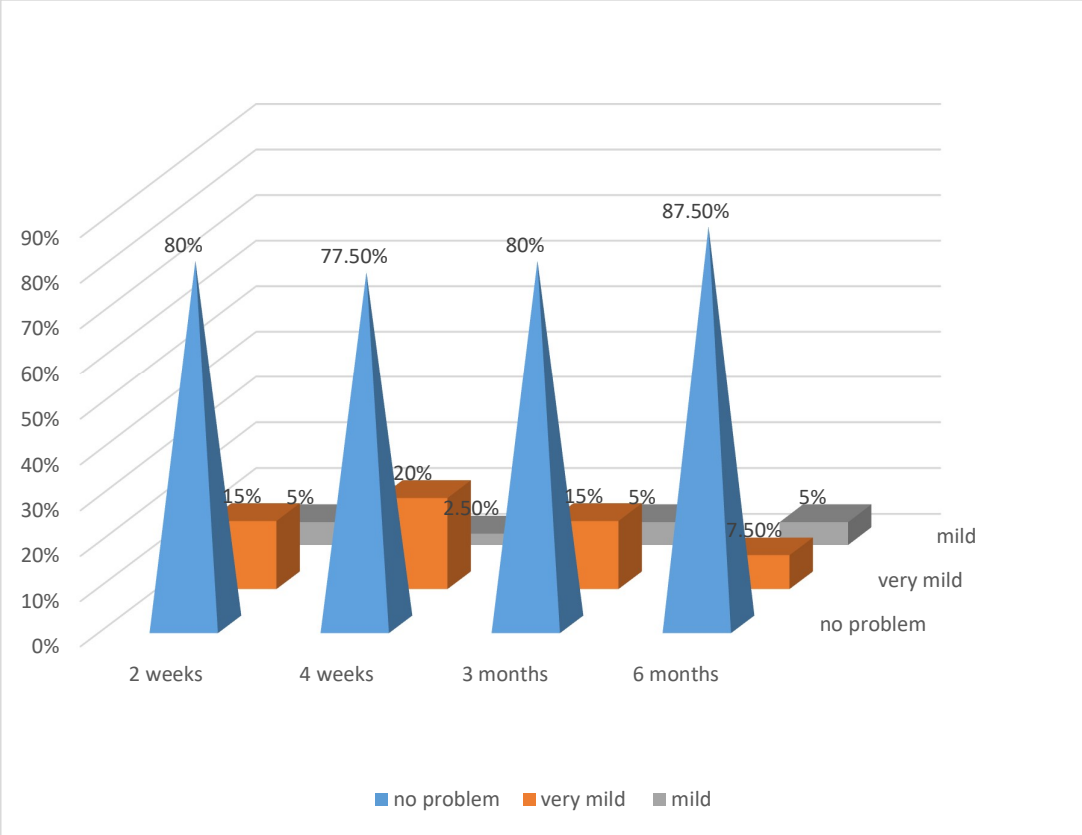
Post operative symptom profile-sleep disturbances

Table 17.Frequency distribution of post operative symptoms- lack of sleep

S.no	Lack of sleep	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	32, 80%	31, 77.5%	32, 80%	35, 87.5%
2.	1-very mild	6, 15%	8, 20%	6, 15%	3, 7.5%
3.	2-mild	2, 5%	1, 2.5%	2, 5%	2, 5%

Among the study populations , at the end of 6 months review 87.5% of the patients had no lack of sleep post operatively.

Chart 17.Frequency distribution of post operative symptoms- lack of sleep



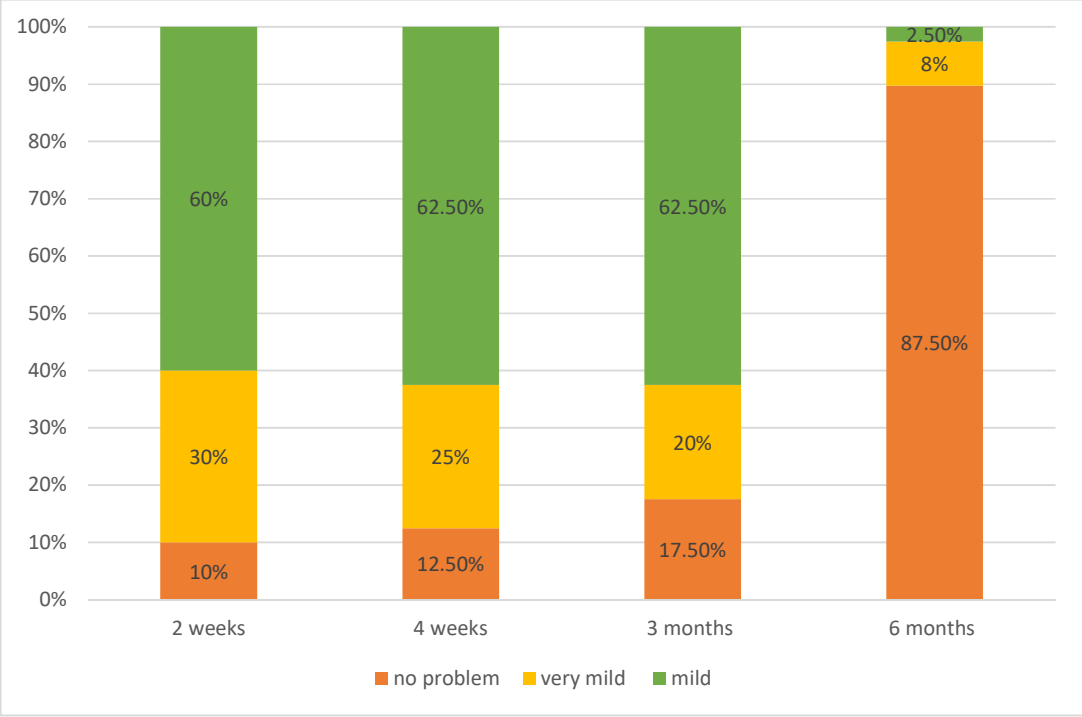
Post operative symptom profile-sleep disturbances

Table 18.Frequency distribution of post operative symptoms- fatigue

S.no	Fatigue	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	4, 10%	5, 12.5%	7, 17.5%	35, 87.5%
2.	1-very mild	12, 30%	10, 25%	8, 20%	3, 7.5%
3.	2-mild	24, 60%	25, 62.5%	25, 62,5%	2, 5%

Among the study populations , at the end of 6 months review 87.5% of the patients had no fatigue post operatively.

Chart 18.Frequency distribution of post operative symptoms- fatigue



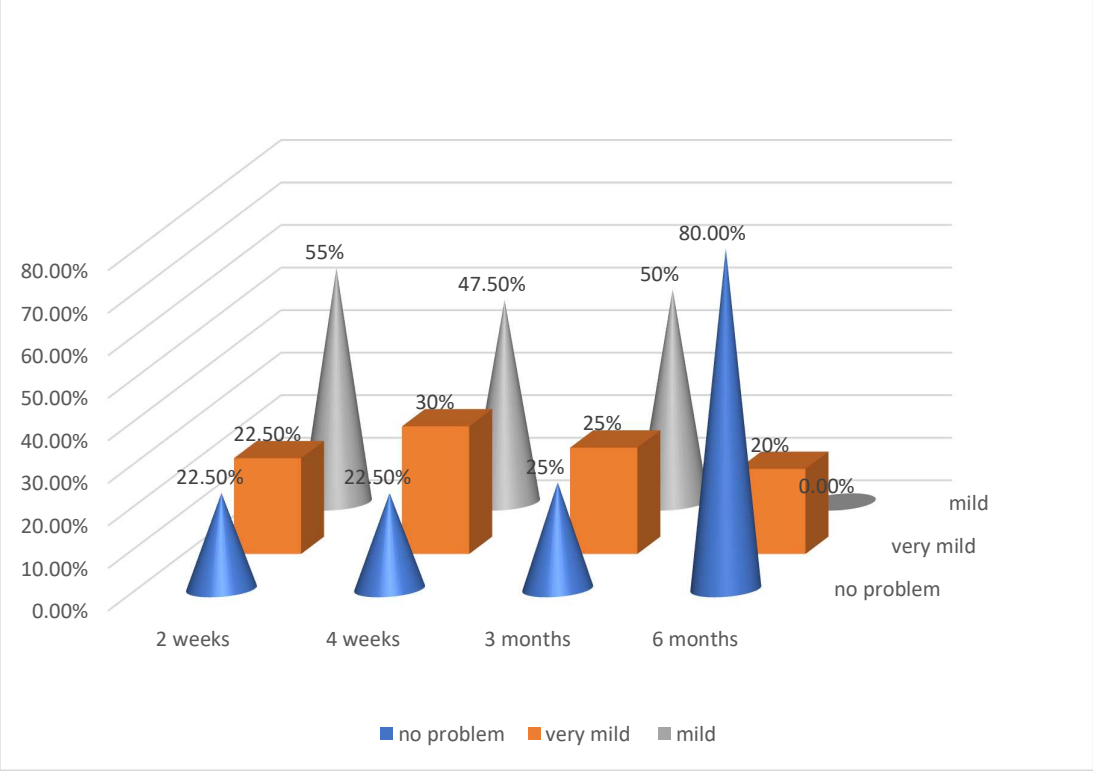
Post operative symptom profile-psychological and performance related disturbances

Table 19.Frequency distribution of post operative symptoms- reduced productivity

S.no	Reduced productivity	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	9, 22.5%	9, 22.5%	10, 25%	32, 80%
2.	1-very mild	9, 22.5%	12, 30%	10, 25%	8, 20%
3.	2-mild	22, 55%	19, 47.5%	20, 50%	0,

Among the study populations , at the end of 6 months review 80% of the patients had no reduced productivity post operatively.

Chart 19.Frequency distribution of post operative symptoms- reduced productivity



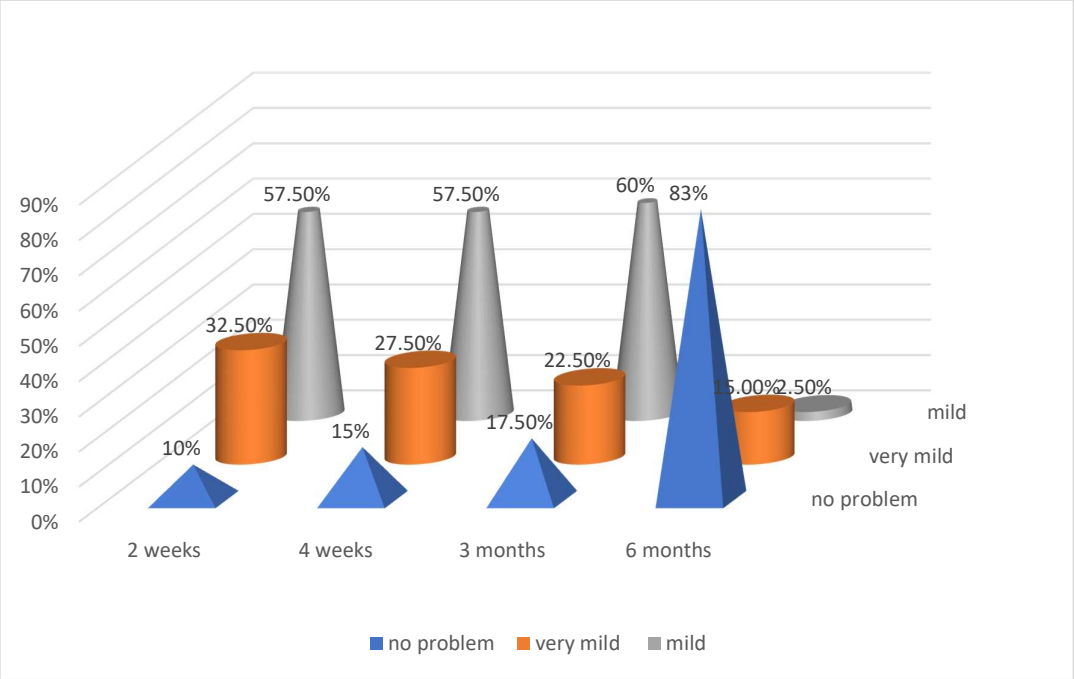
Post operative symptom profile-psychological and performance related disturbances

Table 20. Frequency distribution of post operative symptoms- reduced concentrations

S.no	Reduced concentrations	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	4, 10%	6, 15%	7, 17.5%	33 82.5
2.	1-very mild	13, 32.5%	11, 27.5%	9, 22.5%	6, 15%
3.	2-mild	23, 57.5%	23, 57.5%	24, 60%	1 2.5%

Among the study populations , at the end of 6 months review 40 % of the patients had reduced concentrations post operatively.

Chart 20.frequency distribution of post operative symptoms- reduced concentrations



Post operative symptom profile-psychological and performance related disturbances

Table 21.Frequency distribution of post operative symptoms- embarrassed

S.no	embarrased	2 weeks	4 weeks	3 months	6 months
1.	0-no problem	6, 15%	7, 17.5%	24, 60%	32 80%
2.	1-very mild	11, 27.5%	9, 22.5%	15, 37.5%	8, 20%
3.	2-mild	23, 57.5%	24, 60%	1, 2.5%	0 0%

Among the study populations , at the end of 6 months review 80 % of the patients had no embaressment post operatively.

Chart 21.frequency distribution of post operative symptoms- embarrassed

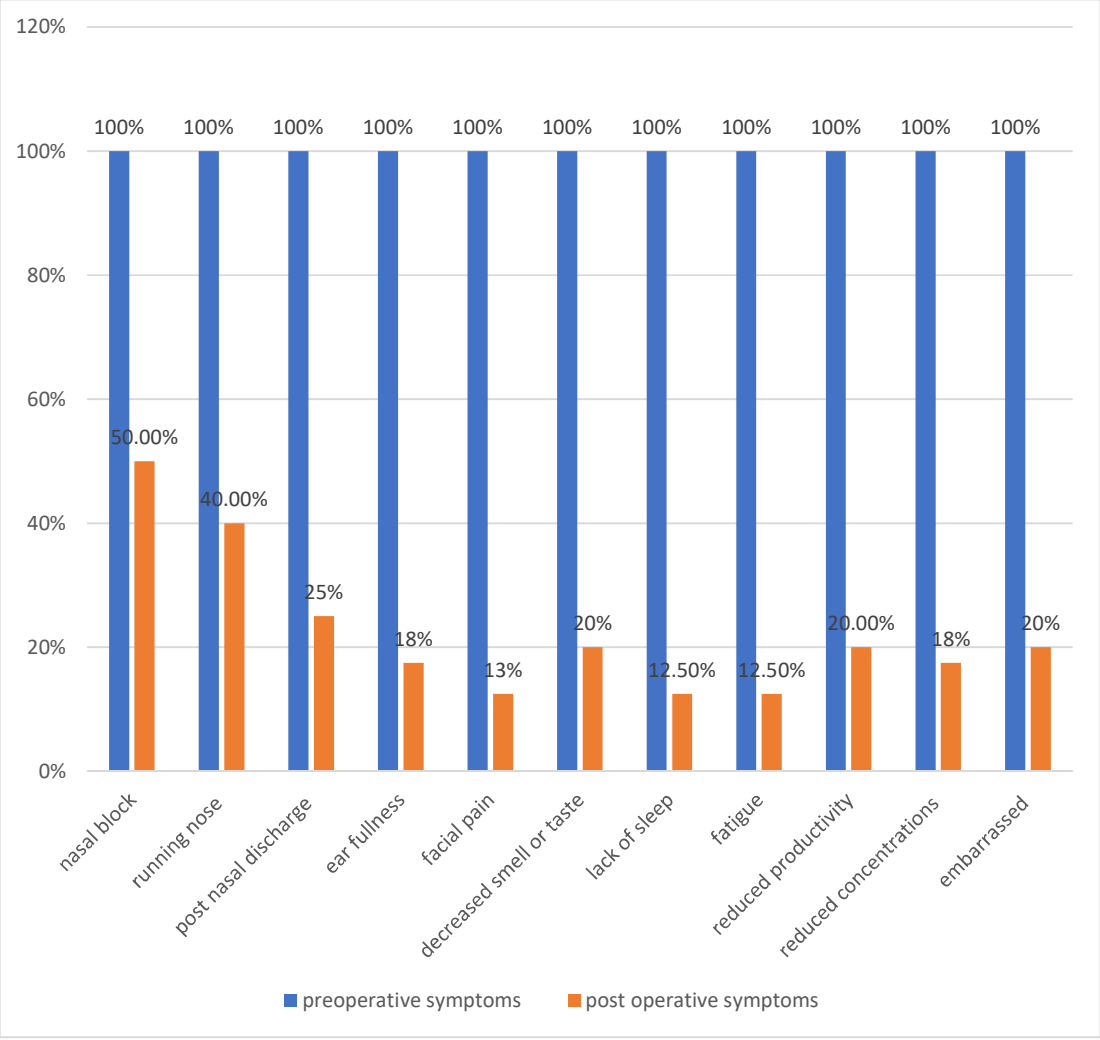
Comparing preoperative and post operative symptom after 6 th month review

Table 22.Frequency distribution of preoperative and post operative symptom after 6 th month review

S.no	Variables	Pre operative symptoms	Post operative symptoms (6 months)	P value
1.	Nasal block	100%	50	0.5
2.	Running nose	100%	40%	0.3
3.	Post nasal discharge	100%	25%	0.210
4.	Ear fullness	100%	17.5%	0.123
5.	Facial pain	100%	12.5%	0.103
6.	Decreased smell or taste	100%	20%	0.152
7.	Lack of sleep	100%	12.5%	0.103
8.	Fatigue	100%	12.5%	0.103
9.	Reduced productivity	100%	20%	0.152
10.	Reduced concentrations	100%	17.5%	0..12
11.	Embarrassed	100%	20%	0.152

Among the study populations , at the end of six months,more than 85% reduction in lack of sleep post operatively, more than 30% reductions in the symptoms of post nasal discharge ,facial pain ,decreased smell or taste post operatively,

Chart 22.Frequency distribution of preoperative and post operative symptom after 6 th month review

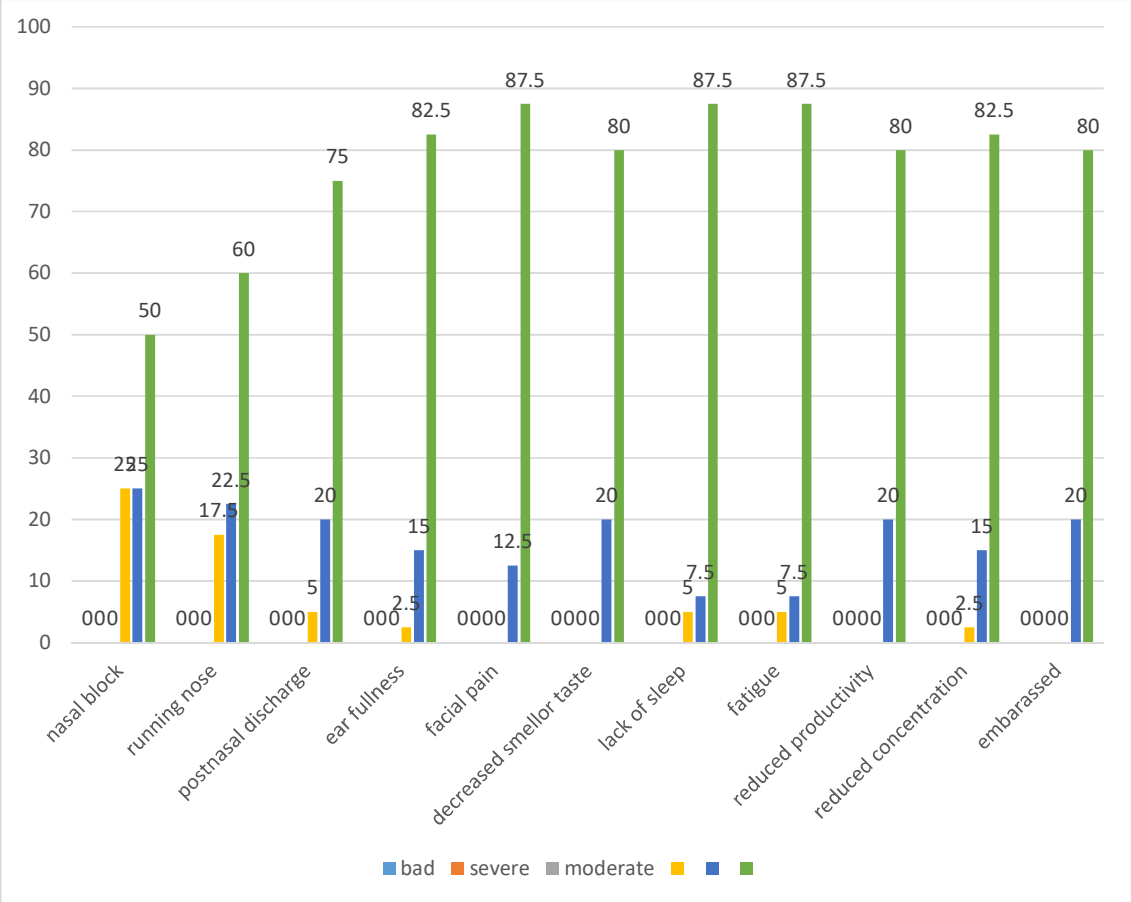


Post operative symptom after surgery at 6 th month review

Table 23.Frequency distribution of post operative symptom at the 6 th month review

S.no	Post operative symptoms at 6 th month	Bad	severe	Moderate	Mild	Very mild	No symptoms
1.	Nasal block	0	0	0	25%	25%	50%
2.	Running nose	0	0	0	17.5%	22.5%	60%
3.	Post nasal discharge	0	0	0	5%	20%	75%
4.	Ear fullness	0	0	0	2.5%	15%	82.5%
5.	Facial pain	0	0	0	0	12.5%	87.5%
6.	Decreased smell or taste	0	0	0	0	20%	80%
7.	Lack of sleep	0	0	0	5%	7.5%	87.5%
8.	Fatigue	0	0	0	5%	7.5%	87.5%
9.	Reduced productivity	0	0	0	0	20%	80%
10.	Reduced concentrations	0	0	0	2.5%	15%	82.5%
11.	Embarrassed	0	0	0	0	20%	80%

Chart 23 : Frequency distribution of post operative symptom at the 6 th month review



DISCUSSION

Chronic Rhinosinusitis is one of the most common diseases in many parts of the world including India. The prevalence of CRS is on the rise posing a serious health care problem in the society and hence a proper evaluation of the disease and its treatment modality by testing its effectiveness is very much needed. The most important part of evaluation remains history. This includes nasal obstruction, headache, anosmia, facial pressure/pain-, post-nasal drip & purulent nasal discharge Fever was not one of the presenting complaint in any of the patients. Symptoms dental pain , cough , earache and ear fullness . Post operatively, 50% of patients with nasal obstruction as a symptom showed marked improvement., 80% of pts with anosmia, 87.5 % pts with facial pain / pressure, 75 % pts with post-nasal drip and 60 % pts with nasal discharge as a major symptom showed marked improvement post- FESS after 6 months follow up. . The symptom that responded the least was nasal obstruction and the best one was facial pain. In few proportion of the subjects in whom these symptoms showed a moderate improvement the patients said they experienced marked improvement of these non specific symptoms like fatigue and body pain. The findings of our study were consistent with many other similar series of study. The percentage of patients in the study who showed marked improvement after FESS and good symptom relief and satisfaction is 86.66% and they required no medical treatment after 6 month follow up. Brain L Mathew et al (1991) documented nasal obstruction as the commonest symptom (n=146,96%) followed by postnasal drip (n=143,92%), & facial pain/headache (n=139-90%). Overall, 140 patients (91%) believed that surgery was beneficial. Patients with facial pain

preoperatively showed greatest improvement. . In the pre operative work up of our study, 8 cases were found to have mild DNS and 6 inferior turbinate hypertrophy, all requiring no surgical intervention for the same.. patients (85%) had their OMU blocked bilaterally, strongly establishing the Messerklinger's concept of OMU block in pathophysiology of CRS.21 patients (67.5 %) revealed nasal polypi on diagnostic nasoendoscopy. 30 cases underwent the procedure under local anesthesia and another 10 underwent the procedure under general anesthesia. Certain factors like age,sex, disease severity, patient's will and general condition determined the type of anesthesia with no significant difference in the period of hospital stay. However, patient was comfortable in general anesthesia. Majority of the patients underwent uncinectomy (100%, N=40), followed by middle meatal antrostomy (90%,). The other procedures done were anterior ethmoidectomy (87.5%), posterior ethmoidectomy (77.5%,), sphenoidotomy (62.5%,), frontal recess surgery (22.5%) and middle turbinate reduction (37.5%). Average duration of hospitalization was 3 to 4 days. (One patient had to be admitted for 6 days because of a minor complication). FESS is an effective and safe procedure when performed by surgeons experienced in the technique. In inexperienced hands, the major complications that may occur after FESS are CSF leak, intracerebral hemorrhage, diplopia, blindness,meningitis,severe nasal hemorrhage and intracranial penetration.In our study, there were no major complications recorded. The most common minor complication was post-operative bleeding , which was managed successfully with nasal packing. Synechiae (N=3) were the next common complication, which were released during the postoperative follow up. .Average postoperative healing time

was 4 to 8 weeks. A few (N=5, 16.66 %) of them required 12 weeks, during which time regular nasal toiletting was done to remove crusts/debris (fig 29). Schaffer SD et al, in his study noticed minor complications in 14 patients, the most common complication being synechiae between middle turbinate and septum in 6 patients, resulting in revision surgery in four patients . In the series conducted by Howard L. Levine (1990) 8.3% developed minor complications and 0.7% developed major complications . Hemorrhage occurred postoperatively in 2 patients (1.5%) in the study 99 done by Brain L Mathew et al (1991) . Nasser A Fageeh et al recorded minor complications like mild to moderate nasal bleeding, synechiae & facial swelling. One major complication in the form of internal carotid artery rupture was noted.. Jakobsen J and Svendstrup F (2000) came across no serious complications , while RothY et al (1995) observed 17% complications (all minor) .

CONCLUSION

- FESS is the best available treatment modality for Chronic Rhinosinusitis. Symptomatic relief was successfully established in 86.66%of patients
- .FESS plays an important role in improving the quality of life of patients suffering from chronic rhinosinusitis
- The preoperative Non Contrast Computed Tomography of nose and paranasal sinuses revealed the disease/infection predominantly involved the anterior ethmoids and infundibulum and of rhinogenic in origin followed by the posterior ethmoids and maxillary sinus.
- The common procedures that were done bilaterally in most of the cases were uncinectomy, MMA and anterior ethmoidectomy.
- In the hands of an experienced surgeon the post operative complications of FESS are minimal.
- Post FESS after the period of 6 months follow up no medical treatment was required by most of the patient.

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ABBREVATIONS

AN - Aggernasi

AR - Allergic rhinitis

AP - Anteroposterior

A - Artery

BL - Basal lamella

BLPB - Beta lactamase producing bacillus

BIPP - Bismuth iodoform paraffin paste

BT - Bleeding time

BUN - Blood urea nitrogen

Cms - Centimeters

CRS - Chronic rhino sinusitis

CT - Clotting time

CT-scan - Computer tomographic scan

C-AMP - Cyclic adenine monophosphate

DNS - Deviated nasal septum

DM - Diabetes mellitus

DLC - Differential leukocyte count

ENT - Ear Nose Throat

ECG - Electrocardiogram

EAC - Ethmoid air cells

EB - Ethmoid air cells

EC - Ethmoid cells

EI - Ethmoid infundibulum

e.g. - For Example

FR - Frontal recess

FS - Frontal sinus

FESS - Functional endoscopic sinus surgery

PROFORMA

Name:

Age:

Adress:

Case Number:

D.O.A:

D.O.S:

D.O.D:

I.D.:__ **SINO-NASAL OUTCOME TEST (SNOT-22)** DATE:_____

Below you will find a list of symptoms and social/emotional consequences of your rhinosinusitis. We would like to know more about these problems and would appreciate your answering the following questions to the best of your ability. There are no right or wrong answers, and only you can provide us with this information. Please rate your problems as they have been over the past two weeks.

1. Considering how severe the problem is when you experience it and how often it happens, please rate each item below on how "bad" it is by circling the number that corresponds with how you feel using this scale: ®	No Problem	Very Mild Problem	Mild or slight Problem	Moderate Problem	Severe Problem	Problem as bad as it can be	5 Most Important Items
1. Need to blow nose	**0**	**1**	**2**	**3**	**4**	**5**	¡
2. Nasal Blockage	**0**	**1**	**2**	**3**	**4**	**5**	¡
3. Sneezing	**0**	**1**	**2**	**3**	**4**	**5**	¡
4. Runny nose	**0**	**1**	**2**	**3**	**4**	**5**	¡
5. Cough	**0**	**1**	**2**	**3**	**4**	**5**	¡
6. Post-nasal discharge	**0**	**1**	**2**	**3**	**4**	**5**	¡
7. Thick nasal discharge	**0**	**1**	**2**	**3**	**4**	**5**	¡
8. Ear fullness	**0**	**1**	**2**	**3**	**4**	**5**	¡
9. Dizziness	**0**	**1**	**2**	**3**	**4**	**5**	¡
10. Ear pain	**0**	**1**	**2**	**3**	**4**	**5**	¡
11. Facial pain/pressure	**0**	**1**	**2**	**3**	**4**	**5**	¡
12. Decreased Sense of Smell/Taste	**0**	**1**	**2**	**3**	**4**	**5**	¡
13. Difficulty falling asleep	**0**	**1**	**2**	**3**	**4**	**5**	¡
14. Wake up at night	**0**	**1**	**2**	**3**	**4**	**5**	¡

15. Lack of a good night's sleep	**0**	**1**	**2**	**3**	**4**	**5**	¡
16. Wake up tired	**0**	**1**	**2**	**3**	**4**	**5**	¡
17. Fatigue	**0**	**1**	**2**	**3**	**4**	**5**	¡
18. Reduced productivity	**0**	**1**	**2**	**3**	**4**	**5**	¡
19. Reduced concentration	**0**	**1**	**2**	**3**	**4**	**5**	¡
20. Frustrated/restless/irritable	**0**	**1**	**2**	**3**	**4**	**5**	¡
21. Sad	**0**	**1**	**2**	**3**	**4**	**5**	¡
22. Embarrassed	**0**	**1**	**2**	**3**	**4**	**5**	¡

Thank you for your participation. Do not hesitate to ask for assistance if necessary.

2. Please mark the most important items affecting your health (maximum of 5 items)_____

SNOT-22 Developed from modification of SNOT-20 by National Comparative Audit of Surgery for Nasal Polyposis and Rhinosinusitis Royal College of Surgeons of England.

External Pyramid	
Anterior Rhinoscopy	
Turbinate	
Mucosa	
Discharge	
Airway	
Others (eg: polyp)	
Posterior Rhinoscopy	
Sinus Examination/Tenderness	

Past History:

Family History:

Personal History:

Drug History:

Examination of the Nose:

Examination of the Ear:

Examination of the Throat:

Examination of the Head and Neck

Diagnostic Nasal Endoscopy:

Passes	Right	Left
First Pass		
Second Pass		
Third Pass		

NCCT of the Nose and PNS

Sinuses		
Anterior Ethmoid Posterior Ethmoid		

Maxillary Sinus		
Frontal sinus		
Sphenoid Sinus		
Osteomeatal Unit		
Others		

No opacification,partialopacification,completeopacification

OMU not blocked,OMU blocked

Surgery Details: LA/GA

Procedure	Right	Left
Uncinectomy		
Reduction of MT		
Anterior Ethmoidectomy		
Posterior Ethmoidectomy		
Sphenoidotomy		
Frontal Recess Surgery		

Surgery not performed.surgery performed

Surgery not performed.surgery performed

Follow Up:

Week/Month	SNOT22
firstweek	
Second week	
thirdweek	
Fourth week	
Second month	
Third month	
Sixth month	

1. Considering how severe the problem is when you experience it and how often it happens, please rate each item below on how "bad" it is by circling the number that corresponds with how you feel using this scale: ®	No Problem	Very Mild Problem	Mild or slight Problem	Moderate Problem	Severe Problem	Problem as bad as it can be	5 Most Important Items
1. Need to blow nose	**0**	**1**	**2**	**3**	**4**	**5**	¡
2. Nasal Blockage	**0**	**1**	**2**	**3**	**4**	**5**	¡
3. Sneezing	**0**	**1**	**2**	**3**	**4**	**5**	¡
4. Runny nose	**0**	**1**	**2**	**3**	**4**	**5**	¡
5. Cough	**0**	**1**	**2**	**3**	**4**	**5**	¡
6. Post-nasal discharge	**0**	**1**	**2**	**3**	**4**	**5**	¡
7. Thick nasal discharge	**0**	**1**	**2**	**3**	**4**	**5**	¡
8. Ear fullness	**0**	**1**	**2**	**3**	**4**	**5**	¡
9. Dizziness	**0**	**1**	**2**	**3**	**4**	**5**	¡
10. Ear pain	**0**	**1**	**2**	**3**	**4**	**5**	¡
11. Facial pain/pressure	**0**	**1**	**2**	**3**	**4**	**5**	¡
12. Decreased Sense of Smell/Taste	**0**	**1**	**2**	**3**	**4**	**5**	¡
13. Difficulty falling asleep	**0**	**1**	**2**	**3**	**4**	**5**	¡
14. Wake up at night	**0**	**1**	**2**	**3**	**4**	**5**	¡
15. Lack of a good night's sleep	**0**	**1**	**2**	**3**	**4**	**5**	¡
16. Wake up tired	**0**	**1**	**2**	**3**	**4**	**5**	¡
17. Fatigue	**0**	**1**	**2**	**3**	**4**	**5**	¡
18. Reduced productivity	**0**	**1**	**2**	**3**	**4**	**5**	¡
19. Reduced concentration	**0**	**1**	**2**	**3**	**4**	**5**	¡
20. Frustrated/restless/irritable	**0**	**1**	**2**	**3**	**4**	**5**	¡
21. Sad	**0**	**1**	**2**	**3**	**4**	**5**	¡
22. Embarrassed	**0**	**1**	**2**	**3**	**4**	**5**	¡

Thank you for your participation. Do not hesitate to ask for assistance if necessary.

DIAGNOSTIC NASAL ENDOSCOPY

PASS		
FIRST		
SECOND		
THIRD		

PART 2 of 2- Participant consent form

Participant's name: Address:

Title of the project:
"A PROSPECTIVE STUDY ON THE QUALITY OF LIFE OUTCOMES OF PATIENTS WITH CHRONIC RHINOSINUSITIS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY"

The details of the study have been provided to me in writing and explained to me in my own language. I confirm that I have understood the above study and had the opportunity to ask questions. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). I have been given an information sheet giving details of the study. I fully consent to participate in the above study.

(I also consent / do not consent to use my stored biological samples for future scientific purposes) – if applicable

Signature of the participant: _____ Date: _____

Signature of the witness: _____ Date: _____

Signature of the investigator: _____ Date: _____

MASTER CHART																													
					nasal symptoms							extranasal symptoms					sleep disturbances					psychological and perfomance related					anterior rhinoscopy		
sl no	name	age	sex	duration of symptoms	Need to blow nose	2. Nasal Blockage	sneezing	running nose	cough	postnasal discharge	thick nasal discharge	ear fullness	dizziness	earache	facial pain	decreased smell or taste	difficulty in falling sleep	wake up at night	lack of sleep	wake up tired	fatigue	reduced productivity	reduced concentration	frustration	sad	embarrassed	DNS	ITH	polyp
1	muthiah	58	m	8 years	4	4	3	4	3	4	3	3	2	3	5	3	3	3	4	3	3	2	3	3	2	2	YES	NO	NO
2	janaki	43	f	4 yrs	4	5	5	4	2	3	5	4	1	3	4	5	3	4	4	3	4	3	3	3	2	1	NO	NO	NO
3	ravi	32	m	4yrs	3	5	2	4	3	5	4	2	2	3	4	4	3	3	3	4	4	3	3	3	4	3	NO	YES	YES
4	rajeesh	29	m	3yrs	5	3	4	4	2	3	4	4	2	4	3	4	3	4	4	4	3	3	4	3	3	3	NO	NO	NO
5	raman	27	m	2yrs	4	3	4	4	1	4	3	3	3	3	4	4	2	3	5	4	3	3	3	4	3	3	YES	NO	NO
6	selvi	37	f	5yrs	3	4	3	4	1	2	3	3	1	4	4	3	2	4	4	3	3	3	3	2	2	2	NO	NO	YES
7	sathish	32	m	6yrs	2	4	5	3	1	5	4	3	3	3	4	3	2	5	3	4	3	3	4	3	3	3	NO	YES	NO
8	sreedhar	37	m	6 yrs	3	3	2	3	1	3	5	3	3	4	4	4	4	4	3	4	3	2	3	3	4	3	NO	NO	YES
9	soman	56	m	10 yrs	4	2	4	3	3	4	3	2	4	2	4	5	1	3	3	4	4	3	3	3	3	3	NO	NO	YES
10	jayanthi	42	f	5 yrs	2	3	4	2	4	3	3	4	2	2	4	3	1	3	4	3	3	3	3	3	4	3	NO	NO	NO
11	shanthi	43	f	6 yrs	5	4	3	2	2	4	3	3	3	3	4	5	5	3	3	4	3	4	4	3	3	3	NO	YES	NO
12	sarada	45	f	5 yrs	2	4	2	3	4	2	3	4	1	3	4	4	3	3	2	4	3	3	4	3	4	3	NO	NO	YES
13	sumathi	33	f	3 yrs	1	2	1	3	3	3	3	2	3	3	3	4	2	4	3	3	3	3	2	3	3	4	NO	NO	YES
14	jagadheesh	25	m	2 yrs	4	3	5	4	3	4	3	4	2	4	3	3	4	3	3	3	3	2	3	3	2	3	NO	NO	NO
15	jose	36	m	4 yrs	5	3	4	3	3	5	3	3	2	3	3	5	2	3	3	3	3	3	4	3	3	2	YES	YES	YES
16	jayaran	48	m	5 yrs	3	3	2	3	3	3	3	3	2	3	3	4	3	4	4	3	3	4	3	2	3	3	NO	NO	NO
17	rohini	24	f	6 yrs	3	2	3	3	2	5	3	3	1	4	3	3	3	5	3	4	3	3	4	3	3	3	NO	NO	YES
18	seethal	28	f	4 yrs	2	4	3	5	2	4	4	4	1	4	4	3	4	4	4	4	4	3	3	3	3	3	NO	NO	YES
19	aishwarya	26	f	4 yrs	5	4	3	3	2	2	4	3	1	2	4	4	2	3	3	5	3	3	4	3	2	3	NO	YES	NO
20	anand	26	m	3 yrs	2	5	3	3	1	4	2	3	2	3	3	3	4	3	5	4	3	3	3	4	3	3	NO	NO	YES
21	maiyyappan	59	m	5 yrs	4	3	4	4	3	3	2	3	2	4	3	3	4	3	4	3	3	4	3	3	3	2	NO	NO	YES
22	marimuthu	58	m	10 yrs	5	3	4	3	2	4	2	2	2	2	4	4	3	4	3	3	3	4	3	4	3	2	NO	NO	YES
23	meghala	32	f	5 yrs	3	2	4	2	1	5	2	2	3	3	4	4	2	3	5	5	3	3	4	4	3	3	NO	NO	YES

sl no	name	age	sex	duration of symptoms	nasal symptoms							extranasal symptoms					sleep disturbances					psychological and perfomance related					anterior rhinoscopy		
					Need to blow nose	2. Nasal Blockage	sneezing	running nose	cough	postnasal discharge	thick nasal discharge	ear fullness	dizziness	earache	facial pain	decreased smell or taste	difficulty in falling sleep	wake up at night	lack of sleep	wake up tired	fatigue	reduced productivity	reduced concentration	frustration	sad	embarrassed	DNS	ITH	polyp
24	mahitha	31	f	3 yrs	3	4	3	3	3	3	4	4	2	3	3	3	2	4	4	4	3	3	4	4	3	3	NO	NO	NO
25	ganesan	47	m	4 yrs	2	4	5	3	2	3	2	2	3	3	3	5	3	3	3	3	4	3	3	4	4	4	YES	NO	NO
26	ranjith	28	m	7 yrs	1	3	5	4	1	3	3	5	3	4	2	5	4	4	4	3	3	3	3	4	4	3	NO	NO	YES
27	ragav	30	m	5 yrs	1	3	5	3	4	4	5	3	3	3	4	4	3	3	3	5	3	3	4	3	4	3	NO	NO	YES
28	seethal	34	f	6 yrs	3	4	2	4	3	3	5	4	3	1	3	4	4	4	4	5	4	3	4	2	2	3	NO	YES	NO
29	saroja	45	f	5 yrs	5	4	4	3	2	5	2	3	2	2	3	5	2	3	5	5	4	3	3	4	3	2	NO	NO	YES
30	suganya	29	f	3 yrs	3	4	4	3	4	4	2	4	3	3	4	3	3	4	4	4	3	3	3	4	3	3	NO	NO	YES
31	veeraiyan	60	m	10 yrs	2	5	4	3	4	3	4	3	4	4	3	5	5	3	5	4	3	3	3	4	3	3	YES	YES	NO
32	venkatesh	37	m	4 yrs	4	4	3	3	4	3	3	3	3	4	3	3	4	5	3	5	3	3	4	4	3	3	NO	NO	NO
33	narayanan	26	m	4 yrs	5	3	3	4	3	4	4	4	3	3	4	4	3	3	4	4	3	4	4	3	3	4	YES	NO	YES
34	sethupathi	54	m	8 yrs	3	2	3	4	3	5	4	4	3	3	3	5	3	4	3	4	4	4	4	3	3	4	YES	YES	YES
35	nagaveni	33	f	7 yrs	3	3	4	5	2	4	3	3	3	3	3	5	2	3	5	3	4	3	3	3	4	4	NO	YES	NO
36	nagaraj	35	m	3 yrs	2	3	2	5	2	4	3	4	4	4	4	4	4	5	5	3	3	3	3	3	3	4	NO	YES	YES
37	nived	26	m	1 yrs	3	4	5	4	2	3	2	4	2	3	2	3	3	4	4	3	3	3	4	4	4	3	YES	NO	NO
38	mohan	36	m	2 yrs	4	5	4	3	3	3	3	3	3	3	3	3	3	3	4	3	4	4	3	3	3	3	YES	NO	YES
39	anusha	27	f	1 yrs	2	3	3	5	3	4	2	3	3	2	5	3	2	3	3	3	3	3	3	3	3	3	NO	YES	YES
40	swathi	28	f	2 yrs	1	3	5	3	2	5	2	3	2	3	4	3	2	4	5	4	3	4	3	4	3	4	YES	NO	YES

u-1
mma-2
aety-3
pety 4
sphy-5
frs-6
mtr-7

sl no	name	age	XRAY PNS					DNE				NCCT-PNS				procedure	NASAL BLOCK				running nose			
			MUCOPUS	MAXILLARY	FRONTAL	ETHMOIDS	SPHENOID	DNS	POLYPS	MUCOPUS	ACCESSORY OSTIA	MAXILLARY	ETHMOID	FRONTAL	SPHENOID		2WK	4WK	3MONTH	6MONTH	2WK	4WK	3MON	6MON
1	muthiah	58	NO	Normal	Normal	Hazy	Normal	YES	-	-	-	Normal	b/l opacified	Normal	Normal	U+MMA+A.ETY+P.ETY	1	2	2	2	1	1	2	2
2	janaki	43	YES	b/lopacified	Normal	Normal	Normal	-	-	YES	YES	L-opacified	L-opacified	Normal	Normal	U+MMA	0	0	0	0	0	0	0	0
3	ravi	32	YES	b/lhazy	Normal	Normal	Normal	-	YES	YES	no	b/l partial	b/l partial	Normal	Normal	U+MMA+A.ETY+P.ETY	1	2	2	2	0	0	0	0
4	rajeesh	29	NO	Normal	Normal	Hazy	Normal	-	-	-	no	Normal	b/l opacified	Normal	Normal	U+A.ETY+MTR	1	1	2	2	0	1	2	2
5	raman	27	NO	Normal	Normal	opacified	Normal	YES	-	-	no	Normal	b/l opacified	Normal	b/l opacified	U+A.ETY+P.ETY+SPHY	1	2	2	2	1	1	1	1
6	selvi	37	YES	b/l hazy	b/l hazy	Normal	Normal	-	YES	YES	no	b/l partial	b/l partial	b/l partial	Normal	U+MMA+A.ETY+P.ETY	1	2	2	2	1	1	1	1
7	sathish	32	NO	Normal	Normal	Hazy	Normal	-	-	-	no	Normal	b/l opacified	Normal	Normal	U+A.ETY+P.ETY	1	1	2	2	0	0	0	0
8	sreedhar	37	YES	b/l hazy	b/l hazy	Normal	b/l hazy	-	YES	YES	no	b/l partial	b/l partial	b/l partial	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY	1	1	2	2	0	0	0	0
9	soman	56	YES	b/l hazy	Normal	Normal	Normal	-	YES	YES	no	b/l partial	b/l opacified	Normal	Normal	U+MMA+MTR	0	0	0	0	1	2	2	2
10	jayanthi	42	NO	b/l hazy	b/l hazy	Normal	Normal	YES	YES	-	no	b/l partial	b/l partial	b/l partial	b/l partial	U+MMA+A.ETY+P.ETY+SPHY	0	1	1	2	1	1	1	0
11	shanthi	43	NO	b/l hazy	Normal	Normal	Normal	-	YES	-	no	b/l partial	b/l partial	Normal	Normal	U+MMA+A.ETY+R-MTR	1	1	2	2	0	1	1	1
12	sarada	45	NO	b/l opacified	b/l opacified	Normal	b/l hazy	-	YES	-	no	b/l opacified	b/l partial	b/l opacified	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY+FRS	1	1	1	1	0	0	0	0
13	sumathi	33	YES	b/l hazy	b/l hazy	Normal	Normal	-	YES	YES	no	b/l partial	b/l partial	b/l partial	Normal	U+MMA+A.ETY+R-P.ETY	0	0	0	0	2	2	2	2
14	jagadheesh	25	NO	b/l hazy	Normal	Normal	Normal	-	-	-	no	b/l partial	b/l partial	Normal	Normal	U+MMA+A.ETY+P.ETY	0	1	1	1	0	1	1	1
15	jose	36	NO	b/l hazy	b/l hazy	Normal	Normal	YES	YES	-	no	b/l partial	b/l partial	b/l partial	b/l partial	U+MMA+A.ETY+P.ETY+SPHY	0	1	2	2	1	1	1	1
16	jayaran	48	NO	b/l opacified	Normal	b/lopacified	Normal	-	-	-	no	Normal	b/l opacified	Normal	Normal	U+A.ETY+P.ETY	2	2	2	2	0	0	0	0
17	rohini	24	NO	b/l hazy	b/l opacified	Normal	Normal	-	YES	-	no	b/l opacified	b/l partial	b/l opacified	b/l partial	U+MMA+A.ETY+P.ETY+SPHY+FRS	0	0	0	0	2	2	2	2
18	seethal	28	YES	b/l hazy	b/l hazy	b/lopacified	b/l hazy	YES	YES	YES	no	b/l opacified	b/l opacified	b/l partial	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY	0	0	0	1	0	0	0	0
19	aishwarya	26	NO	b/l hazy	Normal	b/l hazy	Normal	-	-	-	no	Normal	b/l opacified	Normal	Normal	U+A.ETY+P.ETY	1	1	1	1	1	1	1	1
20	anand	26	NO	b/l opacified	b/l opacified	Normal	Normal	-	YES	YES	no	b/l opacified	b/l partial	L-opacified	Normal	U+MMA+A.ETY+P.ETY	1	1	2	2	0	0	0	0
21	maiyyappan	59	YES	b/l hazy	b/l hazy	Normal	b/l hazy	-	YES	YES	no	b/l opacified	b/l partial	b/l partial	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY+R-FRS	0	0	0	0	1	2	2	2
22	marimuthu	58	NO	b/l hazy	b/l hazy	Normal	Normal	-	YES	-	no	b/l partial	R-opacified	b/l partial	Normal	U+MMA+A.ETY	0	1	1	0	2	2	2	2
23	meghala	32	NO	b/l hazy	Normal	Normal	Normal	-	YES	-	yes	b/l partial	Normal	Normal	Normal	U+MMA	0	0	0	0	1	2	2	2

sl no	name	age	XRAY PNS					DNE				NCCT-PNS				procedure	NASAL BLOCK				running nose			
			MUCOPUS	MAXILLARY	FRONTAL	ETHMOIDS	SPHENOID	DNS	POLYPS	MUCOPUS	ACCESSORY OSTIA	MAXILLARY	ETHMOID	FRONTAL	SPHENOID		2WK	4WK	3MONTH	6MONTH	2WK	4WK	3MON	6MON
24	mahitha	31	NO	b/l opacified	Normal	Normal	Normal	-	-	-	no	L-opacified	L-opacified	Normal	Normal	L-MMA+A.ETY+P.ETY	0	1	1	1	1	1	1	1
25	ganesan	47	NO	b/l opacified	b/l opacified	b/l hazy	b/l hazy	YES	YES	-	no	b/l opacified	b/l opacified	b/l opacified	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY+FRS+MTR	0	1	1	1	1	2	2	2
26	ranjith	28	NO	b/l hazy	Normal	Normal	Normal	-	YES	-	no	b/l partial	b/l partial	Normal	Normal	U+MMA+A.ETY+P.ETY	1	1	1	2	0	0	0	0
27	ragav	30	YES	b/l hazy	b/l hazy	Normal	Normal	-	YES	YES	no	b/l opacified	b/l opacified	b/l opacified	b/l partial	U+MMA+A.ETY+P.ETY+SPHY+FRS	1	1	1	2	1	1	1	1
28	seethal	34	NO	b/l hazy	b/l hazy	Normal	Normal	-	YES	-	no	b/l partial	b/l partial	b/l partial	Normal	U+MMA+A.ETY	0	1	1	2	2	2	2	2
29	saroja	45	YES	b/l opacified	b/l opacified	b/lopacified	b/l hazy	-	YES	YES	no	b/l opacified	b/l opacified	b/l opacified	b/l opacified	U+MMA+A.ETY+P.ETY+SPHY+FRS	0	0	0	0	1	2	2	2
30	suganya	29	NO	b/l opacified	b/l opacified	Normal	Normal	-	YES	YES	no	b/l opacified	b/l opacified	b/l opacified	Normal	U+MMA+A.ETY+P.ETY+FRS	0	0	0	0	1	2	2	2
31	veeraiyan	60	NO	b/l hazy	Normal	Normal	Normal	YES	YES	NO	no	b/l opacified	b/l partial	Normal	b/l opacified	U+MMA	0	1	1	0	1	0	2	1
32	venkatesh	37	YES	b/l hazy	b/l hazy	Normal	Normal	YES	NO	YES	no	b/l partial	l opacified	b/l opacified	Normal	U+MMA+ANT ETY	1	0	0	1	1	0	0	1
33	narayanan	26	YES	b/l opacified	b/l hazy	Normal	b/l hazy	NO	YES	YES	YES	l opacified	b/l partial	b/l partial	Normal	U+MMA+MTR+SPHY	1	2	0	0	0	1	1	0
34	sethupathi	54	NO	b/l opacified	b/l opacified	b/lopacified	Normal	NO	YES	YES	no	b/l partial	b/l partial	b/l opacified	Normal	U+MMA+A.ETY+P.ETY+FRS	2	0	1	1	0	1	1	0
35	nagaveni	33	YES	b/l hazy	b/l opacified	Normal	b/l hazy	YES	NO	NO	no	b/l partial	b/l opacified	b/l opacified	b/l opacified	U+MMA+A.ETY+P.ETY+FRS+SPHY	1	1	0	1	1	0	2	1
36	nagaraj	35	YES	b/l hazy	Normal	Normal	b/l hazy	YES	YES	NO	yes	b/l opacified	r opacified	Normal	b/l opacified	U+MMA+A.ETY+PETY+SPHY	1	0	0	1	2	2	1	1
37	nived	26	NO	b/l opacified	b/l hazy	Normal	Normal	NO	YES	YES	no	b/l partial	b/l partial	Normal	b/l opacified	U+MMA+A.ETY+PETY+SPHY	2	1	1	0	1	2	1	1
38	mohan	36	YES	b/l opacified	b/l hazy	Normal	Normal	NO	NO	NO	yes	b/l partial	b/l partial	b/l partial	b/l opacified	U+MMA+A.ETY+PETY+SPHY	0	2	0	0	0	1	0	0
39	anusha	27	YES	b/l hazy	b/l opacified	b/lopacified	b/l hazy	NO	YES	YES	no	b/l partial	l partial	b/l opacified	b/l opacified	U+MMA+A.ETY+PETY+SPHY	1	1	1	0	0	1	0	0
40	swathi	28	YES	b/l opacified	b/l opacified	normal	normal	yes	no	no	yes	b/l opacified	b/l opacified	b/l opacified	normal	U+MMA+A.ETY+FRS	1	2	1	0	1	1	1	1

sl no	name	age	postnasal discharge				ear fullness				facial pain				decreased smell or taste				lack of sleep				fatigue				reduced productivity				reduced concentration				embarrassed			
			2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON
1	muthiah	58	0	0	0	0	1	0	1	0	2	2	2	2	2	0	0	0	0	0	0	0	2	2	2	1	2	2	2	1	2	2	2	1	2	2	1	0
2	janaki	43	1	1	2	2	2	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	2	2	2	0	0	0	0	0	2	2	2	0	2	2	0	1
3	ravi	32	1	1	1	2	2	1	1	1	2	2	2	2	0	0	1	1	2	1	1	1	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	1
4	rajeesh	29	0	0	0	0	0	0	0	0	2	2	2	2	1	0	0	0	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	0
5	raman	27	1	1	2	2	2	0	0	0	2	2	2	2	2	0	1	1	0	0	0	0	0	0	0	1	2	2	2	0	0	0	0	1	0	0	1	0
6	selvi	37	1	1	1	2	2	0	0	0	2	2	2	2	2	0	1	1	0	0	0	0	0	0	0	1	2	2	2	1	0	0	0	1	0	0	1	0
7	sathish	32	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	0
8	sreedhar	37	1	1	1	1	2	1	1	1	2	2	2	2	0	1	1	1	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	1
9	soman	56	1	1	1	2	2	0	1	1	0	0	0	0	2	0	1	1	0	0	0	0	1	2	2	0	0	0	0	1	1	2	2	0	2	2	0	1
10	jayanthi	42	0	1	1	1	2	0	0	0	2	2	2	2	1	0	0	1	2	2	2	2	2	2	2	0	2	2	2	0	2	2	2	0	2	2	0	0
11	shanthi	43	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	0
12	sarada	45	2	2	2	2	2	0	1	2	1	1	2	2	0	1	2	2	0	0	0	0	2	2	2	1	1	2	2	0	2	2	2	1	2	2	1	1
13	sumathi	33	1	2	2	2	2	1	1	1	0	0	0	0	2	0	1	2	0	0	0	0	2	2	2	0	0	0	0	1	2	2	2	0	2	2	0	1
14	jagadheesh	25	1	1	2	2	2	0	0	0	1	2	2	2	2	1	1	1	0	0	0	0	2	2	2	0	2	2	2	0	2	2	2	0	2	2	0	0
15	jose	36	0	1	1	1	2	0	0	0	2	2	2	2	2	0	0	1	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
16	jayaran	48	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0	0	0	0	1	2	2	2	2	2	2	0	1	2	2	2	2	2	2	0
17	rohini	24	2	2	2	2	2	0	0	0	0	0	0	0	2	1	2	2	1	1	2	2	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0
18	seethal	28	1	1	1	2	2	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	2	2	2	0	1	1	0	0	2	2	2	0	2	2	0	1
19	aishwarya	26	0	0	0	0	0	0	0	0	1	2	2	2	2	0	0	0	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	0
20	anand	26	0	1	1	0	1	0	0	0	2	2	2	2	0	1	0	1	0	0	0	0	2	2	2	1	2	2	2	0	2	2	2	1	2	2	1	0
21	maiyyappan	59	1	1	1	1	2	1	2	2	0	0	0	0	2	0	1	1	0	0	0	0	2	2	2	0	0	0	0	0	2	2	2	0	2	2	0	2
22	marimuthu	58	1	2	2	2	2	1	1	1	0	0	0	0	2	0	1	2	0	0	0	0	1	2	2	0	0	0	0	1	1	2	2	0	2	2	0	1
23	meghala	32	1	1	1	2	2	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	2	2	2	0	0	0	0	1	2	2	2	0	2	2	0	0

sl no	name	age	postnasal discharge				ear fullness				facial pain				decreased smell or taste				lack of sleep				fatigue				reduced productivity				reduced concentration				embarrassed			
			2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON	2WK	4WK	3MON	6MON
24	mahitha	31	0	1	1	2	2	0	0	0	1	1	1	2	2	0	0	1	0	0	0	0	2	2	2	0	1	1	2	1	2	2	2	0	2	2	0	0
25	ganesan	47	0	0	0	0	0	0	0	0	1	1	1	2	2	0	0	0	0	0	0	0	1	2	2	0	1	1	2	1	1	2	2	0	2	2	0	0
26	ranjith	28	1	1	1	1	2	0	0	0	2	2	2	2	0	1	1	1	0	0	0	0	1	0	0	1	2	2	2	0	1	0	1	1	0	1	1	0
27	ragav	30	2	2	2	2	2	1	1	1	2	2	2	2	2	1	2	2	0	0	0	0	0	0	0	1	2	2	2	0	0	0	0	1	0	0	1	1
28	seethal	34	0	0	0	0	0	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0	2	2	2	0	2	2	2	2	2	2	2	0	2	2	0	0
29	saroja	45	1	2	2	2	2	1	1	2	0	0	0	0	2	1	1	2	0	0	0	0	2	2	2	0	0	0	0	0	2	2	2	0	2	2	0	1
30	suganya	29	1	2	2	2	2	0	1	2	0	1	1	2	2	1	1	2	0	0	0	0	1	1	2	0	0	0	0	0	1	1	2	0	1	2	0	1
31	veeraiyan	60	0	0	1	1	1	1	1	1	1	1	2	1	1	1	1	0	1	0	0	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	0	1
32	venkatesh	37	0	0	2	1	0	0	1	1	0	1	1	1	0	2	1	0	0	1	0	0	1	2	1	0	2	1	1	0	2	1	1	0	1	1	0	0
33	narayanan	26	1	0	1	1	2	1	1	1	2	0	1	0	1	0	0	1	0	0	1	0	1	1	2	0	1	1	1	1	1	1	1	1	1	1	1	1
34	sethupathi	54	1	1	1	0	0	0	0	0	1	2	2	2	1	2	2	0	1	1	1	1	2	1	1	0	2	1	1	0	1	1	0	0	1	0	0	1
35	nagaveni	33	1	1	2	2	1	1	0	2	1	2	1	1	0	1	1	2	1	1	1	0	2	1	1	0	2	1	1	1	2	1	1	0	1	1	0	1
36	nagaraj	35	2	2	1	1	1	1	0	1	2	1	1	1	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	0
37	nived	26	2	2	1	1	1	2	2	0	1	0	2	0	2	1	0	0	1	0	0	0	2	2	1	0	2	2	1	0	2	1	1	1	1	1	1	1
38	mohan	36	1	1	1	1	0	1	1	1	1	1	1	2	1	2	0	1	1	1	0	0	1	1	1	0	1	1	1	0	2	1	1	0	1	1	0	2
39	anusha	27	1	1	0	1	1	1	1	2	2	1	1	1	1	1	1	1	0	1	0	0	2	1	0	0	2	1	1	0	1	1	0	0	1	0	0	1
40	swathi	28	0	1	0	0	1	0	1	1	1	1	0	0	2	1	1	2	0	1	1	1	2	1	0	0	1	1	1	1	1	1	1	0	1	1	0	1