

**PERCENTAGE OF POSITIVE OUTCOME OF  
SYMPTOMS IN PATIENTS UNDERGOING  
FUNCTIONAL ENDOSCOPIC SINUS  
SURGERY**

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# **CERTIFICATE**

This is to certify that **Dr.THILAK SANTHARAM**, postgraduate student (2013 – 2015) in the Department of Otorhinolaryngology, Government Kilpauk Medical College and Hospital, Chennai has done this dissertation titled **“PERCENTAGE OF POSITIVE OUTCOME OF SYMPTOMS IN PATIENTS UNDERGOING FUNCTIONAL ENDOSCOPIC SINUS SURGERY”** under the direct guidance and supervision in partial fulfillment of the regulations laid down by the Tamil Nadu Dr.M.G.R. Medical University, Chennai, for M.S. Branch–IV Otorhinolaryngology Degree Examination.

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## **DECLARATION**

I **Dr.THILAK SANTHARAM** solemnly declare that the dissertation titled “**PERCENTAGE OF POSITIVE OUTCOME OF SYMPTOMS AFTER FUNCTIONAL ENDOSCOPIC SINUS SURGERY**” is a bonafide work done by me at Government Kilpauk Medical College under the guidance and supervision of **Prof.Dr.K.RAVI MS, DLO., DNB**, Professor and Head of Department of Otorhinolaryngology.

This dissertation is submitted to the Tamil Nadu Dr.M.G.R. Medical University towards the partial fulfillment of the requirements of M.S. Branch – IV, Otorhinolaryngology degree examination.

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**INSTITUTIONAL ETHICAL COMMITTEE**  
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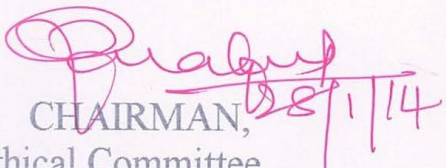
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**CERTIFICATE OF APPROVAL**

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study on percentage of positive outcome of symptoms after functional endoscopic sinus surgery" – For Project Work Submitted by Dr.Thilak Santharam, MS (ENT), PG Student, KMC, Chennai.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.



  
CHAIRMAN,  
Ethical Committee  
Govt.Kilpauk Medical College,  
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## **LIST OF ABBREVIATIONS**

Agger nasi	AN
Allergic rhinitis	AR
Anteroposterior	AP
Artery	A
Basal lamella	BL
Beta lactamase producing bacillus	BLPB
Bismuth iodoform paraffin paste	BIPP
Bleeding time	BT
Blood urea nitrogen	BUN
Centimeters	Cms
Chronic rhino sinusitis	CRS
Clotting time	CT
Computer tomographic scan	CT-scan
Cyclic adenine monophosphate	C-AMP
Deviated nasal septum	DNS
Diabetes mellitus	DM
Differential leukocyte count	DLC
Ear Nose Throat	ENT
Electrocardiogram	ECG
Ethmoid air cells	EAC
Ethmoid bulla	EB
Ethmoid cells	EC
Ethmoid infundibulum	EI

For Example	e.g.
Frontal recess	FR
Frontal sinus	FS
Functional endoscopic sinus surgery	FESS
Grams	Gms
Haemoglobin percentage	Hb %
Hiatus semilunaris	HS
Histopathology	HPE
Hypertension	HTN
Inferior turbinate	IT
Instrument	I
Lateral nasal wall	LNW
Magnetic resonance imaging	MRI
Maxillary sinus ostium	MSO
Middle meatal antrostomy	MMA
Middle turbinate	MT
Middle meatus	MM
Mucopus	MP
Nasal septum	NS
Nasoturbinals	NT
Nerve	N
Once daily	OD
Osteomeatal unit	OMU
Paranasal sinus	PNS
patients	Pts



Professor	Prof
Polyp	P
Posterior ethmoid cell	PEC
Sinus lateralis	SL
Sphenoid sinus	SS
Suprabullar recess	SBR
Species	spp
Total differential count	TLC
Tubal openings	TO
Twice daily	BD
Uncinate process	UP
years	Yrs/yr

## **ABSTRACT**

### **Background And Objective:**

The commonest disease that disturbs the day to day activity of thousands of individuals was recognised as chronic rhinosinusitis. The purpose of the research was to analyse the degree of improvement of symptom profile in patients suffering from chronic sinusitis undergoing endoscopic sinus surgery and to explain about the success or limitation of the procedure depending upon the extent to which patient experiences improvement in individual symptoms.

### **Study design:**

Prospective Study

### **Methods:**

A group of 60 individuals with symptom of chronic sinusitis were considered in the study. They underwent FESS at the department of oto-rhino-laryngology, Govt. Kilpauk Medical College Hospital and Govt. Royapettah Hospital. Patients were assessed for the CRS related and unrelated symptoms preoperatively using SNOT-22 system and scores were as no symptom (0), very mild (1), mild (2), moderate (3) severe (4), problem as bad as it can be (5). Three times scoring, one before surgery and two after surgery done. Statistical analysis was done using Chi square test.

**Results:**

The symptoms that showed the marked improvement in majority of the subjects were nasal obstruction (88.3%),nasal discharge(78.3%),post nasal dripping (68.3%),ear discharge(70%),decreased sensation of smell (68.3%) and which showed no or mild improvement were ,headache, cough, rhinnorrhoea, sneezing, facial pain, those symptoms associated with allergic rhinitis.

**Conclusion:**

The symptoms that showed the marked improvement in majority of the subjects were nasal obstruction, nasal discharge, post nasal dripping, ear discharge, headache and which showed no or mild improvement is cough, rhinnorrhoea, sneezing, facial pain those symptoms associated with allergic rhinitis. And the non specific symptoms such as fatigue and bodily pain are largely dependant on the symptoms which show not much improvement. So they too showed poor improvement in parallel to those poorly improved symptoms. In few proportion where these symptoms showed a moderate improvement the patients said they experienced marked improvement of these non specific symptoms like fatigue and bodily pain. If patients who come to the out patient department and diagnosed to have chronic rhinosinusitis and have their predominant symptoms like in this study which showed no or only poor improvement then it is not to intervene them with endoscopic sinus surgery. And its better to give them a course of anti allergic measures.

**Key words:**

Chronic rhinosinusitis; Nasal obstruction; Treatment outcome.

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## INTRODUCTION

Many disease processes including Chronic Rhino Sinusitis (CRS) Clinical diagnostic measures are not able to identify the full burden of the disease. The discordance between Radiological / Pre op endoscopic findings and Patient symptoms highlights this dilemma. Degree of sinonasal inflammation as measured by CT/DNE (diagnostic nasal endoscopy) fails to correlate with the extent of symptoms experienced by the patient. At present Chronic Rhino Sinusitis (CRS) remains a symptom based diagnosis corroborated by objective signs. A lack of agreement between objective assessment and patient centered assessment is seen in CRS, obstructive sleep apnoea, asthma and low back pain. Its important to assess the minimally clinically important difference (MCID), defined as the minimal change in symptom after a given intervention that is perceptible / relevant to the concerned individual.

The extent of symptoms experienced by the patient remains the overriding factor in seeking medical or surgical treatment. Study of patient centered disease impact is critical in understanding quality of life outcomes after FESS. Many studies such as Rhinosinusitis Disability index(RSDI),Chronic Sinusitis Survey (CSS), Rhinitis QOL questionnaire, 22 stem Sino Nasal Outcome Test (SNOT-22) provide validated means to objectively quantify patients perception of disease burden in terms of symptoms before and after instrumentation.

Therefore its important to analyse in order of priority the symptoms experienced by the patients suffering from chronic rhino sinusitis / sinonasal polyposis ,undergoing FESS, and to assess the outcome, taking into consideration few comorbid factors, which explains the success/limitation of the procedure and thus its impact in ultimately determining the Quality of Life outcome (QOL) after FESS.

In the early twentieth century, Mosher said that intranasal ethmoidectomy is one of the most dangerous and blindest of all surgeries. This view changed dramatically with the advent of the endoscopes. Throughout the history of medicine numerous attempts have been made to illuminate and examine the inside of the various hallow cavities located within the body.

In 1907, Hirschmann used a modified cystoscope to examine the middle meatus and study sinus ostia. The most significant development in nasal endoscopy was noticed during 1950's when Hopkins developed solid rod lens with proximal cold light source. In the latter part of twentieth century sinonasal endoscopy has been established as an important component in our diagnostic and therapeutic armamentarium.

The pioneering work of Prof Walter Messerklinger of Graz, Austria on sinus mucosa and mucociliary transport has brought light into the understanding the pathophysiology of sinus diseases. This can be summarized as below:

1. Most PNS infections spread from nose to sinus.
2. Recurrent sinusitis is secondary to insufficient outflow or ostial obstruction
3. Sites of obstruction or partial stenosis are the ethmoid infundibulum at the entrance to the maxillary and frontal sinus<sup>3,4</sup>.

This work of Messerklinger has been appreciated and accepted. The earlier concept that frontal and maxillary sinuses are the culprits for chronicity of the disease is no longer accepted. This point was again confirmed by the introduction of CT-scan.

Two Basic approaches namely the Messerklinger (1985) which is from anterior to posterior and Wigand approach (1978) which is from posterior to anterior approach done. Principles of both of these are once drainage is established, mucosa reverts from its temporary damage.

FESS has gained popularity and continues to do so among the ENT surgeons in the recent years with the better understanding of the lateral wall of the nose.

The present study is an attempt to assess the effect of FESS on the symptoms of patients with chronic sinonasal inflammatory disease before and after surgery.

Chronic rhinosinusitis is one of the most frequent otolaryngologic diseases encountered in routine ENT practice. Chronic rhinosinusitis significantly impacts the quality of life by interfering with the general health, vitality and social functioning and cause decrease in productivity in the work force, which is comparable with that observed in patients with coronary heart disease and chronic lung disease. Chronic rhinosinusitis is one of the commonest conditions for which antibiotics are prescribed. Most cases of chronic rhinosinusitis respond to medical treatment but if no improvement in symptoms is achieved, FESS advocates systematic approach to the surgical treatment of the disease of the nose and sinuses<sup>6,7</sup>.

#### **A BRIEF NOTE ABOUT SINO NASAL OUTCOME TEST SCORING (SNOT-22)**

1. Developed in the year 2003 in Danish language
2. It encompasses the major symptoms as well as minor symptoms of chronic rhinosinusitis.
3. There are about 22 items and asked in form of questionnaire.
4. The scale ranges from 0-no problem to 5-problem as bad as it can be



5. It has been shown to have a good reliability, validity and responsiveness among patients and it takes around 7 mins to complete the questionnaire

### **IMPORTANCE OF SNOT-22:-**

The Royal college of surgeons of England used the SNOT-22 scoring for National comparative audit of surgery for chronic rhinosinusitis ,the questionnaire was simple and had a better discriminant value and finally in 2009 it was validated and SNOT 22 came for routine clinical practise.

## **AIM OF THE STUDY**

1. To assess the various symptoms of CRS before FESS.
2. To compare the various symptoms of CRS before and after FESS.
3. To assess the success or the limitation of FESS depending on the degree of improvement of individual symptoms which the patient experienced before and after the procedure.

## REVIEW OF LITERATURE

According to Draf<sup>1</sup>, Hirschmann performed the first attempts at nasal and sinus endoscopy in 1907 using a modified cystoscope. It was Maliz in New York who introduced the term sinoscopy and laid the methods for diagnosis of rhinosinusitis. In 1978, Messerklinger published the first systematic and detailed work documenting endoscopic findings in English. Messerklinger noted that wherever two opposing mucosa come into contact, the mucociliary transport mechanism is hampered, leading to stagnation and thus creating increased potential for infection even in the absence of ostial closure. The potential areas of mucosal contact lie in the middle meatus and the ethmoid air cell system. Messerklinger identified ventilatory defects in the middle meatus & anterior ethmoidal cells in patients with chronic and recurring sinus infections. These areas of persistent mucosal contact occurred either as a result of mucosal inflammation and hyperplasia following an infection, or as a result of an anatomic malformation. In majority of cases, infection spreads from the ethmoids to secondarily affect the maxillary and frontal sinuses. So the diseases of the frontal and the maxillary sinuses can be cured by clearance of the disease of the ethmoids<sup>8,9</sup>.

Many years of endoscopic investigations and observations proved that most infections of PNS are rhinogenic, spreading from the nose into the sinuses. The common focus of infection in cases of

recurring sinusitis is the stenotic area of the anterior ethmoids with infection recurring in the larger sinuses. The anterior ethmoid, especially its infundibulum is the key location for infection, & cure of maxillary or frontal sinuses is fully dependent on the pathophysiologic condition there<sup>3</sup>.

FESS aims at the primary focus in the anterior ethmoids, clearing the stenotic clefts and infected ethmoid cells. The maxillary ostium is enlarged into nasal fontanellae to provide drainage and ventilation. Once the ethmoidal focus is cleared, the dependent larger sinuses usually heal without having been touched even if their mucosal pathology seemed almost irreversible<sup>4</sup>.

The use of FESS has become popular with the improvement in understanding the lateral nasal wall skeletal framework and the surgical technique. Professor Messerklinger and Wigand introduced FESS in 1960's. It was popularized in Europe by Stammberger, and in North America by Kennedy. FESS has been accepted as a minimally invasive technique for treatment of CRS resistant to medical therapy. FESS restores sinus drainage, improves mucociliary clearance and reverts the sinus function to normal.

Although much has been written about the surgical techniques of FESS, not much has appeared about its results. An analysis by Steven et al (1999) of 100 consecutive patients undergoing FESS over 23

months' duration with average follow-up time of 5 months had average age of 39 yrs (range 6-83 yrs), 50 males and 50 females. 59 patients had recurrent sinusitis, 4 had polyps only, and 37 had both. 49 patients had previous sinus surgery. After FESS, 14 patients had minor complications, the most common complication being synechiae, between middle turbinate and septum in 6 patients. 83 patients had significant improvement after FESS while 10 had one episode of sinusitis postoperatively. The results of this series suggest that FESS is an efficacious advancement in treatment of sinusitis <sup>10</sup>. In another study done by Howard L Levine (1990), 250 patients who underwent FESS (42 unilateral, 208 bilateral) for nasal polyposis and chronic inflammatory disease of the sinuses from Jan 1986-1988, were evaluated. 21 had concomitant resections of conchae bullosa and 41 had septoplasties. Nasal drainage and facial pain were among the most common symptoms. 8.3% had minor complications and 0.7% experienced major complications. There were about 221 patients who were available for long term follow up of 12 to 42 months (mean=17 months) with series success rate for polyposis was 89.7% and for chronic sinusitis was 80.2% <sup>11</sup>.

Brain L Mathew et al (1991) studied pre-operative complaints, clinical findings, CT - extent of disease and surgical outcomes, retrospectively in 155 persons, with a median study period of 1 year. Nasal obstruction was the commonest symptom (n=146-96%) followed

by postnasal drip (n=143,92%) & facial pain/headache (n=139-90%). Indications for FESS were persistence of symptoms despite aggressive medical therapy and radiologic evidence of a significant sinus abnormality. Hemorrhage occurred postoperatively in 2 patients (1.3%) & 17 patients (12.7%) required additional endoscopic surgery. Overall, 140 patients (91%) believed that surgery was beneficial. Patients with facial pain preoperatively showed greatest improvement. Total opacification of maxillary sinuses was not a predictor of outcome, but opacification of sphenoid sinus correlated with a poorer outcome<sup>12</sup>.

Nayak et al (1991) studied a group of 78 patients (30 unilateral disease & 48 bilateral disease) between 12 to 57 yrs with chronic sinusitis over a period of 16 months with various nasal complaints, the commonest complaint being nasal discharge (27 unilateral, 34 bilateral), followed by headache (26 unilateral, 33 bilateral) and nasal obstruction (21 unilateral, 38 bilateral), with a range of duration of symptoms being 3 months to 30 yrs. All except 3 of these patients were subjected to FESS under local anesthesia. 47 of these patients had total relief, 12 had partial relief and 7 had no relief. 12 patients were lost for follow up.

6 patients had recurrence and were taken up for a second procedure. There were no complications reported<sup>13, 14</sup>.

A retrospective study of 129 patients was done between July 1991-Dec 1993 (30 months) with CRS refractory to medical treatment by Nasser A Fageeh et al. They were treated with FESS. The commonest complaint being nasal obstruction (76%), followed by headache (74.4%), anosmia (56.5%), & facial pressure/pain (50 %). Postoperatively, patients were followed up for at least 6 months. The most significant improvement was noticed in patients with nasal obstruction (60%). The least improvement occurred in patients with anosmia (40%). All the symptoms were assessed pre and postoperatively according to the severity of their symptoms by allotting grades. Most of the cases were done under general anaesthesia (90.5%). Minor complications like mild to moderate nasal bleeding, synechiae, and facial swelling were noted in a few patients. One major complication in the form of internal carotid artery rupture was observed. He was managed successfully with immediate nasal packing, fluid replacement and blood transfusion. He had no neurological sequelae. Two patients developed orbital haematoma. Fortunately, no loss of vision was encountered. The complications were comparable with other studies. There were 85.1 % of the patients who had a favorable opinion of the procedure and would recommend it to others with similar problems. It was also concluded in this study that preoperative CT imaging is essential for the diagnosis and operative planning of sinus disease. It is also an excellent intraoperative guide <sup>15</sup>.

Jakobsen J and Svendstrup F (2000) conducted a prospective study on 237 consecutive patients, from 1989 to 1999, to study the effect of FESS in patients suffering from long standing sinusitis and /or nasal polyp. Nasal obstruction was the most frequent symptom (61%) followed by purulent nasal discharge, and other symptoms. They had symptoms for a period in average of 9.3 years. Among them for 86% were performed surgery. In them 72% ethmoids opened, 54% sphenoidotomy performed, 82% meatal antrostomy performed and for 51% frontal sinusotomy done. No serious complications were registered. At the end of 1 year follow up, 45% were satisfactory with the results and were symptom-free, and 44% more definitely felt good<sup>16</sup>.

To determine the effectiveness of FESS for CRS, a non-randomized prospective clinical study was done by Bhattacharyya A (2004). 100 patients with and 1 month. Pre operative major symptom marks were ranging 2.5-3.5 and minor symptoms marks were 0.8 to 2.8 as per Likert's scale and post operative decrease in both the scores occurred for the individual symptoms ( $P < 0.001$ ). Thus FESS produced significant improvement of all the symptoms<sup>17</sup>.

Senior B A et al (1998) study shows a long observation period (average 7.8 years) of 72 patients. In them 91.6 % (n=66) improved post-operatively. The subject improved in terms of scoring on longer observation period but was statistically insignificant. 13(18%) required



revision surgery. This study emphasised the fact that if sufficient post operative care given then it alleviates the need for second sitting <sup>18</sup>.

Retrospective analysis of data on 100 rhinosinusitis patients who had undergone FESS was presented by Roth Y et al (1995). High rate of good results (79%) and a low rate of complications (17% all minor). All satisfactorily comparable to those reported from other centers <sup>19</sup>.

A review of recent FESS literature, including 10 large series having a sample size of 1,713 subjects, by Terris M H and Davidson T M (1999) shows a 91 % improvement rate. Subjectively, 63% of patients reported very good result, 28% a good result and 9% an unsatisfactory result. 12 % of the patients required revision surgery. Major complications occurred in 1.6% of the patients <sup>20</sup>.

CRS restricts quality of life of many of involved patients. 279 such patients were included in a study done by Damm M et al (2002) from 1995-1999 assessed the effect of FESS on symptoms and nature of life. The nature of life was restricted by CRS in 94% of all the patients before surgery and ranked as severe or intolerable in 74%. The predominant symptoms of CRS were nasal obstruction in 92% and postnasal discharge in 87%. Furthermore, patients reported respiratory tract infection in 68%, decreased smell in 66%, cephalalgia in 64% and asthmatic complaints in 34%. After a post surgical follow-up of 31.7 months, an improvement of quality of

life was achieved in 85%, nil change in 12%, and worsening in 3%. The ranking of symptoms improved from severe to mild ( $P<0.01$ ). Mainly symptoms that improved were nasal obstruction (84%), headache (82%), and postnasal drip (74%) (All  $P<0.01$ ). Hence, it was decided that the above symptoms improved in excellent explaining the success of FESS <sup>21</sup>.

Hoffmann et al (1993) conducted a study which was outcome based and longitudinal study of sinus symptoms prevalence in 31 patients treated with endoscopic sinus surgery for chronic sinusitis. Patients completed structured data collection forms to quantify the prevalence of commonly experienced sinus-related symptoms during an eight-week period preoperatively and six months post operatively. Significant improvement in nasal symptoms prevalence (post-surgery versus pre-surgery) were noted for cephalalgia, nasal obstruction, nasal congestion, recurrent infection. In addition, the proportion of subjects said their health as "better" compared to a year previously their percentage of improvement of symptoms increased from 27% pre-operatively to 58% six months post operatively. These statistical data in terms of quantification give a clear cut evidence of improvement of symptoms which affected their day to day activities thus once again proving that Functional Endoscopic sinus surgery is the best method in improving the nature of life for individuals suffering from chronic rhinosinusitis <sup>22</sup>.

Iro H et al (2004) assessed, in a retrospective study, the medium-term clinical outcome of FESS in 208 patients with CRS with a mean follow up of 3.1 years. A questionnaire focusing on nasal obstruction, rhinorrhea, nasal dryness/crusting, sneezing, headache, smell, numbness in cheeks and lips, ear fullness, epiphora and sore throat was used. In addition, subjective influence of sinus surgery on asthma, bronchitis and allergic disease was evaluated. Overall success was reported by 92% of all patients. 41% of all patients with complete ethmoidectomy and 32% of all patients with pansinus surgery described complete resolution of complaints. No difference in clinical success rates was noted when comparing primary surgery or revision. A favourable effect was also reported for asthma, bronchitis and allergic disease. It was concluded in the study that there was improvement for nasal symptoms and coexisting complaints after FESS. The value of FESS is underlined for treatment of patients with CRS <sup>23</sup>.

## **ANATOMY - LATERAL WALL AND PARA NASAL SINUSES**

### **A. DEVELOPMENTAL ANATOMY**

#### **I) LATERAL WALL OF THE NOSE**

The relationships of structures contributing to lateral wall of nose are complicated and understood if embryology is considered. Zukerkandl and others showed that ethmoid turbinate originate from ridges in the lateral wall of the fetus in the 9th to 10th weeks. Six major furrows (S1-S6) develop that may be reduced by fusion to 3 to 4. These furrows are separated by ridges, that have an anterior portion (ramous ascenders) and posterior, inferior and more horizontal portion (ramous descendents) (fig 1).

The complex ethmoid labyrinth of the adults are reduced into a series of lamellae depending on embryologic precursors. Their significance are appreciated during the endoscopic sinus surgery as they are encountered from anterior to posterior. The first basal lamella is uncinate process, the second one is ethmoid bulla, the third one is the base of middle turbinate and the fourth one is the base of the superior concha. Maxillo turbinals (MT) form the inferior turbinate which is an individual bone.

**Table - 1 : Development of the lateral wall of the nose**

<b>FURROWS</b>	<b>STRUCTURES FORMED</b>
First furrow	Frontal recess, Ethmoidal infundibulum, Middle meatus.
Second Furrow	Superior meatus
Third furrow	Supreme meatus
Fourth, fifth & sixth furrow	Disappears

<b>RIDGES</b>	<b>STRCTURES FORMED</b>
First ridge	Agger nasi, Uncinate.
Second ridge	Middle concha
Third ridge	Superior concha
Fourth & Fifth ridges	Supreme concha

### **1) PARANASAL SINUSES (fig 2)**

#### **MAXILLARY SINUS-ANTRUM OF HIGHMORE**

Maxillary sinus first appears at 7-10 weeks as shallow grooves which expands from the ethmoidal infundibulum (primitive) into the main maxillary mass bulk. At birth the dimensions are 7x 4x 4 mm pyramid shaped cavity filled with fluid. The Sinus grows in a biphasic manner with growth during 0-3 yrs and 7-12 yrs at the rate of about

2mm vertically and 3mm anteroposteriorly (fig 2). During the second stage, when permanent teeth take their place pneumatization spreads inferiorly. Either pneumatisation is so extensive that the root of tooth can be separated from the sinus by only a thin mucosa intervening. In old age secondary to tooth loss, alveolus gets resorbed and secondary to it the sinus gets enlarged.

## **ETHMOID SINUS**

The ethmoidal cells are found as furrows in the lateral wall from the 3rd month of intrauterine life. A few cells filled with fluid are present at birth. Anterior ethmoidal cells are the one which develop initially followed by posterior group. The growth of cells take place at the age of 12 years. Radiologically not seen till 1 year of age. The pneumatisation expands and correspondingly septa thin out as the child grows. Ethmoidal cells can be found above the orbit (supra orbital 15%), lateral to sphenoids (Onodi cells 10%), into the superior wall of maxillary sinus (Haller cells 10%) and in front into the floor of the frontal sinus. These cells can cause obstruction of the normal sinus drainage. These variations in the normal anatomy of the sinuses emphasise the importance of pre operative imaging in individual patients.

## **FRONTAL SINUS**

Embryologically it corresponds to anterior ethmoidal air cells and is the most variable sinus in terms of shape. A small frontal recess is recognized from 3rd month of intrauterine life, but upward expansion rarely occurs before birth till the membranous frontal bone ossification starts around 2 years of age. Between the age of 4 to 7 medial and upward expansion occurs and by 12 years the development of frontal sinus is complete. This sinus is the last to complete its development and takes place till early adolescence.

## **SPHENOID SINUS**

Sphenoid sinus starts developing around 3rd month of intrauterine life as an evagination from the sphenoethmoidal recess represents a fluid filled small cavity, 2x2x1.5mm at birth; and its full size reached in adolescence and may further expand in old age. The rate of pneumatization is 0.25mm per year from the age of 4 yrs but this is inconstant.

### **A) MACROSCOPIC ANATOMY**

#### **I. NOSE-LATERAL 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 meatae named accordingly.

## **INFERIOR TURBINATE**

Its surface is irregular and vascular channels groove it and mucoperiosteum is firmly attached to it. Its process which goes towards the maxilla articulates with the lower border of maxillary sinus ostium. In addition it joins with the lacrimal, ethmoid and palatine bones completing the inner wall of the duct that connects the nasal cavity with the lacrimal sac. The turbinate submucosally has numerous cavernous plexus with enormous sinusoids and the autonomic nervous system controls them. They contribute maximally to nasal resistance

## **INFERIOR MEATUS**

Part of lateral nasal wall that is inferolateral to the inferior turbinate. Its extent is to the entire anteroposterior dimension of the cavity of the nose. The height is maximum at the junction of anterior and middle third .

## **NASOLACRIMAL DUCT**

This duct drains the lacrimal sac with extension from the lacrimal fossa in the orbit down behind the maxillary vertical buttress and finally terminates in the front portion of the inferior meatus. The opening is covered by a small fold of mucosa called plica lacrimalis [Valve of Hausner]. The duct on an average lies 4 to 9 mm anterior to ostium<sup>26</sup>.



## **MIDDLE TURBINATE**

It forms part of the ethmoid bone. The antero-superior portion of middle turbinate is adjacent to crista ethmoidalis of maxilla, which forms a bulge known as agger nasi. The posterior end attaches to the ethmoidal crista of the perpendicular plate of the palate. The intermediate portion depending on its attachment is divisible into three portions, the front portion is vertical and oriented in sagittal plane and inserted directly to the base of skull at the outer edge of the cribriform plate. The central third attaches to lamina papyracea by its ground lamella, where it runs in an frontal plane. The posterior third, oriented in a axial plane attaches to the papyry thin partition or lamina papyracea or medial wall of the maxillary sinus by means of ground lamella, and forms posterior part of roof of middle meatus. Posterior ethmoidal cells can indent the ground lamella anteriorly, and anterior ethmoid cells or retrobullar recess can indent the ground lamella posteriorly<sup>26, 27</sup>.

## **AGGER NASI**

It is a prominence on the side wall just in front of middle turbinate insertion. Frequently pneumatized by an agger nasi cell that arises from the upper aspect of the infundibulum. A large agger nasi cell may cause frontal recess to become narrow and may hinder in frontal sinus drainage.

## **MIDDLE MEATUS**

Part of the lateral wall of the nose lying inferolateral to the middle concha. It receives drainage from anterior group of sinuses which are frontal sinus, maxillary sinus and the anterior ethmoidal cells.

## **UNCINATE PROCESS [latin: uncinatus-hook shaped]**

It is a sickle shaped structure measuring about 3-4 mm wide, 1.5–2 cm long entirely sagittally oriented. It is attached in front to the back edge of the lacrimal bone and lower to the upper edge of the lower turbinate. It has a back free margin, bordering the hiatus semilunaris. Superiorly, it may attach to lamina papyracea, superior wall of the ethmoid or middle turbinate 25, 27.

## **BULLA ETHMOIDALIS**

Its a prominent and constant feature in the meatus that is inferolateral to the middle turbinate, containing the anterior ethmoidal cells which is the largest. It is variable in size and its pneumatization may be complete (torus lateralis) or partial. Backwards the bulla may merge with the lamina basilaris or may have a space between them called sinus lateralis / retrobulbar recess, which drains medially through the hiatus semilunaris posterioris. Upwards it may reach the superior wall of the ethmoids forming the posterior boundary of frontal recess. Suprabulbar recess develops between the skull base and superior surface of the bulla

if the bulla doesn't reach the skull base. Lateral boundary of the bulla is formed by the thin papery bone between labyrinth and orbit <sup>25, 26, 27</sup>.

### **HIATUS SEMILUNARIS (fig 4)**

It is a two dimensional space sandwiched between the posterior border of the uncinate process and anterior face of the ethmoidal bulla<sup>27</sup>. This is also referred to as hiatus semilunaris anterioris. The ethmoid infundibulum is reached through this.

### **ETHMOID INFUNDIBULUM (fig 4)**

It is a three dimensional space connecting the maxillary sinus ostium through hiatus semilunaris to the middle meatus. Infundibulum may communicate in front and in upper aspect to the frontal recess in about 14% of the cases. But in most situations, the infundibulum ends blindly into a recess formed by the upper attachment of uncinate to the lamina papyracea. This is known as recessus terminalis. In this case the frontal sinus drainage is between middle turbinate and uncinate. The boundaries of infundibulum are as follows Medially- the uncinate and hiatus semilunaris through which it communicates with the middle meatus Laterally- lamina papyraceae Anteriorly - acute angle formed by attachment of uncinate to the lamina papyraceae Posteriorly - the anterior face of bulla ethmoidalis Inferiorly - the process from the inferior turbinate articulating with the maxilla Superiorly- depends on superior attachment the uncinate.

## **OSTEOMEATAL UNIT (fig 5)**

Osteomeatal unit is a functional rather than an anatomic nomenclature, which was coined by Naumann [1965] in discussing the pathophysiology of sinusitis. This does not refer to a discrete anatomic structure, but rather to several middle meatal structures collectively, namely the uncinate process, ethmoid infundibulum, and ostia of the anterior ethmoid cells, maxillary sinus and frontal sinus.

## **MAXILLARY SINUS OSTIUM**

It is located at the upper aspect of its nasal wall of the maxillary bone. Its situation corresponds roughly to ethmoid infundibulum in its posterior half or just behind lower third of the uncinate. Compared to the bony defect the ostium is much smaller, due to articulation with the surrounding bones. In a disarticulated bone the medial wall of maxillary bone has a large ostium but in articulated bone this ostium is limited by articulations from nearby bones such as Inferiorly- maxillary process of inferior turbinate Anterosuperiorly- part of lacrimal bone Posteriorly- perpendicular plate of palatine bone Superiorly- Bulla and ethmoidal labyrinth .

## **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 always indicative of previous sinus infection. The antrochoanal polyp or the Killian's polyp always arises from the accessory ostia situated in the posterior fontanelle.

### **FRONTAL RECESS (fig 6)**

This is found in upper and front portion of the middle meatus. The natural ostium of frontal sinus presents as an hourglass narrowing opening directly into the recess.

The boundaries of frontal recess are

Superiorly- skull base

Medially - middle turbinate

Laterally- lamina papyracea

Inferiorly- depends on the superior attachment of the uncinate process

## **SUPERIOR TURBINATE**

It is a part of the ethmoid bone and is the smallest turbinate, situated about :

1.25 cms inferior to the cribriform plate. SUPERIOR MEATUS

It is the space lying inferolateral to the upper concha. Posterior group of ethmoids drain in this area.

## **SUPREME TURBINATE**

This may be found above the superior meatus in 60 to 70% of the subjects, sometimes posterior ethmoids may drain in this area also.

## **SPHENOETHMOIDAL RECESS**

It is the space posterior and superior to the highest concha. The posterior ethmoidal cells and the sphenoid usually drain in this region.

## **ANATOMIC VARIATIONS**

### **CONCHA BULLOSA (Fig 7)**

This is a pneumatisation of middle turbinate by the ethmoidal air cells. When present the concha bullosa may obstruct the infundibulum and cause narrowing of the osteomeatal complex .

## **PARADOXICAL MIDDLE TURBINATE**

This is middle turbinate with its convexity facing laterally as opposed to the usual medial convexity. A paradoxical middle turbinate may cause narrowing of osteomeatal complex.

## **UNCINATE**

This is either medially or laterally rotated. When medially rotated, the uncinate process may be in contact with the middle turbinate, narrowing the middle meatus. The surgeon should be careful while incising the laterally rotated uncinate process to prevent entry into the orbit. At times, the uncinate process may be pneumatized causing narrowing of the infundibulum.

## **BULLA ETHMOIDALIS**

Over pneumatization of bulla ethmoidalis produces extensive contact areas with the middle turbinate causing obstruction in the mucociliary pathway.

## **AGGER NASI**

When well pneumatized the agger nasi cells may hinder the drainage of the frontal recess and must be cleared.

## **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 extend in a outward or backward fashion beyond the anterior wall of the sphenoid . These posterolateral cells are called Onodi cells. Its importance is while dissection in this plane it is possible to penetrate the skull base or injure the optic nerve.

## **LATERAL WALL -ARTERIAL SUPPLY**

The antero superior quadrant is supplied mainly by the anterior ethmoidal artery in addition to posterior ethmoidal and facial artery. Anteroinferior quadrant is supplied by branches from the facial and greater palatine artery. The posterosuperior quadrant is by the sphenopalatine artery and the posteroinferior quadrant is by the greater palatine branches.

## **VENOUS DRAINAGE**

The veins form a plexus, form three groups, the anterior group into facial vein, the middle group into the pterygoid plexus and the posterior group into the pharyngeal plexus.



## **NERVE SUPPLY**

### **GENERAL SENSATION :**

The anterosuperior quadrant is supplied by the anterior ethmoidal nerve, anteroinferior quadrant by the anterior superior alveolar nerve, posterosuperior quadrant by the posterior superior lateral nasal branches of the sphenopalatine ganglion, and posteroinferior quadrant is supplied by the anterior palatine branches of sphenopalatine ganglion.

### **SPECIAL SENSORY:**

Olfactory nerves supply the area above superior concha and corresponding part of the septum.

## **LYMPHATIC DRAINAGE**

Anteriorly lateral wall drains into the submandibular lymph node, posteriorly directly to upper deep cervical or indirectly through the retropharyngeal group of nodes.

## **I. PARANASAL SINUSES**

### **MAXILLARY SINUS**

It is pyramid shaped, which has a volume of 15 ml. Its dimensions are 34x 33x 23 mm. Its like a pyramid with its base directed towards lateral wall of nose and apex pointing towards zygoma. The

anterior wall has a foramen through which the infra orbital nerve comes out and ends by supplying the cheek. The medial wall is the lateral wall of the nasal cavity and the superior wall forms the floor of the orbit and the posterior wall forms anterior wall of the pterygopalatine fossa . Initially the floor is above the nasal cavity. At age 9 yrs it is at the level of the nasal floor. The depth of floor of the sinus increases as the pneumatisation increases.

### **ARTERIAL SUPPLY**

Branches from infraorbital, sphenopalatine, greater palatine and superior alveolar Arteries.

### **VENOUS DRAINAGE**

Drains into facial vein in front and into maxillary vein posteriorly.

### **NERVE SUPPLY**

By greater palatine and infra orbital nerve branches

### **ETHMOID SINUS**

Anterior and posterior ethmoid cells have a total volume of about 15 ml. Its dimensions are 33x 27x 14 mm. They are shaped like a pyramid with the widest base directed posteriorly towards the sphenoid and apex directed anteriorly. They are divided into numerous cells by

thin septations. The roof of the ethmoid slopes inferomedially and is thin medially than laterally (by a factor of 10). Medially, the roof is formed by the lamella lateralis of the cribriform plate, which is variable in vertical height with respect to the olfactory fossa depth . KEROS'S classification is based on olfactory fossa depth (fig 8)

1 to 3 mm deep – Type I 4 to 7 mm deep – Type II

8 to 16 mm deep – Type III

Type III is said to carry the greatest risk of inadvertent anterior skull base injury.

The posterior ethmoidal cells border the sphenoid sinus, and lamina papyracea forms the lateral wall.

## **ARTERIAL SUPPLY**

It is supplied by the sphenopalatine and ophthalmic arteries.

## **VENOUS DRAINAGE**

Go along with the corresponding arterial tree.

## **NERVE SUPPLY**

Upper part by the branches of ophthalmic division and lower part by the maxillary division of the trigeminal nerve.

## **ETHMOIDAL ARTERIES AND VEINS (fig 9)**

The ethmoidal arteries are branches from the ophthalmic artery, a branch of the internal carotid. The anterior ethmoidal artery passes through the anterior ethmoidal artery canal in the medial orbital wall, usually at the junction of the frontal bone and lamina papyracea, traverses the roof of the ethmoid, passes through the attachment of the middle turbinate in its vertical plane where it abuts base of the skull and reaches the superior surface of the cribriform plate where it gives a meningeal branch. The artery then passes down to supply the upper nasal septum and lateral wall of the nose, sending a terminal branch to the nasal dorsum between the nasal bones and upper nasal cartilages. The artery crosses the roof of the ethmoid immediately behind the frontal recess and may run in a dehiscent canal or in a mucosal fold. The place the artery enters the anterior fossa medially may be readily breached. The anterior ethmoidal artery may show variations as absent unilaterally in 14%, bilaterally absent in 2%, or multiple in 30%. In its absence its posterior counterpart replaces it. The smaller posterior ethmoidal artery runs through the canal in the inner wall of orbit to supply the posterior ethmoid cells, and gives a meningeal branch, and terminates in the nasal branches anastomosing with the sphenopalatine artery. The ethmoidal veins drain into the ophthalmic veins following the arteries.

## **FRONTAL SINUS**

This sinus has a volume of approximately 6-7 ml. Its dimensions are 28x 24x 20 mm. Anatomically the frontal sinus is funnel shaped. Both the frontal sinuses have their natural ostia at the most dependent portion of the sinus (posteromedial). Posterior wall is thinner compared to the anterior wall.

## **ARTERIAL SUPPLY**

Supratrochlear and supraorbital branches of ophthalmic arteries.

**VENOUS DRAINAGE** By ophthalmic vein to cavernous sinus.

## **NERVE SUPPLY**

By the supra orbital and supra trochlear nerve.

## **SPHENOID SINUS**

It has a volume of 7.5 ml and dimensions are 23x 20x 17mm. Depending on its degree of pneumatization it is classified into three types.

**CONCHAL TYPE:** The pneumatization is limited to the area of the attachment of the superior concha. This type of sphenoid is a contraindication for pituitary surgery.

**PRE-SELLAR TYPE :** The pneumatization does not extend beyond a perpendicular plate of tuberculum sella

**POST-SELLAR TYPE:** This is the most common and pneumatisation extends posteriorly along the entire anteroposterior length of the body of the sphenoid upto the clivus.

The anterior and superior walls are of variable thickness and the roof is the thinnest . The other walls are thicker. Two projections that are visualised in the lateral wall within the sphenoid sinus are the optic nerve above and the internal carotid artery below. In about 25% of the cases the carotid artery may be totally or in part dehiscent. Optic nerve is dehiscent in 6 % of the cases. The front surface of the sphenoid sinus is approximately 7 cms posterior to anterior nasal spine making an angle of 30 degrees to the floor. In the roof of the sphenoidal sinus presents a convex bulge produced by the pituitary fossa.

### **ARTERIAL SUPPLY**

Sphenopalatine and the posterior ethmoidal arteries supply the sphenoid sinus. **VENOUS DRAINAGE**

This is by the maxillary vein and the pterygoid venous plexus into the jugular veins.

## **NERVE SUPPLY**

Are by the nasociliary N, posterior ethmoidal N and a branch of the sphenopalatine nerve.

### **A) MICROSCOPIC ANATOMY**

The lining epithelium of the sinuses is pseudostratified ciliated columnar epithelium or the respiratory epithelium, which is in continuity with the mucosa of the nasal cavities. The four cells and their functions are first the ciliated cells with their (9+2) arrangement of microtubule with dynein arms in each cilia clear secretions at a rate of 9mm/min and beat rate is 70-80 times/min, there are 50-200 cilia/cell. The cells which do not have cilia have microvilli which increase the surface area and aids in humidification. The basal cells act as reserve cells and helps in regeneration of cells when damaged. The goblet cells secrete glycoprotein which increases the viscosity of the nasal secretions. They are supplied by the parasympathetic and sympathetic nervous system. Parasympathetic are secretomotor and their stimulation induces thicker mucous and sympathetic stimulation induces watery secretion. A thin basement membrane, lamina propria and periosteum support the epithelium. The secretory glands extend into the lamina propria. Highest density of goblet cells are found in maxillary sinus. The openings of the sinuses contain increased number of submucosal serous and mucinous glands<sup>25</sup>.

## **PHYSIOLOGY - OF PARANASAL SINUSES**

The direction of beat of the ciliated cells are in a specified manner. A specific pattern of mucus flow results. The mucociliary transport of mucous occurs in a genetically predetermined fashion. The transport is always directed towards the natural ostia and a dependent opening like intranasal antrostomy doesn't help in drainage. Mucosa contact between two adjacent areas such as when it occurs in case of osteomeatal unit narrowing arrests the mucociliary transport leading to stagnation and subsequent infection. Restoration of the mucociliary transport mechanism leads to clearance of the disease and this forms the basis of Functional endoscopic sinus surgery.

Mucociliary clearance in the frontal sinuses advances along the medial wall, and then moves laterally along the roof, then to lateral wall and medially along the floor towards the ostia. It recirculates several times within the sinus before it is cleared off the sinus. In the maxillary sinus, mucociliary movement is towards the ostium. It begins at the floor and radiates along the wall of the sinus superiorly. Even after creation of antral windows by intranasal antrostomy mucociliary movements persist in its upward direction towards the natural ostium. The frontal and maxillary sinuses are dependent sinuses, subordinate to their prechambers in the ethmoid and lateral nasal wall<sup>29</sup>.



## **PATHOPHYSIOLOGY OF SINUS INFECTION**

Drainage and ventilation of the larger sinuses play a vital role in the maintenance of their normal functions. The ventilation and drainage of the maxillary and frontal sinuses pass through very narrow and complicated clefts before they reach the middle meatus. These clefts are the ethmoidal infundibulum and frontal recess respectively, are parts of the anterior ethmoids. The larger sinuses therefore depend on the health and proper functioning of these prechambers. Those disorders which produces stenosis of these very narrow important areas may result in the contact of the mucosal surfaces with mucus retention. Naumanns concept says a vicious cycle is initiated by the infundibular blockage. This blockage results in stagnation of secretions and predisposing to infections which attracts inflammation which results in further edema and destruction of the respiratory epithelium and impaired mucociliary activity aggravating further stagnation and infection. Thus the cycle continues.

Though the symptoms of infection are attributed to these larger sinuses, the underlying cause is generally not to be found in the larger sinuses themselves, but in the clefts of the anterior ethmoid in the lateral nasal wall. Messerklinger in his study observed that limited resection of the disease with the clearing the vital areas of the anterior ethmoid, re-establishes the aeration and clearance via the natural

pathways. Even massive mucosal diseases in the frontal and maxillary sinuses usually heal without much intervention in these sinuses.

## **CHRONIC RHINOSINUSITIS**

Chronic inflammation of mucosa of nasal cavity one or more sinuses is known as chronic rhinosinusitis. Depending upon the duration of symptoms sinusitis may be classified as acute(7 days to 4 weeks),sub acute(4 weeks to 12 weeks) or chronic( >12 weeks). Statistics suggest that CRS is more commoner than arthritis and hypertension in general population. CRS impairs the quality of life of an individual worse, than chronic non communicable diseases such as diabetes mellitus and congestive heart failure. Furthermore, Chronic sinusitis causes significant physical symptoms in addition to affecting the functional and emotional aspects of an individual.

A better understanding of the etiopathogenesis of CRS plays a vital role in developing effective treatment. A recent concept of “one airway disease”, as the upper/lower respiratory tract, middle ear cleft are related to one and other. Hence treatment of the upper airway automatically leads to improvement of lung function.. Patients with sinonasal polyp also suffer from bronchial asthma and aspirin hypersensitivity - Samter's triad. By definition CRS is a chronic inflammation of the mucosal lining of the nose and the paranasal sinuses for a period of more than 12 weeks<sup>31,32</sup>. Histopathologically, CRS is divided into two broad categories:

1. Polypoidal mucosal changes with eosinophilia, representing more severe damage.
2. Submucosal serous gland hyperplasia.

The use of HPE in the diagnosis of CRS is not feasible <sup>30</sup>. Tissue sampling is invasive not available to all physicians involved in CRS diagnosis and treatment.

**Table – 2 : Factors associated with CRS**

<b>SYSTEMIC HOST FACTORS</b>	<b>TOPICAL HOST FACTORS</b>	<b>ENVIRONMENTEL FACTORS</b>
Allergy Immune deficiency Genetic Congenital Mucociliary malfunction Endocrine Neuromechanism	Anatomical Concha bullosa Enlarged ethmoidal bullae Everted uncinate process Paradoxical middle Turbinate Agger nasi cells Haller cells Deviated nasal septum Neoplastic Acquired mucociliary dysfunction	Micro-organisms (bacteria, fungus, viruses)  Irritant chemicals, pollutants, smoke

## **Pathophysiology of CRS**

### **1) Allergies and CRS**

There is an increase in association of AR in patients with CRS. Mechanism by which AR can cause CRS include sinonasal mucosal edema produced by allergic inflammatory mediators like histamine, cytokines and other allergy mediators, causing obstruction of the ostium leading to infection by bacteria which proves the Naumann concept. Hence allergic patients having CRS do not respond much to medical management.

### **2) Bacteria and CRS**

Their role may be direct by initiating inflammation and edema thus obstruction and stagnation of secretions or indirect as secondary to stagnation of secretions due to edema by non infective cause. Bacteria found in association with CRS are peptostreptococcus, propionibacterium spp, prevotella, streptococcal variants, cornyobacterium spp, Haemophilus influenzae, pseudomonas spp, enterobacter spp 31.

### **3) Fungi in CRS**

Two types are recognised one is the disease due to actual fungal colonisation due to secondary infection and in these situations treatment aimed at eradication of the fungus. And in the second scenario actual

fungal elements are little but the inflammatory chain of reactions to the fungus are debilitating and hence treatment aimed at suppressing the inflammation<sup>31</sup>.

### **Clinical features of CRS**

Diagnosis of CRS requires the presence of either two major factors, or one major and two minor factors <sup>30</sup>. The signs and symptoms must persist for at least 12 consecutive weeks to qualify for CRS.

**Table 3 : Sinus Symptoms**

<b>Major criteria</b>	<b>Minor criteria</b>
Facial pressure/pain Nasal obstruction Purulent nasal discharge Post nasal drip Hyposmia/anosmia Fever (acute)	Headache Fever (non-acute) Halitosis Dental pain Cough Ear pain Ear fullness

### **Clinical examination**

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

Anterior nasal examination: hyperemia, edema, crusts, purulence, polyps, and changes in appearance after topical decongestion<sup>33</sup>.

## **Investigations of CRS**

Apart from the routine blood and urine examinations certain specific investigations are done namely nasal endoscopy, radiographs, CT Scan, & MRI.

### **A) Diagnostic Nasal Endoscopy**

Nasal endoscopy is commonly used by otolaryngologist and can be helpful in the diagnosis of CRS. Nasal endoscopic findings in CRS may be: Narrowed osteomeatal complex/purulent discharge in sinus ostia, polyp . Other associated findings are blue discoloration of mucosa, DNS, concha bullosa, paradoxical middle turbinate, prominent bulla, enlarged agger nasi narrowing frontal recess, medialised uncinate and other physical/obstructive anomalies .

### **B) Radiological**

Radiological evaluation depicts the accurate clear cut extent of the disease and the deranged or the normal anatomy containing or surrounding the disease. The information subsequently facilitates safe surgery with a well-defined “road map” prior to surgical intervention .

## 1) **Radiographs:**

Excepting for poor delineation of bony anatomy due to the problem of superimposition, antero-posterior or the Water's view gives good view of the maxillary and the frontal and skull lateral view of the sphenoid sinus.

## 2) **Computed Tomography (fig 12,13):**

This is the investigation of choice as bony landmarks and other anatomical variations are delineated accurately like extent of pneumatization of the sinuses in particular the ethmoids and low lying anterior skull base etc. It actually forms a roadmap prior to surgery.<sup>35,36</sup>. 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 frontal sinus through sphenoid sinus. Slice thickness: 3 mm. Table incrementation: 3 mm Field of view: 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.

3) **Magnetic Resonance Imaging:** MRI is best suited for visualising soft tissues alone and disadvantage is bone and air doesn't give good signal intensities and assessing osteomeatal air passages and their bony perimeter is difficult. The signal intensities don't differ between those emitted from the inflammatory process from that due to normal mucosa which is in an edematous phase.

### **Treatment of CRS**

**Antimicrobial agents:** generally used are penicillins in combination with beta lactamase inhibitors or third or fourth generation cephalosporins or aminoglycosides or fluoroquinolones depending on the culture sensitivity of the offending organism. The length of therapy is at least 3 weeks, and may be extended up to 10 weeks. Debridement of the affected sinuses forms the mainstay of treatment for fungal sinusitis followed by antifungal therapy (e.g.: fluconazole)

1) **Decongestants:** Decongestants are important in reducing local mucosal edema and to improve ventilation and drainage of stagnated secretions via the sinus ostia. These alpha-adrenergic agonists may be administered either topically or systemically.

**Topical decongestants:** Long acting nasal preparations such as oxymetazoline, which can be administered twice daily, possess the advantage of direct application and relative freedom from systemic



effects (when used in normal dosage). Nasal decongestant sprays or drops can however have a side effect of rebound phenomenon of mucosal congestion when withdrawn when administered for periods longer than 5 to 7 days. Hence, topical decongestants are not used in the long-term management of sinusitis.

**Systemic decongestants:** The most commonly used systemic decongestants are pseudoephedrine and phenylpropanolamine. Their actions are similar and both possess the potential for producing the side effects due to alpha-adrenergic stimulation: nervousness, insomnia, tachycardia and hypertension<sup>39</sup>.

**Mucolytics:** One of the main symptoms of CRS is purulent nasal discharge and postnasal drip. To thickness of secretions of these secretions, both to aid in evacuation of sinus contents and to increase patient comfort, a systemic mucolytic agent is beneficial. The most widely used, and probably most effective, mucolytic for the treatment of CRS is guaifenesin. This preparation acts as an effective emetic in large doses, and to be effective as mucolytic, it must be administered in doses that are only subemetic (2400 mg of total daily dose)<sup>39</sup>.

**Nasal Toilet:** Saline nasal sprays or irrigations can be used in cleansing thick nasal and sinus secretions. To mucolytic effect of saline is augmented by an alkaline, aromatic solution such as alkalol can be added to the saline in roughly equal parts. A variation in nasal

toilet is the delivery of warm saline into the nasal cavity via a powered, pulsing irrigating device such as Grossan nasal irrigator. This is not only helpful in patients with thick nasal secretions but also helpful for postoperative cleansing following intranasal sinus surgery. Some relief of facial pressure can also be achieved with the use of moist heat to the face and steam inhalation.

**Corticosteroids:** It is one of the agents in medical management. Preoperative administration of steroids is used for two reasons to minimize size of the polyp and to minimise the blood loss. Postoperative steroid pulses are used for recurrent disease. Because of their adverse effects on many organ systems and their significant potential for undesirable side effects, systemic steroids are being largely supplanted by topical intranasal steroid sprays.

**Topical steroids:** The role of intranasal steroids in the treatment of sinusitis is to reduce mast cell degranulation and subsequently stabilisation of mast cells and preventing synthesis and release of secondary inflammatory mediators thus treating the underlying inflammation thus reducing the edema of the osteomeatal complex. To be more effective, topical steroids must contact the mucosa in the desired area, which means that they will be less effective if the airway is obstructed by turbinate edema, severe DNS or large polyp. After the initiation of treatment, it is recommended that the patient be

followed up in 6 to 8 weeks to evaluate efficacy. Topical steroids in children have been shown to be safe, with no much side effect. Potential local side effects are nasal irritation, crusting, bleeding, and septal perforation. Prolonged use of nasal steroids may produce local candidiasis. Various steroid preparations available for topical therapy are beclomethasone, budesonide, fluticasone furoate or propionate and mometasone.

1)       Antihistamines: This group of drugs exerts a competitive antagonism of histamine binding to H1 receptors on the nerve endings, smooth muscle cells of the blood vessels, and glandular cells. They prevent histamine induced vasodilation and decrease vascular permeability and edema, decrease itching sensation, decrease secretion by seromucinous glands by their anti-muscarinic action. In addition, they also possess local anaesthetic and antiserotonin effects. Patients with allergic component in their etiology can be benefited with this. The concern with antihistamines is the excessive drying of secretion leading to crust formation, and drowsiness. General side effect of drowsiness can be overcome with the use of newer second-generation antihistamines.

2)       Some of the antihistamines used are cetirizine (10 mg OD/BD), terfenadine (120 mg/day), fexofenadine (120 mg), Astemizole (10 mg OD). The latest among them being Azelastine and Ebastine.

3) Mast cell stabilisers: sodium chromoglycate stabilizes the mast cells by inhibiting the calcium-dependent degranulation process and favoring the accumulation of c- AMP. Sodium Chromoglycate has the unique property of both preventing an allergic reaction and acting on both the acute and late-phase reactions. Because of the effect of priming, it is important for patients who have CRS with an allergic component to use these group of drugs prior to anticipated antigen challenge, as well as for symptomatic relief during allergy seasons <sup>39</sup>.

4) Immunotherapy: This has evolved as a recent modality of treatment. Immunotherapy involves the administration of carefully determined doses of inciting allergens over a period of years to incite the formation of “blocking antibodies” which are IgG4 ,which prevent the IgE-allergen-mast cell interactions that produces an allergic events.

## **FUNCTIONAL ENDOSCOPIC SINUS SURGERY**

### **Anesthesia**

The choice of anesthesia in FESS usually depends on the surgeon. Local anesthesia is often preferred as it 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. In cases of nasal polyps, the polyps too are infiltrated. It is important to wait for 10 min after infiltration before surgery is commenced .

**Table 4: Instruments for FESS (Fig 14)**

1. Tilley's Nasal dressing forceps
2. Ball probe
3. Blakesley - straight or 45 degree upturned
4. Stamburgers antrum punch forceps -backward cutting-right and left, upward or downward
5. Power driven microdebrider with blade- used in polypectomy or in turbinoplasty
6. Hazek's punch forceps
7. Straight and curved suction tips

### **Surgical Techniques**

The basic steps of the anterior to posterior technique as formulated by Messerklinger 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 (Fig 16)**

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 (Fig 17)**

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

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.

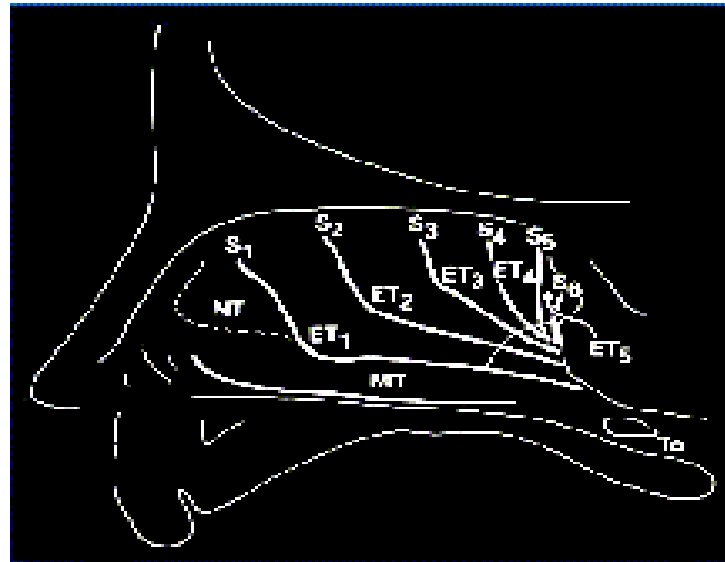
### **Post Operative Management**

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.

**Table 5 : Complications**

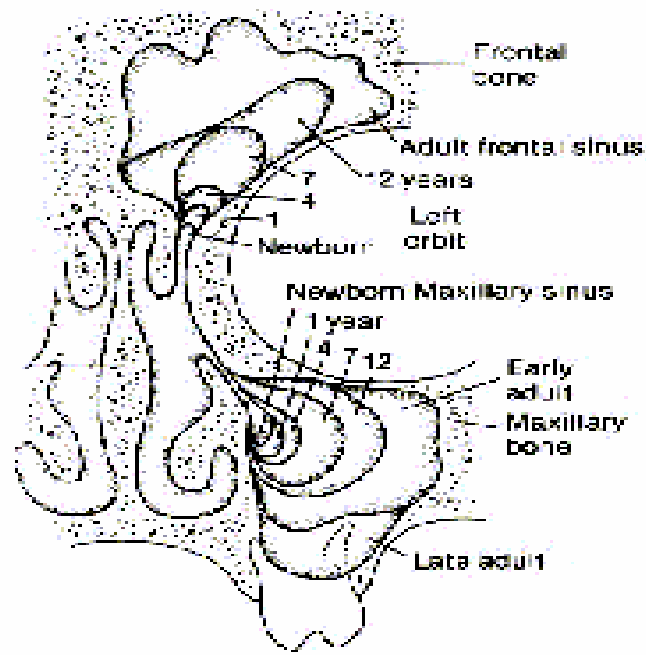
<b>Peroperative</b>	<b>Post operative</b>
Hemorrhage  Entry into the orbit CSF leak Blindness Diplopia  Injury to ICA Intracerebral bleed	Bleeding  Synechia formation Subcutaneous emphysema Pneumocephalocele Meningitis.  Epiphora Antrostomy closure



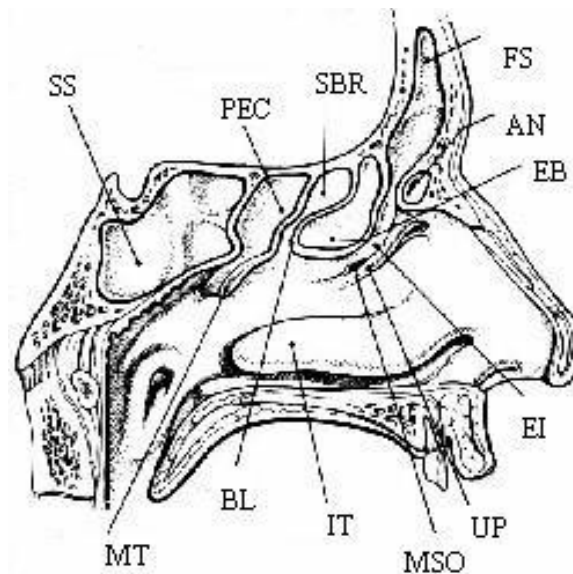


**Fig1: Embryology of the lateral nasal wall.**

(S1 to S6-Furrows, ET-Ethmoturbinals, MT-Maxilloturbinals, NT-Nasoturbinals, TO-Tubal opening)

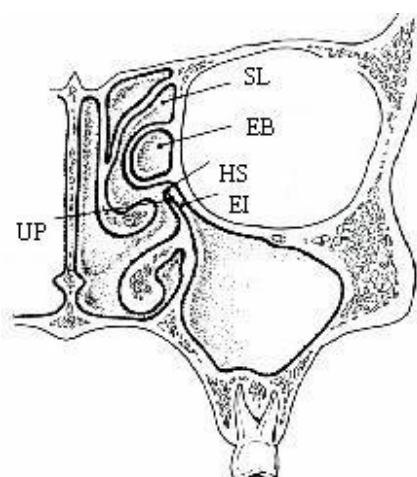


**Fig2: Development of the paranasal sinuses.**



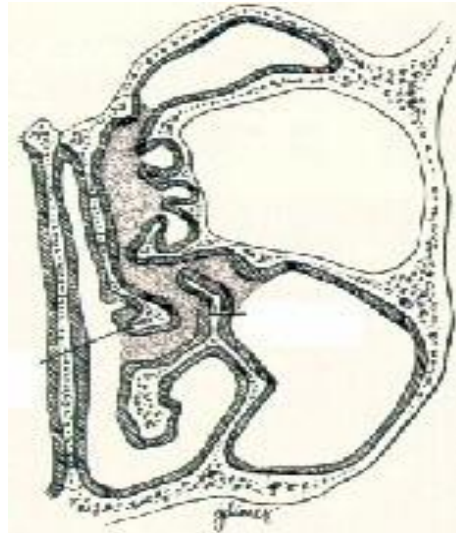
**Fig 3: Anatomy of lateral nasal wall.**

(SS-Sphenoid Sinus, PEC-Posterior ethmoid cell, SBR-Suprabullar recess, FS- Frontal sinus, AN-Agger nasi, EB-Ethmoid bulla, EI-Ethmoid infundibulum, UP- Uncinate process, MSO-Maxillary sinus ostium, IT-Inferior turbinate, BL-Basal Lamella, MT-Middle turbinate)

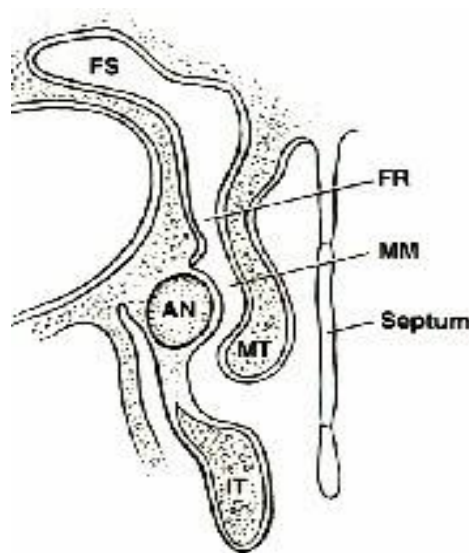


**Fig 4: Hiatus semilunaris and Ethmoidal infundibulum.**

(SL-Sinus lateralis, EB-Ethmoid bulla, HS-Hiatus semilunaris, EI-Ethmoid infundibulum, UP-Uncinate process)

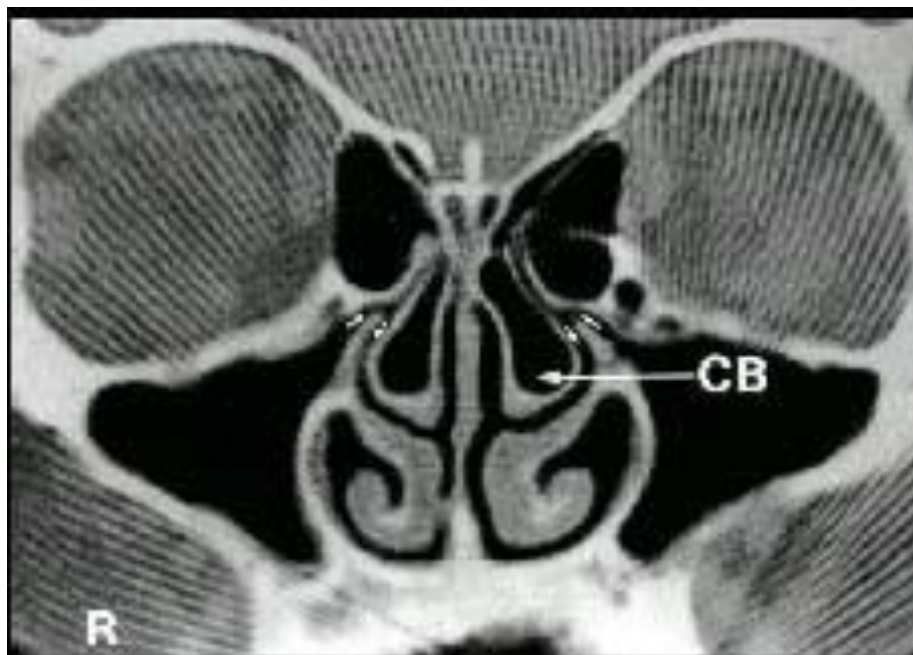


**Fig 5: Osteomeatal unit (shaded area).**

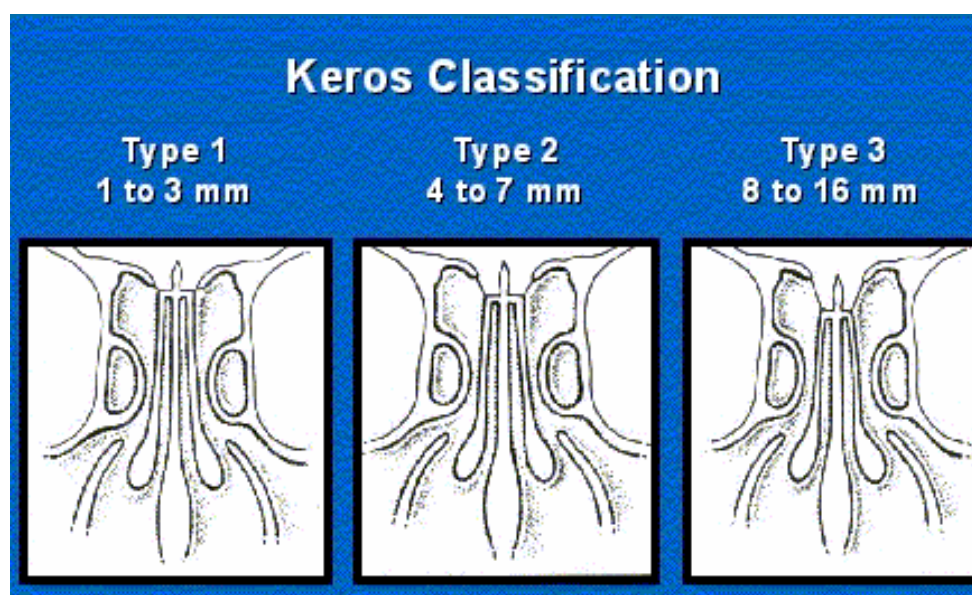


**Fig 6: Frontal recess.**

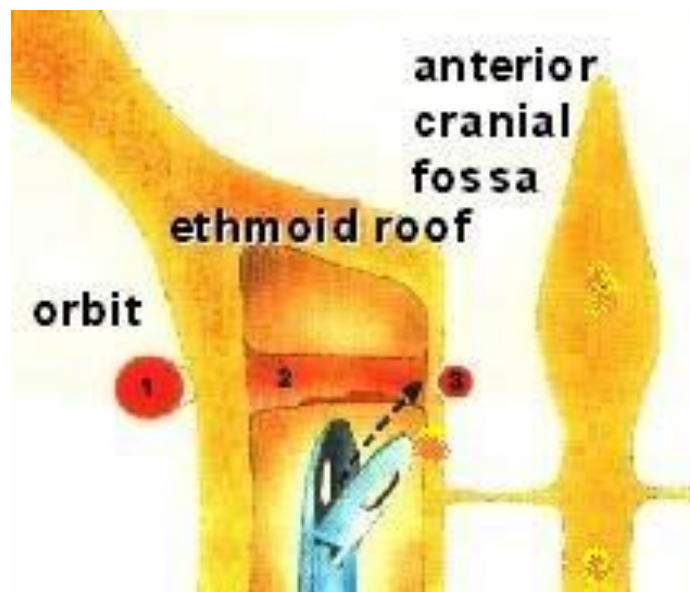
(FS- Frontal sinus, AN-Agger nasi, MT-Middle turbinate, MM-Middle meatus, FR-Frontal recess)



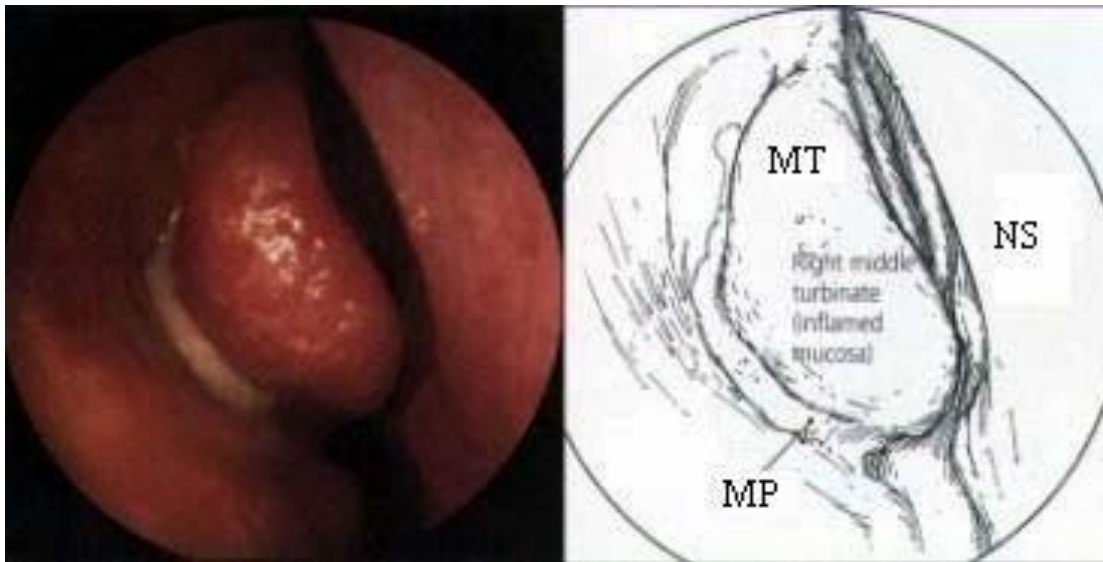
**Fig 7: Concha bulosa (CB).**



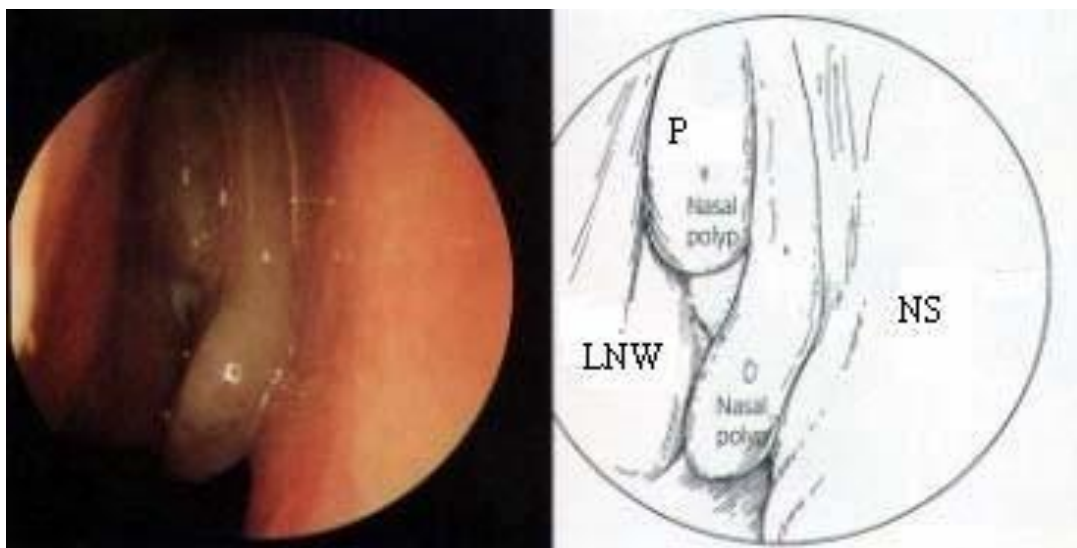
**Fig 8: Kero's classification.**



**Fig 9: Anterior ethmoidal arteries.**



**Fig 10: Nasoendoscopic view of mucopus in middle meatus. (MP- Mucopus, MT-Middle turbinate, NS-Nasal septum)**



**Fig 11: Nasoendoscopic view of polyp arising from middle meatus. (LNW-Lateral nasal wall, P-Polyp, NS-Nasal septum)**





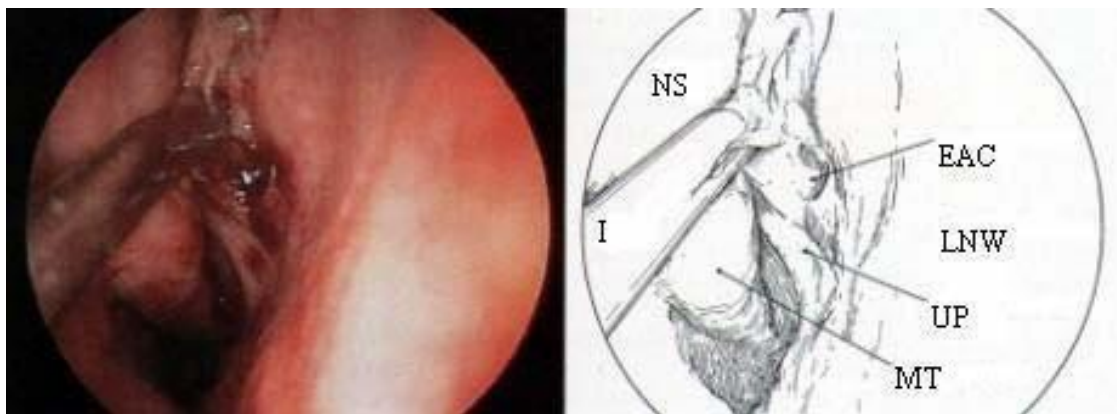
**Fig 12: CT Para Nasal Sinuses - bilateral ethmoidal polyposis.**



**Fig 13: CT Para Nasal Sinuses - bilateral ethmoidal and maxillary sinusitis.**



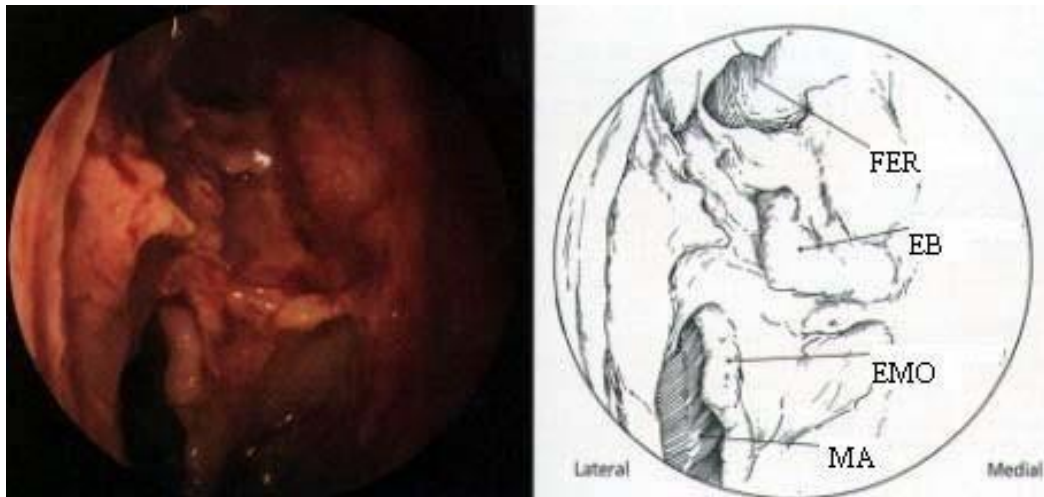
**Fig 14: FESS instruments.**



**Fig 15: Uncinectomy.**

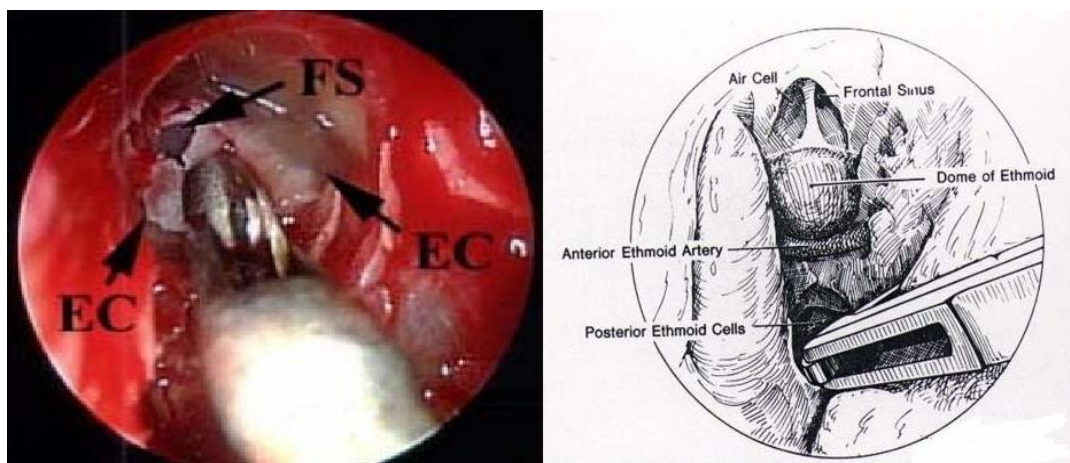
(NS-Septum, I-Instrument, EAC-Ethmoid air cell, LNW-Lateral wall of nose, UP- Uncinate , MT-Middle concha)





**Fig 16: Middle meatal antrostomy.**

(FER-Frontoethmoidal recess, EB-Ethmoid bulla, EMO-Enlarged maxillary ostium, MA-Maxillary antrum)



**Fig 17: Anterior ethmoidectomy, Posterior ethmoidectomy and frontal recess clearance being performed. (EC-Ethmoid cell, FS-Frontal sinus)**



**Fig 18: Sphenoidotomy. Debris seen within the sphenoid sinus.**

## **METHODOLOGY**

60 patients attending ENT Out Patient Department at Govt.Kilpauk medical college hospital and Govt.Royapettah hospital Chennai, with clinical features and investigations suggestive of CRS were randomly selected after applying the following inclusion and exclusion criteria:

### **INCLUSION CRITERIA**

- 1) All cases of CRS, with infective etiology, with symptoms for at least 12 weeks.
- 2) Patients refractory to medical treatment for a minimum of 6 weeks.
- 3) Patients above 20 years and below 60 years old.

### **EXCLUSION CRITERIA**

- 1) Patients below 20 years and above 60 years old
- 2) Gross DNS.
- 3) Previous nasal surgeries.
- 4) Complications of Chronic sinusitis.

- 1) Growth in the nasal cavity, benign or malignant, sinonasal polyposis. Subsequently all the selected candidates were worked up on the following pattern:

## **HISTORY**

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 questionnaire scoring was done preoperatively. Thus the scoring ranged from minimum of 0 to maximum of 60.

Any history of co-existing bronchial asthma, aspirin sensitivity or other systemic ailments like diabetes mellitus or hypertension or other co morbid illnesses was looked into.

Any history of similar complaints in any of their family members was recorded.

Personal habits with regard to smoking and alcohol intake were asked for.

## **GENERAL EXAMINATION**

- \* Vital parameters were recorded.
- \* Systemic examination of the central nervous system, cardiovascular system, respiratory system and per abdominal examination were carried out.

## **ENT EXAMINATION NOSE**

- \* External examination: for presence of any nasal deformity
- \* Para Nasal Sinus tenderness.
- \* Septum: for any Deviation of nasal septum.
- \* Airway: Cottle's test to assess nasal valvular obstruction, cotton wool test, cold spatula test.
- \* Inferior turbinate: for hypertrophy, & condition of its mucosa.
- \* Nasal Mucosa: whether pale/ boggy/congested/normal.
- \* Meatus: For any mucopurulent or mucous discharge/polyps.
- \* Posterior rhinoscopy: to assess the posterior extent of the nasal polyps when present or mucopurulent discharge.

## **ORAL CAVITY & OROPHARYNX**

- \* Buccal mucosa, tongue and dentition examination.
- \* Anterior pillars and tonsil examination.
- \* Posterior pharyngeal wall examined for evidence of postnasal drip or chronic granular changes.
- \* Indirect Laryngoscopic examination done to detect the presence of any pathology of the base of tongue, vallecula, epiglottis, arytenoids, pyriform fossa or glottis.

## **EAR**

- \* Post auricular-area and pinna examined for any operative scar or mastoid tenderness.
- \* External auditory canal examined for the presence of any wax/ debris / discharge.
- \* Tympanic membrane examined and a note made of its motility, colour, lustre any perforation, discharge.

## **INVESTIGATIONS**

- 1) Routine hematological and biochemical examinations were carried out. (Hb%, TLC, DLC, BT, CT. Urine-routine and

microscopy. Blood sugar- fasting and postprandial, BUN, Serum creatinine, when patient above 40 years or with history of DM or HTN).

- 2) Chest X-Ray and ECG done for all patient , or with history of HTN or bronchial asthma: to assess the general condition of the patient, and for fitness for surgery.
- 3) X-Ray PNS-Water's view to assess the condition of the septum, inferior turbinates and air-fluid levels, haziness or opacification of the sinuses.
- 4) Diagnostic Nasal Endoscopy under local anesthesia to record the condition of nasal mucosa, septum, & inferior turbinates. To assess the condition of the nasopharynx and eustachian tube opening, to look for the presence of mucopus or polyp in the middle meatus/sphenoethmoidal recess/nasopharynx. For assessing the group of sinuses affected whether the anterior or posterior group depending on infratubal or supratubal stream of mucopus tracking down respectively. Also, any co-existing anatomical variations of the lateral wall of the nose were noted.
- 5) NCCT PNS to assess the extent of disease, condition of OMU, degree of opacification of sinuses, bony erosion and

roof of the ethmoids among others assessing the level of anterior skull base, degree of pneumatization of ethmoids and its encroachment to the surrounding bones like Haller cells, Onodi cells, Concha bullosa. This was considered as the surgical road map prior to sinus surgery.

Once the diagnosis and extent of the disease was established, the patients were taken up for FESS, after a pre anesthetic evaluation. The surgery was done either under local or general anesthesia, depending on the following factors:

- 1) Disease extent
- 2) The condition of the subject in general, and
- 3) Patient's choice for the type of anesthesia.

The surgical procedures were carried out by two senior surgeons, in operation theater under strict aseptic precautions, using the endoscopes and the entire set of instruments as mentioned. The surgical procedures were performed along the guidelines formulated by Messerklinger and Stammberger. The various procedures performed were uncinectomy, middle turbinate reduction, Middle Meatal Antrostomy, anterior and posterior ethmoidectomy, sphenoidotomy and frontal sinusotomy. The various surgical procedures performed depended upon the laterality and the extent of the disease. At the end of the



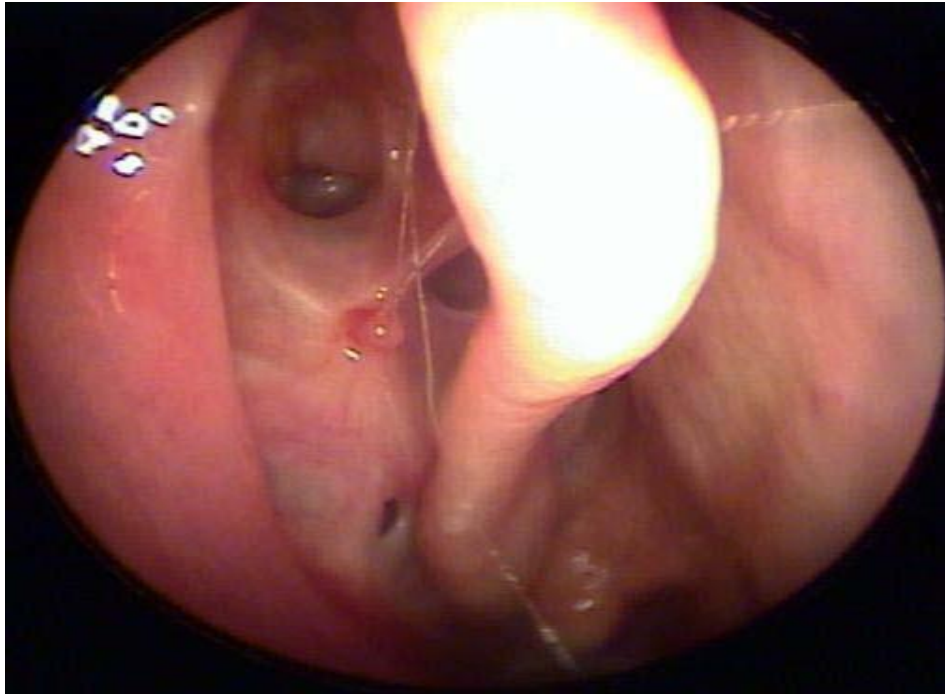
surgery, haemostasis was achieved and the nose packed with Merocel nasal pack only when the surgery was limited to the ground lamella. When the surgery extended beyond the ground lamella the nose was packed with medicated ribbon gauze (BIPP or Soframycin with betadine) in addition to the Merocel nasal pack. Post-operatively patients were started on appropriate antibiotics (e.g. Ampicillin/Cefotaxime), NSAIDS, oral decongestants and antacids. Nasal packs were removed 24 to 48 hours after the surgery depending on the extent of surgery. Local decongestants and alkaline nasal douching (common salt-50 gm, sodium bicarbonate-25 gm and sodium baborate-25 gm in 250 ml of sterile water) was started. The patients were sent home on the 2<sup>nd</sup> or 3<sup>rd</sup> post-operative day with above-mentioned medications for an additional 5 days and asked to come back for review at the end of one week.

During the postoperative follow-up, patient was asked to come once a week for first month and once a month for next two months .During each time endoscopy was done and crusts removed and suction clearance of the secretions done. Post operative questionnaire regarding improvement of symptom profile was done 3 weeks post op and later 3 months post op and improvement in scoring for each symptom as mild or moderate or marked improvement or no improvement depending on degree of downscoring for each symptom were considered.

Alkaline nasal douching was continued for the initial two to four weeks depending upon the amount of crusting seen during the follow-up nasalendoscopic examination. All the above results were tabulated and the symptoms before and after FESS compared statistically using Chi-Square test.



**Fig 19: FESS in progress.**



**Fig 20: Endoscopic picture of post operative healed cavity.**

## RESULTS

**Table-6. Age distribution**

<b>Age range</b>	<b>Number</b>	<b>Percentage</b>
20-30	25	41.67
30-40	20	33.33
40-50	13	21.67
50-60	2	3.34

**Table-7. Sex distribution**

<b>Sex</b>	<b>Number</b>	<b>Percentage</b>
Male	38	63.34
Female	22	36.66

**Table – 8 : Duration of Symptoms**

<b>Duration</b>	<b>Number of Patients</b>	<b>Percentage</b>
3 months to 6 months	20	33.3
6 months to 1 year	28	46.7
1 year to 2 years	10	16.7
> 2 years	2	3.3

**Table – 9 : Anterior Rhinoscopy Findings**

<b>Structures</b>	<b>Number of Patients</b>	<b>Percentage</b>
DNS	10	16.7
Inferior turbinate hypertrophy	10	16.7
Pale boggy mucosa	2	3.3
Congested mucosa	4	6.7
Polyps	2	3.3
Mucopus	56	93.3

**Table – 10 : Pre operative Diagnostic Nasal Endoscopic Findings**

<b>Structures</b>	<b>Number of Patients</b>	<b>Percentage</b>
DNS	10	16.7
Polyps	2	3.3
Mucopus	58	96.7
Paradoxical middle turbinate	8	13.3
Bulbous Middle turbinate	14	23.3
Accessory ostia	2	3.3



**Table – 11 : CT Plain of the PNS**

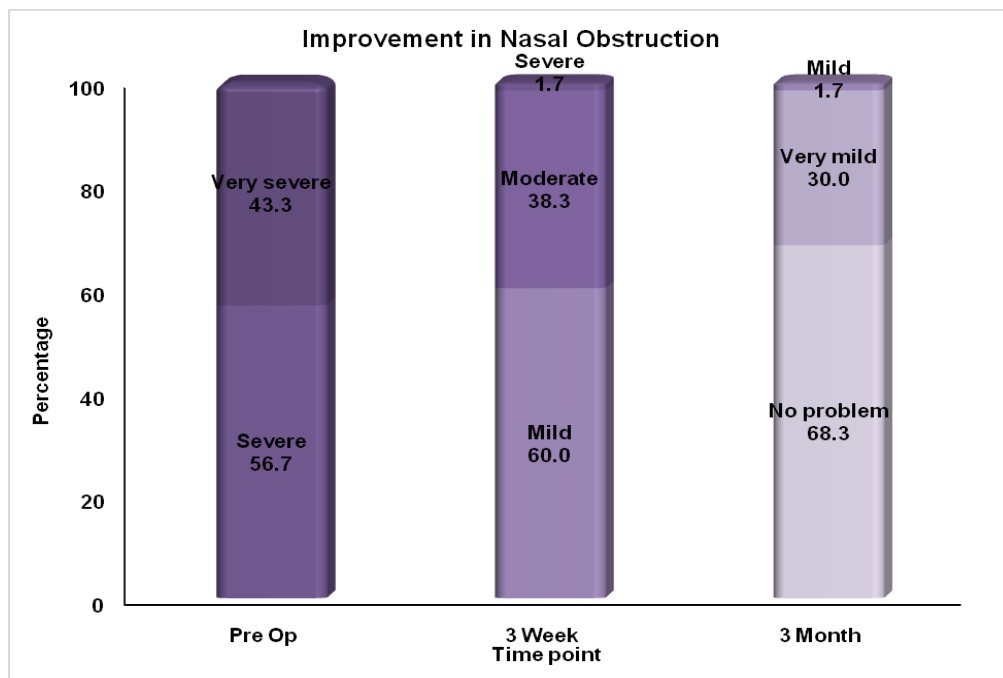
<b>Sinuses</b>	<b>Right</b>				<b>Left</b>			
	<b>Normal</b>		<b>Opacified</b>		<b>Normal</b>		<b>Opacified</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
Anterior Ethmoids	4	6.7	56	93.3	3	5.0	57	95.0
Posterior Ethmoids	4	6.7	56	93.3	3	5.0	57	95.0
Maxillary Sinus	2	3.3	58	96.7	4	6.7	56	93.3
Frontal Sinus	34	56.7	26	43.3	40	66.7	20	33.3
Sphenoid Sinus	46	76.7	14	23.3	50	83.3	10	16.7

**Table – 12 : Procedure Done**

<b>Type of Procedure</b>	<b>Nos.</b>	<b>%</b>
Uncinectomy	60	100.0
Middle Meatal Antrostomy	60	100.0
Anterior Ethmoidectomy	60	100.0
Posterior Ethmoidectomy	60	100.0
Sphenoidotomy	20	33.3
Frontal Recess Drainage	32	53.3
Septal Correction	10	16.7
Reduction of middle turbinate (Conchoplasty)	14	23.3
Out Fracturing of Middle Turbinate	8	13.3
Polypectomy	2	3.3

**Table - 13 percentage of improvement of nasal obstruction****NASAL OBSTRUCTION**

		Nasal Obstruction: Pre Op				Total	
		Severe		Very Severe			
		N	%	N	%	N	%
Nasal Obstruction:  3 month	No Problem	28	82.4	13	50.0	41	68.3
	Very Mild	6	17.6	12	46.2	18	30.0
	Mild	0	.0	1	3.8	1	1.7
	Total	34	100.0	26	100.0	60	100.0

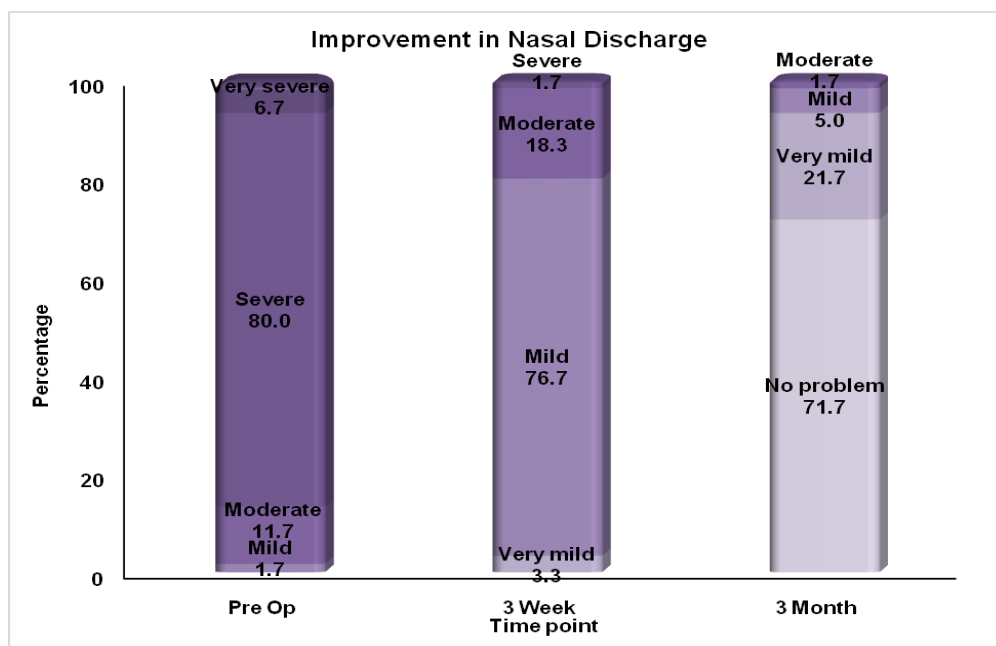


**Fig 21. Percentage of improvement of Nasal Obstruction**

This symptom showed a good degree of improvement as at the commencement of treatment almost 99% of the subjects suffered from this symptom and at the end of 3 months after surgery the success rate was 100% as nearly the same number (98.3%) had mild or no problem.

**Table 14-percentage of improvement of nasal discharge****NASAL DISCHARGE**

		Nasal discharge: Pre Op								Total	
		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%
Nasal discharge: 3 month	No Problem	0	.0	5	71.4	36	75.0	2	50.0	43	71.7
	Very Mild	1	100.0	2	28.6	9	18.8	1	25.0	13	21.7
	Mild	0	.0	0	.0	3	6.3	0	.0	3	5.0
	Moderate	0	.0	0	.0	0	.0	1	25.0	1	1.7
	Total	1	100.0	7	100.0	48	100.0	4	100.0	60	100.0

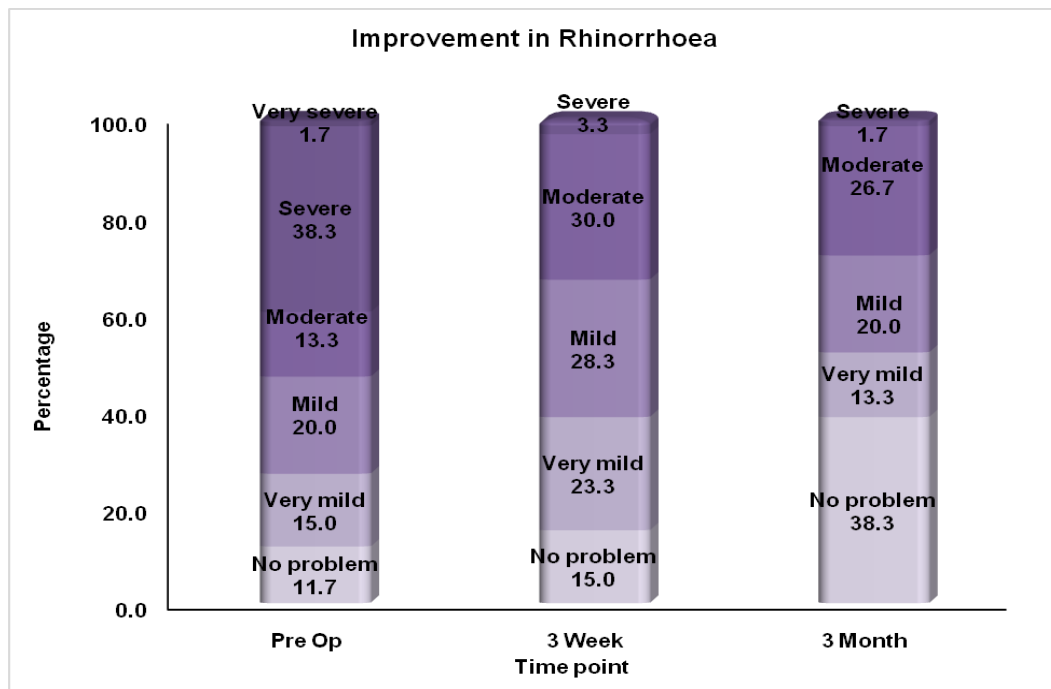


**Fig 22. Percentage of improvement of Nasal Discharge**

The symptom of nasal discharge also paralleled the results of nasal block with the similar outcome after surgery

**Table 15:- percentage of improvement of rhinorrhoea****RHINORRHOEA**

		Rhinorrhoea: Pre Op												Total	
		No Problem		Very Mild		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Rhinorrhoea: 3 month	No Problem	7	100.0	7	77.8	7	58.3	1	12.5	1	4.3	0	.0	23	38.3
	Very Mild	0	.0	2	22.2	4	33.3	1	12.5	1	4.3	0	.0	8	13.3
	Mild	0	.0	0	.0	1	8.3	2	25.0	9	39.1	0	.0	12	20.0
	Moderate	0	.0	0	.0	0	.0	4	50.0	12	17.4	0	.0	16	26.7
	Severe	0	.0	0	.0	0	.0	0	.0	0	.0	1	100.0	1	1.7
	Total	7	100.0	9	100.0	12	100.0	8	100.0	23	100.0	1	100.0	60	100.0

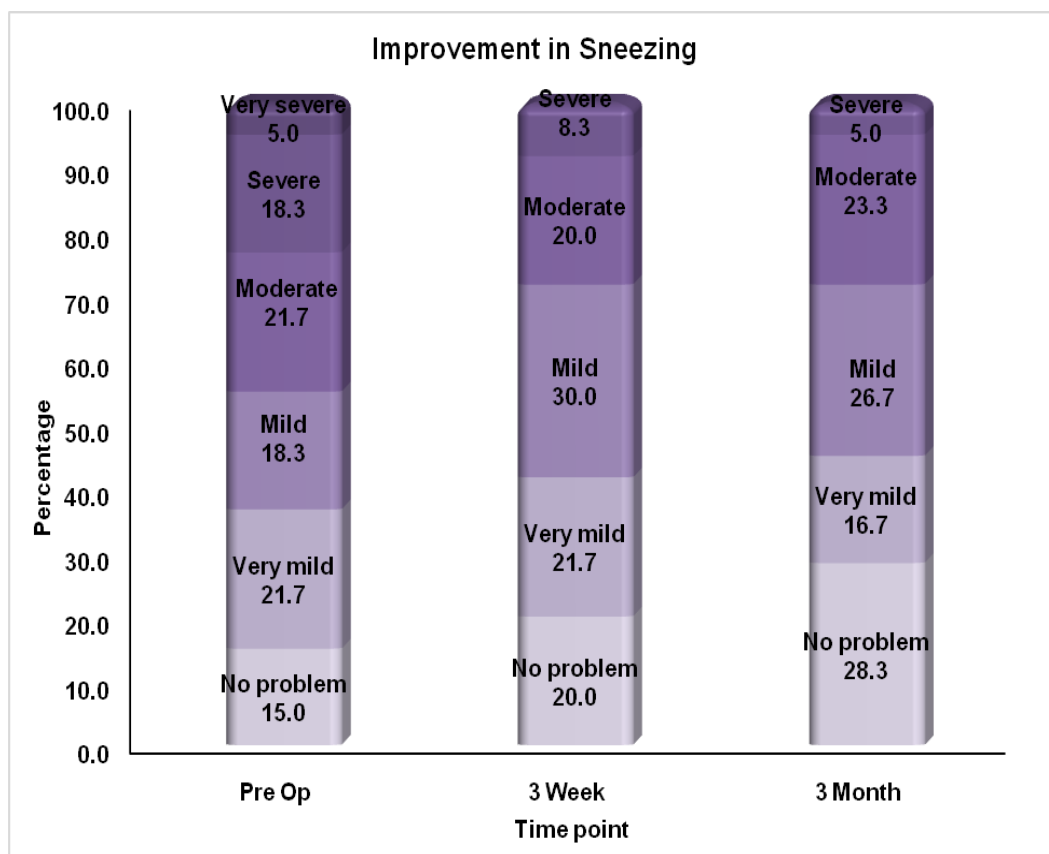


**Fig 23. Percentage of improvement of Rhinorrhoea**

This symptom often associated with allergic rhinitis did not show much improvement as only there was only 26.6% increase in persons whose became symptom free, and majority of them who were having severe problem pre-operatively just fell in the next category of moderate improvement.







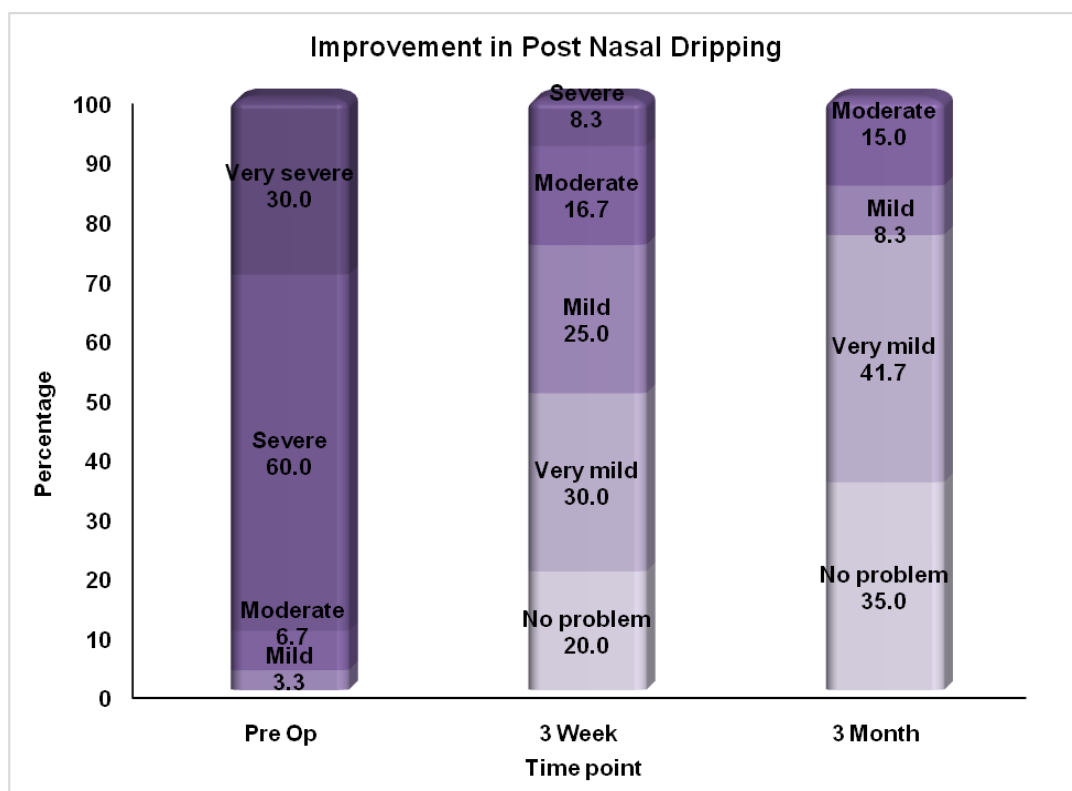
**Fig 24. Percentage of improvement of Sneezing**

This symptom results too paralleled with that of rhinorrhoea.

## POST NASAL DRIPPING

**Table 17. Percentage of improvement of post nasal dripping**

		Post Nasal Dripping: Pre Op								Total	
		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%
Post Nasal Dripping: 3 month	No Problem	2	100.0	4	100.0	14	38.9	1	5.6	21	35.0
	Very Mild	0	.0	0	.0	16	44.4	9	50.0	25	41.7
	Mild	0	.0	0	.0	1	2.8	4	22.2	5	8.3
	Moderate	0	.0	0	.0	5	13.9	4	22.2	9	15.0
	Total	2	100.0	4	100.0	36	100.0	18	100.0	60	100.0



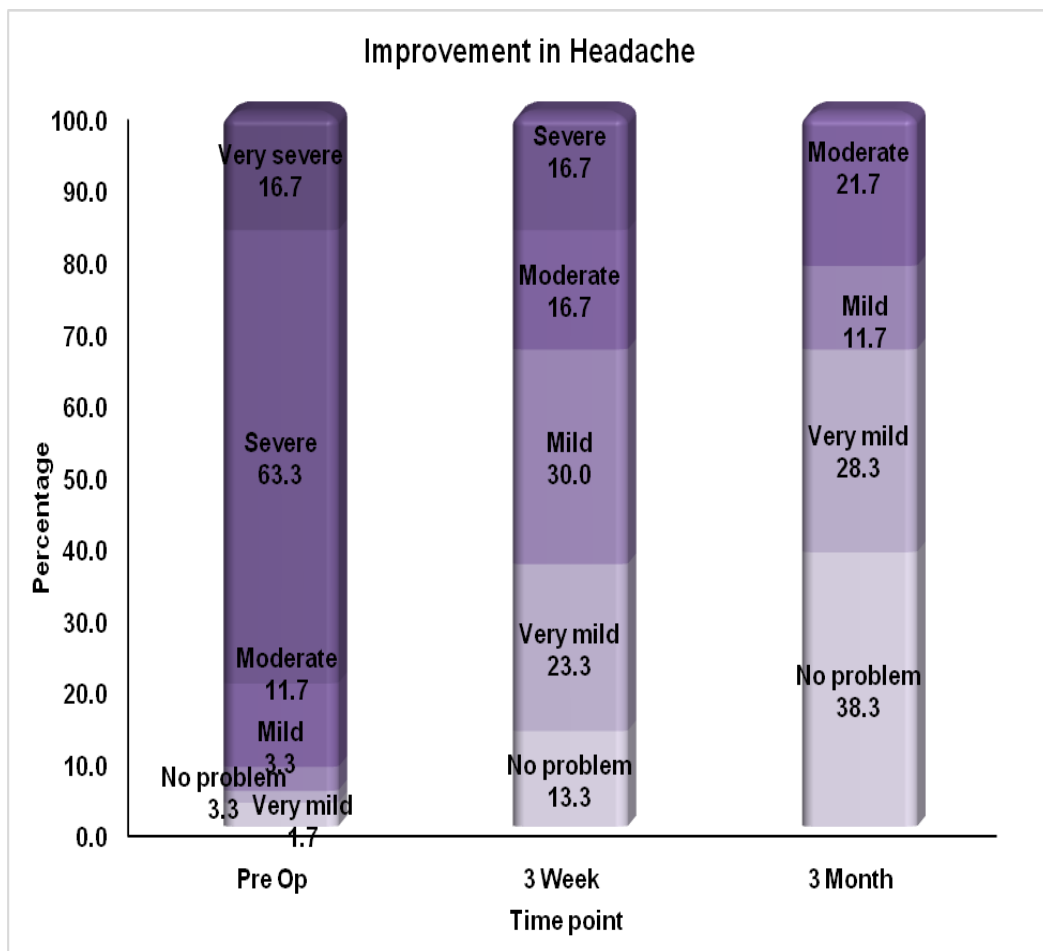
**Fig 25. Percentage of improvement of Post Nasal Dripping**

This symptom showed a good improvement as majority of the patients about 90% suffered pre operatively and about 85% at the end of the procedure showed good relief of symptoms

## HEADACHE

**Table 18. Percentage of improvement of headache**

		Headache: Pre Op													
		No Problem		Very Mild		Mild		Moderate		Severe		Very Severe		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Headache: 3 month	No Problem	2	100.0	0	.0	2	100.0	4	57.1	12	31.6	3	30.0	23	38.3
	Very Mild	0	.0	1	100.0	0	.0	1	14.3	10	26.3	5	50.0	17	28.3
	Mild	0	.0	0	.0	0	.0	1	14.3	5	13.1	1	10.0	7	11.7
	Moderate	0	.0	0	.0	0	.0	1	14.3	11	28.9	1	10.0	13	21.7
	Total	2	100.0	1	100.0	2	100.0	7	100.0	38	100.0	10	100.0	60	100.0



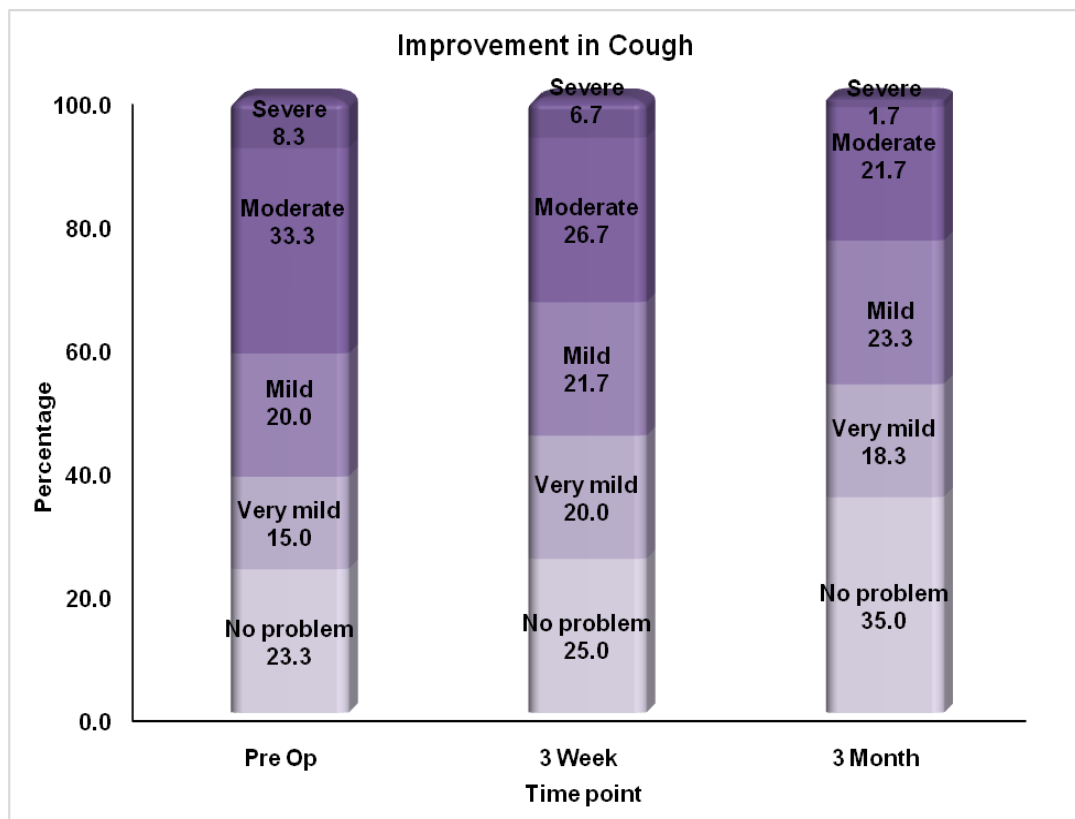
**Fig 26. Percentage Of improvement of Headache**

This symptom did not show moderate improvement as 80% of the patients suffered from severe headache preoperatively and post operatively it reduced to 61.7% patients still having the symptoms.

## COUGH

**Table 19. Percentage of improvement of cough**

		Cough: Pre Op										Total	
		No Problem		Very Mild		Mild		Moderate		Severe			
		N	%	N	%	N	%	N	%	N	%	N	%
Cough: 3 month	No Problem	14	100.0	3	33.3	2	16.7	2	10.0	0	.0	21	35.0
	Very Mild	0	.0	6	66.7	3	25.0	2	10.0	0	.0	11	18.3
	Mild	0	.0	0	.0	7	58.3	7	35.0	0	.0	14	23.3
	Moderate	0	.0	0	.0	0	.0	9	45.0	4	80.0	13	21.7
	Severe	0	.0	0	.0	0	.0	0	.0	1	20.0	1	1.7
	Total	14	100.0	9	100.0	12	100.0	20	100.0	5	100.0	60	100.0



**Fig 27. Percentage of improvement of Cough**

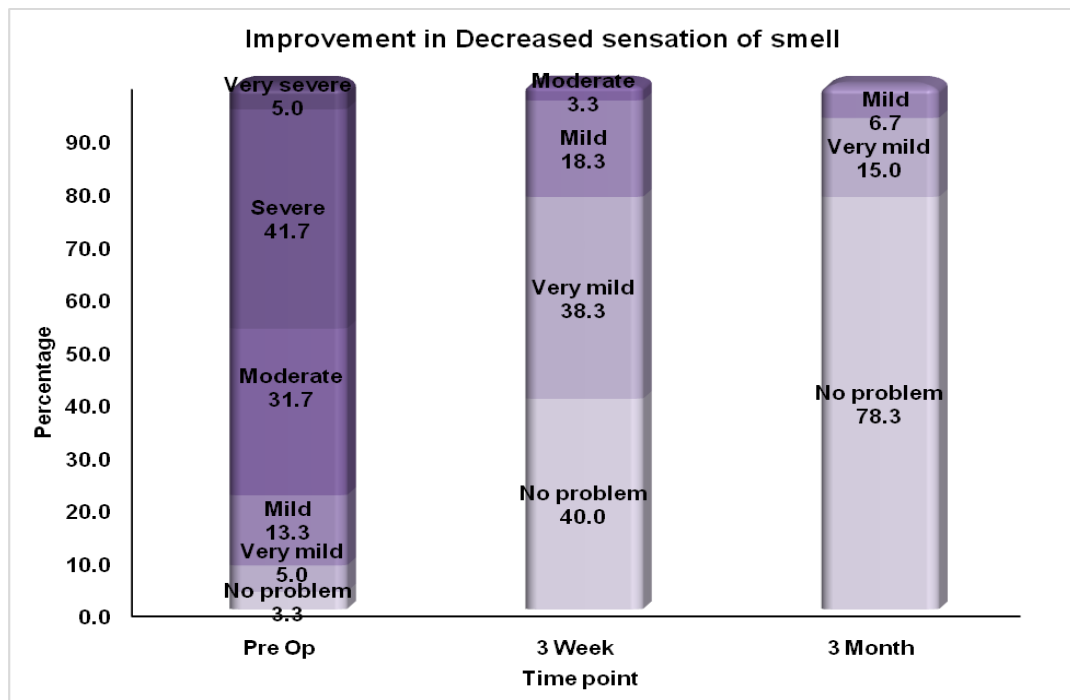
This symptom showed poor improvement with still 65% of the patients having the symptoms at the end of 3 months of the procedure.



## DECREASED SENSATION OF SMELL

**Table 20. Percentage of improvement of decreased sensation of smell**

		Decreased sensation of smell: Pre Op												Total	
		No Problem		Very Mild		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Decreased sensation of smell:  3 month	No Problem	2	100.0	3	100.0	8	100.0	16	84.2	17	68.0	1	33.3	47	78.3
	Very Mild	0	.0	0	.0	0	.0	1	5.3	6	24.0	2	66.7	9	15.0
	Mild	0	.0	0	.0	0	.0	2	10.5	2	8.0	0	.0	4	6.7
	Total	2	100.0	3	100.0	8	100.0	19	100.0	25	100.0	3	100.0	60	100.0

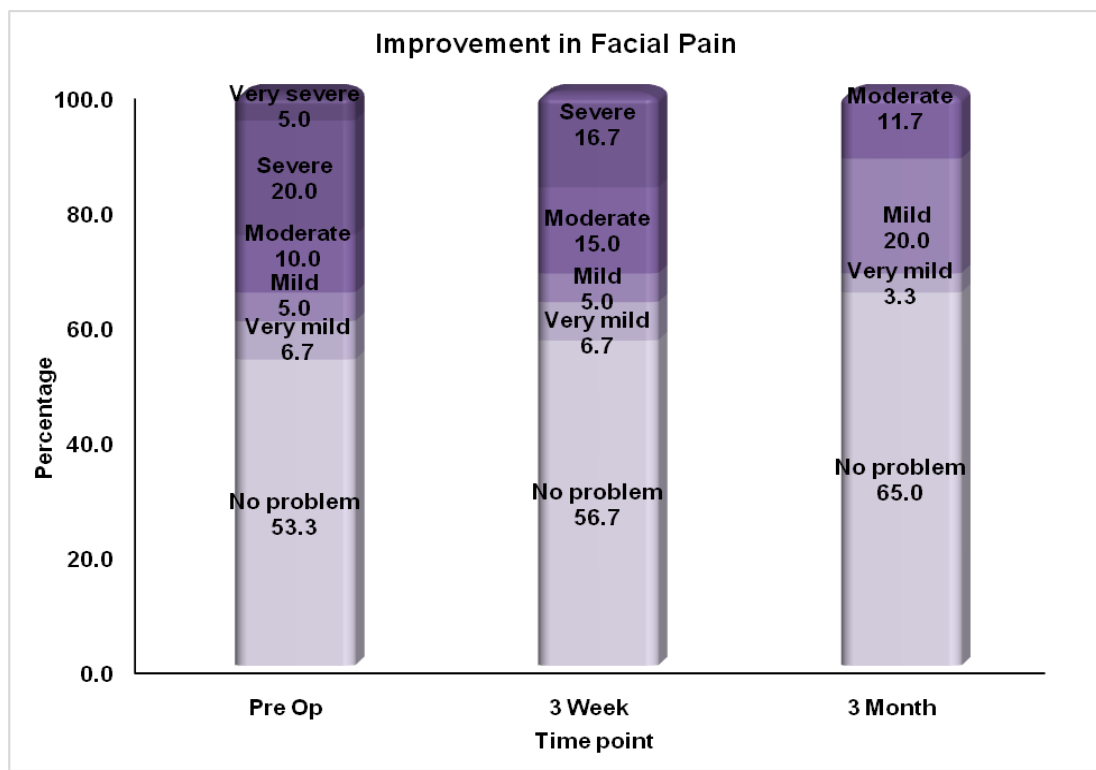


**Fig 28. Percentage of improvement of Decreased sensation of smell**

This showed good improvement with about 78.3% individuals disease free at the end of follow up

**Table 21. Percentage of improvement of facial pain****FACIAL PAIN**

		Facial Pain: Pre Op												Total	
		No Problem		Very Mild		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Facial Pain: 3 month	No Problem	32	100.0	4	100.0	3	100.0	0	.0	0	.0	0	.0	39	65.0
	Very Mild	0	.0	0	.0	0	.0	1	16.7	1	8.3	0	.0	2	3.3
	Mild	0	.0	0	.0	0	.0	5	83.3	7	58.3	0	.0	12	20.0
	Moderate	0	.0	0	.0	0	.0	0	.0	4	33.3	3	100.0	7	11.7
	Total	32	100.0	4	100.0	3	100.0	6	100.0	12	100.0	3	100.0	60	100.0

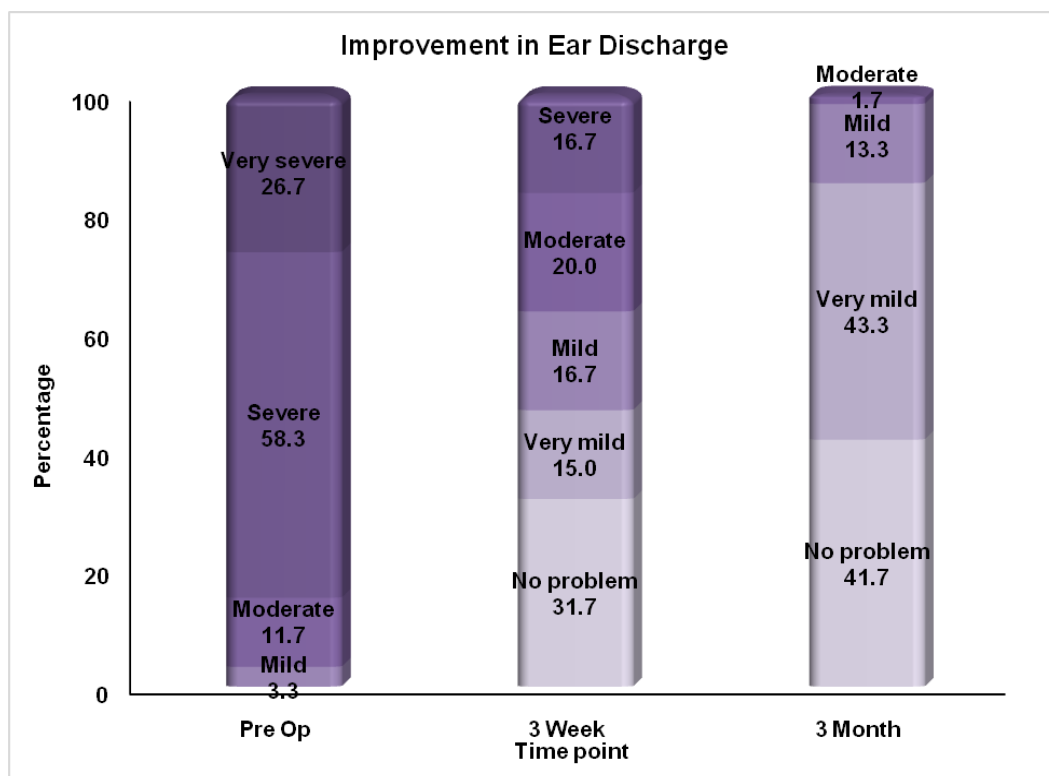


**Fig 29. Percentage of improvement of Facial pain**

This showed only a mild improvement with only 11.7% increase in symptom free subjects at the end of follow up.

**Table 22. Percentage of improvement of ear discharge****EAR DISCHARGE**

		Ear Discharge: Pre Op								Total	
		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%
Ear  Discharge : 3 month	No Problem	2	100.0	5	71.4	14	40.0	4	25.0	25	41.7
	Very Mild	0	.0	1	14.3	16	45.7	9	56.3	26	43.3
	Mild	0	.0	1	14.3	5	14.3	2	12.5	8	13.3
	Moderate	0	.0	0	.0	0	.0	1	6.3	1	1.7
	Total	2	100.0	7	100.0	35	100.0	16	100.0	60	100.0



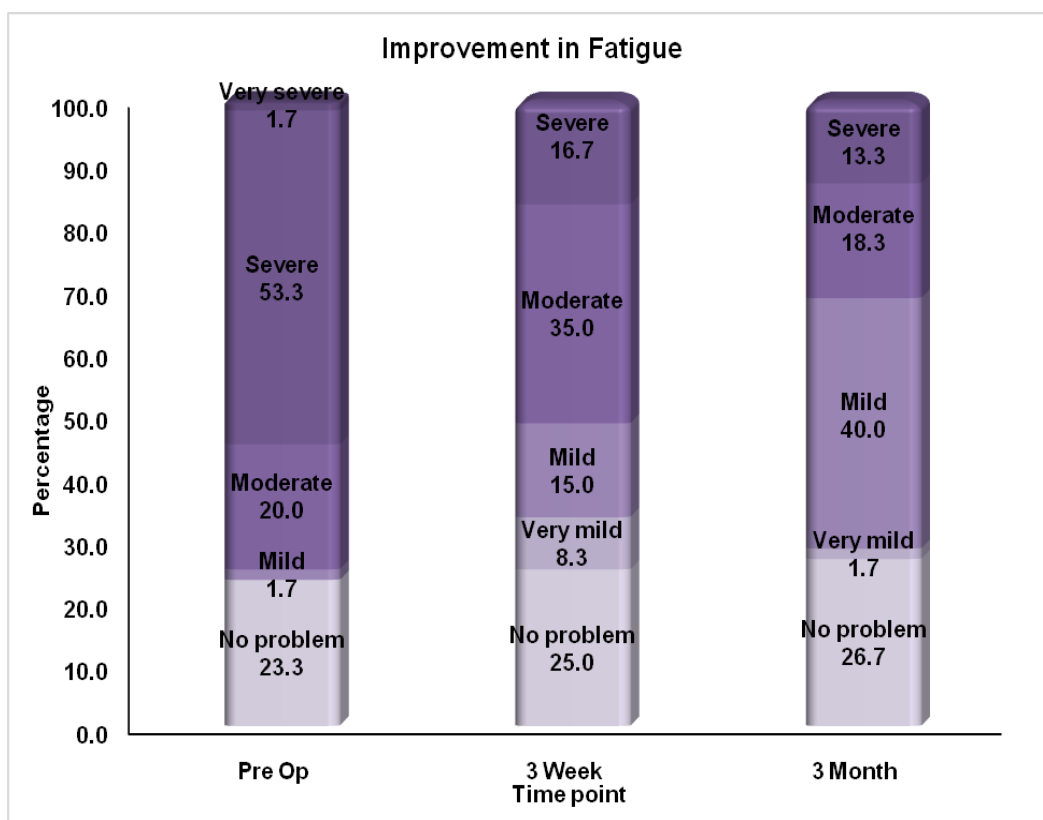
**Fig 30. Percentage of improvement of Ear Discharge**

This symptom showed a good improvement in parallel with nasal obstruction, discharge, post nasal dripping etc as majority of the patients who were initially in the very severe or severe category fell into no problem or mild problem.

## FATIGUE

**Table 23. Percentage of improvement of fatigue**

		Fatigue: Pre Op										Total	
		No Problem		Mild		Moderate		Severe		Very Severe			
		N	%	N	%	N	%	N	%	N	%	N	%
Fatigue: 3 month	No Problem	14	100.0	0	.0	1	8.3	1	3.1	0	.0	16	26.7
	Very Mild	0	.0	0	.0	0	.0	1	3.1	0	.0	1	1.7
	Mild	0	.0	1	100.0	10	83.3	13	40.6	0	.0	24	40.0
	Moderate	0	.0	0	.0	1	8.3	10	31.3	0	.0	11	18.3
	Severe	0	.0	0	.0	0	.0	7	21.9	1	100.0	8	13.3
	Total	14	100.0	1	100.0	12	100.0	32	100.0	1	100.0	60	100.0



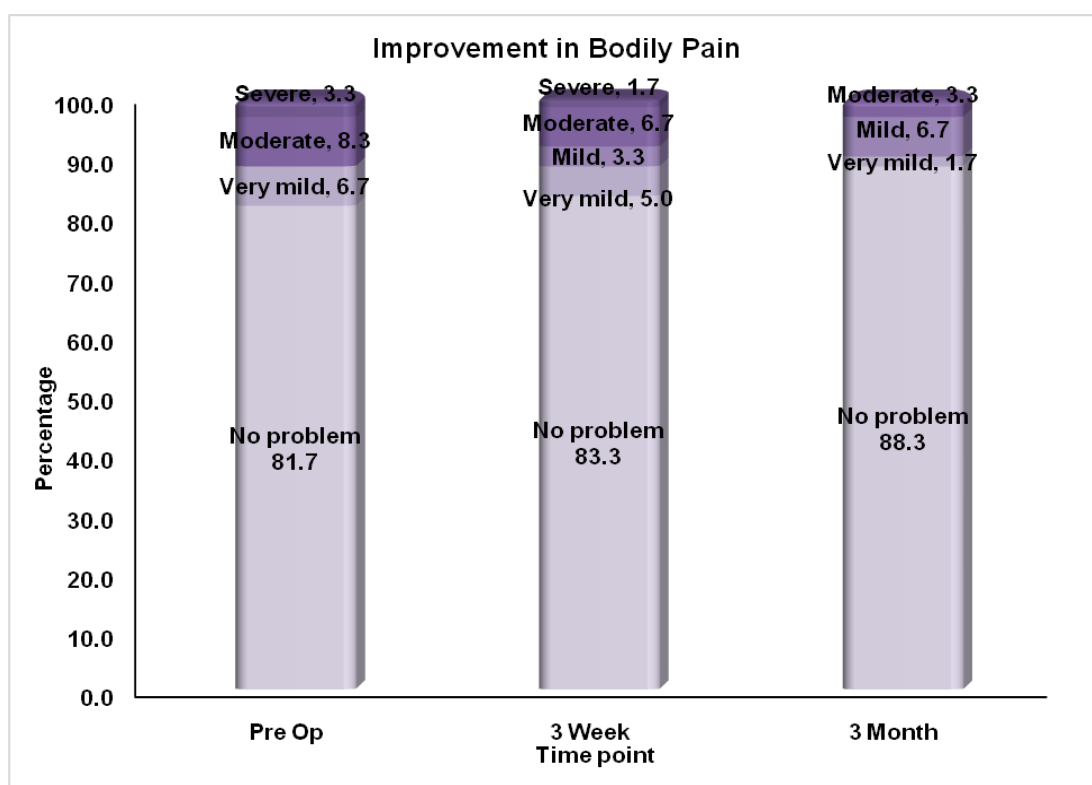
**Fig 31. Percentage of improvement of Fatigue**

This symptom improvement was largely dependant upon improvement of allergic rhinosinusitis related symptoms. Only in proportion of patients who had improvement of cough, sneezing, rhinorrhoea these non specific symptoms gained a significant improvement.



**Table 24. Percentage of improvement of bodily pain****BODILY PAIN**

		Bodily Pain: Pre Op								Total	
		No Problem		Very Mild		Moderate		Severe			
		N	%	N	%	N	%	N	%	N	%
Bodily Pain: 3 month	No Problem	49	100.0	4	100.0	0	.0	0	.0	53	88.3
	Very Mild	0	.0	0	.0	1	20.0	0	.0	1	1.7
	Mild	0	.0	0	.0	2	40.0	2	100.0	4	6.7
	Moderate	0	.0	0	.0	2	40.0	0	.0	2	3.3
	Total	49	100.0	4	100.0	5	100.0	2	100.0	60	100.0



**Fig 32. Percentage of improvement of Bodily Pain**

This symptom improvement paralleled similar to fatigue

**Table 25. Improvement scores of individual symptoms from baseline at end of follow up**

**DEGREE OF IMPROVEMENT OF SYMPTOMS FROM BASELINE**

Overall improvement Pre Op to 3 month	No (0)		Mild (+1)		Moderate (+2)		Good (+3)		Better (+4)		Best (+5)		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Nasal Obstruction	0	0.0	0	0.0	0	0.0	7	11.7	40	66.7	13	21.7	60	100.0
Nasal discharge	0	0.0	0	0.0	6	10.0	7	11.7	37	61.7	10	16.7	60	100.0
Rhinorrhoea	37	61.7	4	6.7	17	28.3	2	3.3	0	0.0	0	0.0	60	100.0
Sneezing	29	48.3	14	23.3	16	26.7	1	1.7	0	0.0	0	0.0	60	100.0
Post Nasal Dripping	0	0.0	2	3.3	7	11.7	12	20.0	32	53.3	7	11.7	60	100.0
Headache	16	26.7	14	23.3	5	8.3	13	21.7	12	20.0	0	0.0	60	100.0
Cough	37	61.7	10	16.7	11	18.3	2	3.3	0	0.0	0	0.0	60	100.0
Decreased sensation of smell	0	0.0	4	6.7	7	11.7	6	10.0	30	50.0	13	21.7	60	100.0
Facial Pain	11	18.3	17	28.3	9	15.0	14	23.3	9	15.0	0	0.0	60	100.0
Ear Discharge	0	0.0	1	1.7	6	10.0	11	18.3	37	61.7	5	8.3	60	100.0
Fatigue	32	53.3	14	23.3	9	15.0	5	8.3	0	0.0	0	0.0	60	100.0
Bodily Pain	50	83.3	5	8.3	2	3.3	3	5.0	0	0.0	0	0.0	60	100.0

**Interpretation:-**

The symptoms for which the improvement was (0) or (+1) from the baseline score were regarded as having no or mild improvement and improvement from (+2) or (+3) from baseline score were regarded as having moderate improvement and those who improved (+4) or (+5) from the baseline score were regarded as having marked improvement.

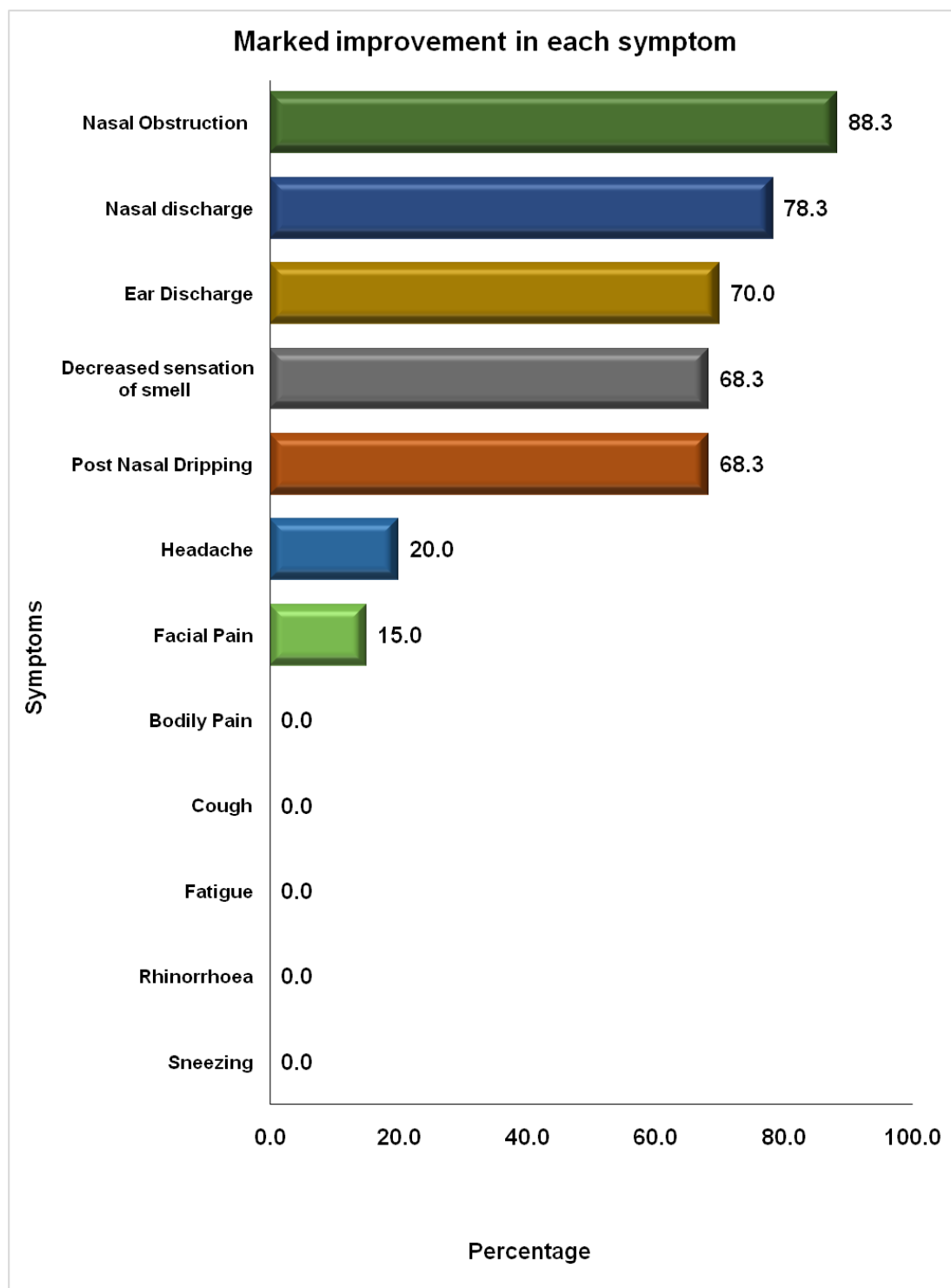
**Table 26. Percentage of patients having mild/moderate/marked improvement with respect to individual symptoms**

**IMPROVEMENT OF INDIVIDUAL SYMPTOMS IN A NUT SHELL**

Overall improvement Pre Op to 3 month	No/Mild Improvement		Moderate Improvement		Marked Improvement		Total	
	N	%	N	%	N	%	N	%
Nasal Obstruction	0	0.0	7	11.7	53	88.3	60	100.0
Nasal discharge	0	0.0	13	21.7	47	78.3	60	100.0
Rhinorrhoea	41	68.3	19	31.7	0	0.0	60	100.0
Sneezing	43	71.7	17	28.3	0	0.0	60	100.0
Post Nasal Dripping	0	0.0	19	31.7	41	68.3	60	100.0
Headache	30	50.0	18	30.0	12	20.0	60	100.0
Cough	47	78.3	13	21.7	0	0.0	60	100.0
Decreased sensation of smell	6	10.0	13	21.7	41	68.3	60	100.0
Facial Pain	28	46.7	23	38.3	9	15.0	60	100.0
Ear Discharge	1	1.7	17	28.3	42	70.0	60	100.0
Fatigue	46	76.7	14	23.3	0	0.0	60	100.0
Bodily Pain	55	91.7	5	8.3	0	0.0	60	100.0

**Interpretation:-**

The symptoms for which the improvement was (0) or( +1) from the baseline score were regarded as having no or mild improvement and improvement from (+2) or( +3) from base line score were regarded as having moderate improvement and those who improved (+4) or( +5) from the baseline score were regarded as having marked improvement.



**Fig 33. Percentage of patients facing marked improvement of individual symptoms**

## ANALYSIS OF FINAL OUTCOME

We used McNemar's test in our study.

Symptoms that showed **MARKED IMPROVEMENT** ( $p < 0.001$ )

1. Nasal Obstruction
2. Nasal Discharge
3. Post Nasal Dripping
4. Ear Discharge
5. Decreased sensation of smell

Symptoms that showed **MODERATE IMPROVEMENT** ( $p < 0.05$ )

1. Facial Pain
2. Headache

Symptoms that showed **NO/MILD IMPROVEMENT** ( $p > 0.05$ )

1. Cough
2. Rhinorrhoea
3. Sneezing
4. Fatigue
5. Bodily Pain

No / mild improvements are not statistically significant ( $p > 0.05$ ).

SPSS version 20.0 is used to analyse the data.

## DISCUSSION

The symptoms that showed the marked improvement in majority of the subjects were nasal obstruction (88.3%), nasal discharge (78.3%), post nasal dripping (68.3%), ear discharge (70%), decreased sensation of smell (68.3%) and which showed no or mild improvement were, headache, cough, rhinnorrhoea, sneezing, facial pain, those symptoms associated with allergic rhinitis.

And the non specific symptoms such as fatigue and bodily pain are largely dependant on the symptoms which showed not much improvement.

So they too showed poor improvement in parallel to those poorly improved symptoms. 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 bodily pain.

## CONCLUSION

To conclude, patients who visit the ENT out patient department diagnosed to have chronic rhinosinusitis generally present with an array of symptoms.

Its critical to analyse as to which symptoms they give priority much. If their priority is directed to the symptoms which showed a marked improvement at the end of this study then patient can be assured of the good quality of life they would get after undergoing endoscopic sinus surgery in terms of their improvement of the ailment for which they sought for a surgical intervention.

And similarly those patients presenting with predominant symptoms of allergy with chronic rhinosinusitis such as ,sneezing, rhinorrhoea, dry cough, headache or facial pain its better not to subject them for surgery taking into consideration the results of this study with regard to these symptoms. Thus anti allergic treatment measures should be the first line of management before planning for any surgical intervention for such patients.



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# PROFORMA

## Case Summary / Pre Operative Questionnaire

Name :

Age & Sex :

Occupation :

OP No :

IP No :

History :

Contact No:

S. No.	Symptoms	No Problem	Very mild problem	Mild or Slight problem	Moderate problem	Severe problem	Problem as bad as it can be
1.	Nasal Obstruction	0	1	2	3	4	5
2.	Nasal discharge	0	1	2	3	4	5
3.	Rhinorrhoea	0	1	2	3	4	5
4.	Sneezing	0	1	2	3	4	5
5.	Post Nasal Dripping	0	1	2	3	4	5
6.	Headache	0	1	2	3	4	5
7.	Cough	0	1	2	3	4	5
8.	Decreased sensation of smell	0	1	2	3	4	5
9.	Facial Pain	0	1	2	3	4	5
10.	Ear Discharge	0	1	2	3	4	5

### Symptoms – Chronic rhinosinusitis specific:-

1.	Fatigue	0	1	2	3	4	5
2.	Bodily pain	0	1	2	3	4	5

Chronic rhinosinusitis non specific:-

Total Score : 0 to 60

Associated factors:-

- 1.Asthma/Allergy/Aspirin hypersensitivity
- 2.Smoking
- 3.Prior sinus surgery

Past History:-

1. Hypertension
2. Diabetes Mellitus
3. Bronchial Asthma
4. Bleeding disorders

Treatment History:-

H/o previous surgery

H/o medication

Clinical Examination:

Nose:

1. Anterior Rhinoscopy
2. Posterior Rhinoscopy
3. Para Nasal Sinus Tenderness
4. Cold Spatula Test
5. Cotton wisp test

Ear :

Throat :

INVESTIGATIONS:-

- 1.Diagnostic Nasal Endoscopy:-
- 2.CT-Para Nasal Sinuses:-
- 3.Routine Blood Investigations:-



## ANALYSIS OF OUTCOME

## Symptoms –Chronic rhinosinusitis specific:- SCORES

S.No.	Symptoms	Pre-operative	Post operative (3 weeks)	Post operative (3 months)	Inference
1.	Nasal Obstruction				
2.	Nasal discharge				
3.	Rhinorrhoea				
4.	Sneezing				
5.	Post Nasal Dripping				
6.	Headache				
7.	Cough				
8.	Decreased sensation of smell				
9.	Facial Pain				
10.	Ear Discharge				

### **Chronic rhinosinusitis non specific:-**

1.	Fatigue				
2.	Bodily pain				
	<b>Total Score</b>				

**Total Score Range: 0 to 60**

**Overall inference of Symptoms for this patient:-**

**No/mild improvement**                      **moderate**                      **marked**

[illegible]

## PRE OPERATIVE SCORING

Sl.No.	Name	Age	Sex	Nasal Obstruction	Nasal discharge	Rhinorrhoea	Sneezing	Post Nasal Dripping	Headache	Cough	Decreased sensation of smell	Facial Pain	Ear Discharge	Fatigue	Bodily Pain
1	Muniyasamy	25	M	5	4	0	2	3	4	0	4	4	0	4	4
2	Kathirvelan	55	M	5	4	0	3	3	4	0	5	0	0	4	4
3	Karthick	22	M	5	4	4	0	4	4	1	4	0	0	0	0
4	Asifullah	25	M	4	2	0	1	2	0	0	3	0	0	3	3
5	Aarumugam	52	M	5	4	2	3	2	4	4	4	0	0	0	0
6	Basha	28	M	5	3	4	5	3	3	0	1	3	0	0	0
7	Ganesh	23	M	4	3	2	2	3	4	1	4	0	0	3	1
8	Farooq	27	M	4	4	2	3	4	4	3	2	3	0	3	0
9	David	29	M	4	4	1	2	4	4	3	3	2	0	0	0
10	John karthick	29	M	4	3	4	4	4	2	3	3	0	0	0	0
11	Sornalakshmi	24	F	5	4	1	1	4	4	3	3	0	0	3	0
12	Xavier	25	M	4	4	1	0	4	5	1	3	0	0	0	0
13	Janardhanan	27	M	4	4	2	1	4	5	1	4	5	0	4	1
14	Santhosh	29	M	4	3	1	1	4	3	0	3	0	0	3	0
15	Saraswathi	22	F	4	4	3	4	4	4	2	4	0	0	4	1
16	Jeslin Jacob	21	M	5	4	4	3	4	2	1	4	0	0	0	0
17	Badrinath	26	M	4	3	1	1	4	3	0	3	0	0	0	0
18	Baskar	29	M	5	4	4	4	4	4	2	4	0	0	3	3
19	Thirumurugan	27	M	4	4	2	1	4	4	2	2	4	0	0	0
20	Gayathri	29	F	4	4	4	0	4	5	0	0	0	0	4	0
21	Sumeetha	26	F	4	4	1	1	4	4	2	3	3	4	0	0
22	Fathima	25	F	4	4	4	4	4	4	1	3	0	0	4	0
23	Vandhana	24	F	4	4	1	2	4	4	2	4	0	4	3	0
24	Vinitha	27	F	4	4	3	3	5	5	3	2	0	0	4	0
25	Vinodhini	25	F	5	3	0	0	4	4	2	1	4	4	3	0
26	Denisha	27	F	5	4	4	5	4	4	3	4	1	0	4	0
27	Ibrahim	29	M	4	3	3	3	4	1	0	4	0	4	0	0
28	Esther	41	F	5	4	0	0	4	4	0	2	4	0	3	0
29	Harish	45	M	4	4	4	4	5	4	2	4	0	0	4	0
30	Ragavendra	41	M	4	4	3	1	4	4	3	0	2	0	0	0
31	Murugan	32	M	4	4	2	0	4	0	0	2	0	4	0	0
32	Pavithra	36	F	4	4	2	2	4	3	0	4	0	0	2	0
33	Joseph	38	M	4	4	2	3	5	4	1	3	1	0	4	0
34	Jahanghir	39	M	4	4	3	3	5	4	2	1	4	0	4	0
35	Chandrasekar	31	M	4	4	0	0	4	4	3	2	0	0	0	0
36	Kulavarshini	33	F	5	4	3	4	4	3	3	3	0	0	4	0
37	Karthick	36	M	5	4	3	0	4	4	0	2	4	4	4	0
38	Kishore	32	M	5	4	4	4	4	3	3	4	0	0	4	0
39	Udhaya Kumar	36	M	4	4	0	1	5	4	2	3	4	0	4	0

40	Chandrika	38	F	4	4	2	2	5	4	1	3	0	0	4	0
41	Yacub	32	M	5	4	2	0	4	4	4	4	0	0	3	0
42	Sebasthin	31	M	4	4	2	1	5	4	3	4	0	0	4	0
43	Lakshmanan	37	M	4	4	1	3	5	4	3	4	3	0	4	0
44	Ramanathan	39	M	5	5	4	4	5	4	2	5	3	0	4	1
45	Sharmila	33	F	4	4	1	2	4	3	0	4	0	0	4	0
46	Shyamala	39	F	5	4	2	2	5	5	0	4	0	0	3	3
47	Sherin	36	F	5	4	4	1	4	4	3	3	4	0	4	0
48	Ganga	36	F	5	5	5	5	4	5	3	5	5	0	5	0
49	Uthev	31	M	4	4	4	4	4	5	1	4	0	0	3	0
50	Ramakrishnan	38	M	4	4	3	1	5	4	4	3	0	4	4	0
51	Winny	44	F	5	4	4	3	4	4	2	4	1	4	4	0
52	Naganathan	47	M	4	4	4	1	5	4	3	4	5	0	4	3
53	Neeraj	42	M	5	4	4	4	5	4	4	3	2	0	4	0
54	Harikrishnan	47	M	5	4	4	3	5	5	4	4	4	4	4	0
55	Gajalakshmi	48	F	5	5	4	2	5	4	3	4	1	0	4	0
56	Walter kumaran	41	M	4	4	4	1	4	4	3	3	0	0	4	0
57	Ramnath seth	44	M	5	4	4	3	5	5	3	4	4	4	4	3
58	Helen	46	F	4	4	4	2	4	4	3	3	3	0	4	0
59	Sugapriya	49	F	5	4	4	3	5	5	2	2	4	0	4	0
60	Janani	43	F	5	5	4	2	5	4	3	3	4	4	4	0

**POST OPERATIVE SCORING - 3 WEEKS**

Sl.No.	Name	Age	Sex	Nasal Obstruction	Nasal discharge	Rhinorrhoea	Sneezing	Post Nasal Dripping	Headache	Cough	Decreased sensation of smell	Facial Pain	Ear Discharge	Fatigue	Bodily Pain
1	Muniyasamy	25	M	2	2	0	2	3	2	0	1	2	0	2	2
2	Kathirvelan	55	M	3	2	0	2	2	2	0	3	0	0	2	2
3	Karthick	22	M	3	3	3	0	2	2	1	2	0	0	0	0
4	Asifullah	25	M	2	1	0	1	1	0	0	2	0	0	2	3
5	Aarumugam	52	M	3	3	1	3	1	3	3	2	0	0	0	0
6	Basha	28	M	3	3	2	4	1	3	0	0	2	0	0	0
7	Ganesh	23	M	2	2	1	2	2	3	1	3	0	0	2	0
8	Farooq	27	M	2	2	2	2	2	3	2	1	2	0	2	0
9	David	29	M	2	2	1	2	2	3	3	2	0	0	0	0
10	John karthick	29	M	2	2	2	3	2	1	2	2	0	0	0	0
11	Sornalakshmi	24	F	3	3	1	2	3	2	3	2	0	0	2	0
12	Xavier	25	M	2	2	0	0	2	4	0	2	0	0	0	0
13	Janardhanan	27	M	2	3	2	1	3	3	1	2	3	0	3	0
14	Santhosh	29	M	2	2	0	1	2	2	0	2	0	0	2	0
15	Saraswathi	22	F	3	3	3	4	3	2	2	3	0	0	3	0
16	Jeslin Jacob	21	M	3	3	3	3	2	1	1	2	0	0	0	0
17	Badrinath	26	M	2	2	0	1	2	1	0	1	0	0	0	0
18	Baskar	29	M	3	2	2	3	2	2	1	2	0	0	2	2
19	Thirumurugan	27	M	2	2	1	1	2	2	2	1	3	0	0	0
20	Gayathri	29	F	2	2	3	0	3	3	0	0	0	0	3	0
21	Sumeetha	26	F	2	2	0	1	2	3	2	1	2	2	0	0
22	Fathima	25	F	2	3	3	3	2	2	1	2	0	0	3	0
23	Vandhana	24	F	2	2	0	2	3	2	2	1	0	3	2	0
24	Vinitha	27	F	2	2	1	2	3	3	3	1	0	0	3	0
25	Vinodhini	25	F	3	1	0	0	2	3	2	0	3	2	2	0
26	Denisha	27	F	3	2	2	3	3	2	3	2	0	0	2	0
27	Ibrahim	29	M	2	2	2	3	3	1	0	2	0	3	0	0
28	Esther	41	F	3	2	0	0	2	2	0	2	1	0	0	0
29	Harish	45	M	2	2	3	3	4	3	2	3	0	0	3	0
30	Ragavendra	41	M	2	2	1	1	2	3	2	0	0	0	0	0
31	Murugan	32	M	2	2	1	0	3	0	0	2	0	2	0	0
32	Pavithra	36	F	2	2	0	2	2	1	0	2	0	0	2	0
33	Joseph	38	M	2	2	1	2	4	3	1	2	0	0	3	0
34	Jahanghir	39	M	3	2	1	2	4	2	1	0	2	0	2	0
35	Chandrasekar	31	M	2	2	0	0	3	2	2	0	0	0	0	0
36	Kulavarshini	33	F	3	3	3	3	3	2	3	2	0	0	4	0

37	Karthick	36	M	3	2	2	0	2	3	0	2	3	3	3	0
38	Kishore	32	M	3	2	2	3	2	1	1	2	0	0	2	0
39	Udhaya Kumar	36	M	2	2	0	0	3	2	1	2	2	0	1	0
40	Chandrika	38	F	2	2	1	2	4	2	0	2	0	0	2	0
41	Yacub	32	M	2	2	1	0	3	3	3	2	0	0	2	0
42	Sebasthin	31	M	2	2	1	0	4	2	3	2	0	0	0	0
43	Lakshmanan	37	M	2	2	0	2	4	2	3	2	2	0	3	0
44	Ramanathan	39	M	4	4	4	4	4	2	2	3	2	0	4	0
45	Sharmila	33	F	2	2	0	1	3	2	0	2	0	0	2	0
46	Shyamala	39	F	3	2	1	1	3	2	0	3	0	0	2	2
47	Sherin	36	F	3	2	2	1	2	2	2	2	2	0	2	0
48	Ganga	36	F	2	2	4	4	4	3	3	3	3	0	4	0
49	Uthev	31	M	3	3	3	4	3	4	1	3	0	0	3	0
50	Ramakrishnan	38	M	2	2	1	0	3	4	4	2	0	3	4	0
51	Winny	44	F	3	2	2	3	3	3	2	2	0	3	3	0
52	Naganathan	47	M	2	2	2	1	3	3	2	3	3	0	2	1
53	Neeraj	42	M	3	3	2	3	4	4	4	2	0	0	4	0
54	Harikrishnan	47	M	3	2	3	3	3	2	4	2	2	3	2	0
55	Gajalakshmi	48	F	2	2	3	1	4	2	3	2	0	0	4	0
56	Walter kumaran	41	M	2	2	3	0	2	4	3	3	0	0	4	0
57	Ramnath seth	44	M	3	2	2	2	3	2	3	2	2	3	2	3
58	Helen	46	F	2	2	2	2	2	2	2	2	1	0	2	0
59	Sugapriya	49	F	2	2	2	1	3	4	0	0	3	0	2	0
60	Janani	43	F	3	2	2	2	3	2	3	1	2	2	4	0

### POST OPERATIVE SCORING - 3 MONTHS

Sl.No.	Name	Age	Sex	Nasal Obstruction	Nasal discharge	Rhinorr hoea	Sneezing	Post Nasal Drippin g	Headache	Cough	Decreased sensation of smell	Facial Pain	Ear Discharge	Fatigue	Bodily Pain
1	Muniyasamy	25	M	0	1	0	2	0	2	0	0	0	0	0	0
2	Kathirvelan	55	M	1	1	0	1	0	0	0	0	0	0	0	0
3	Karthick	22	M	1	0	1	0	0	1	1	0	0	0	0	0
4	Asifullah	25	M	0	1	0	1	0	0	0	0	0	0	2	3
5	Aarumugam	52	M	0	0	1	3	0	2	3	1	0	0	0	0
6	Basha	28	M	1	1	1	4	0	3	0	0	0	0	0	0
7	Ganesh	23	M	0	1	1	2	0	3	1	1	0	0	1	0
8	Farooq	27	M	0	0	0	2	0	1	2	0	0	0	0	0
9	David	29	M	1	1	1	2	1	3	2	0	0	0	0	0
10	John karthick	29	M	0	0	1	3	0	0	2	0	0	0	0	0
11	Sornalakshmi	24	F	1	1	1	2	1	1	3	0	0	0	1	0
12	Xavier	25	M	0	1	0	0	0	1	0	0	0	0	0	0
13	Janardhanan	27	M	1	2	2	1	3	1	1	0	1	0	3	0
14	Santhosh	29	M	0	0	0	1	0	1	0	0	0	0	0	0
15	Saraswathi	22	F	1	2	2	4	2	1	2	2	0	0	3	0
16	Jeslin Jacob	21	M	0	1	1	3	1	0	0	1	0	0	0	0
17	Badrinath	26	M	0	0	0	0	0	0	0	0	0	0	0	0
18	Baskar	29	M	1	0	1	3	1	0	1	0	0	0	0	2
19	Thirumurugan	27	M	0	0	1	1	0	0	2	0	1	0	0	0
20	Gayathri	29	F	0	0	1	0	1	0	0	0	0	0	1	0
21	Sumeetha	26	F	1	0	0	1	1	2	2	0	0	0	0	0
22	Fathima	25	F	0	1	1	3	0	0	1	1	0	0	1	0
23	Vandhana	24	F	0	0	0	2	1	0	1	0	0	1	0	0
24	Vinitha	27	F	0	0	0	2	2	1	3	0	0	0	2	0
25	Vinodhini	25	F	1	0	0	0	1	1	2	0	0	0	1	0
26	Denisha	27	F	0	0	0	3	3	2	2	1	0	0	1	0
27	Ibrahim	29	M	0	0	1	3	3	1	0	1	0	1	0	0
28	Esther	41	F	1	0	0	0	0	1	0	0	0	0	0	0
29	Harish	45	M	0	0	3	3	3	3	2	2	0	0	3	0
30	Ragavendra	41	M	0	0	0	0	0	1	1	0	0	0	0	0
31	Murugan	32	M	0	0	0	0	1	0	0	0	0	0	0	0
32	Pavithra	36	F	0	0	0	2	1	0	0	0	0	0	1	0
33	Joseph	38	M	0	0	0	2	4	3	1	2	0	0	3	0
34	Jahanghir	39	M	1	0	0	2	1	0	1	0	1	0	0	0
35	Chandrasekar	31	M	0	0	0	0	1	0	1	0	0	0	0	0
36	Kulavarshini	33	F	2	2	3	3	3	2	2	2	0	0	3	0

37	Karthick	36	M	1	0	0	0	0	3	0	0	3	1	1	0
38	Kishore	32	M	0	0	0	3	0	0	0	0	0	0	0	0
39	Udhaya Kumar	36	M	0	0	0	0	1	0	0	0	0	0	0	0
40	Chandrika	38	F	0	0	0	2	2	0	0	0	0	0	1	0
41	Yacub	32	M	0	0	0	0	1	3	3	0	0	0	0	0
42	Sebasthin	31	M	0	0	1	0	3	1	3	0	0	0	0	0
43	Lakshmanan	37	M	0	0	0	2	4	1	3	0	1	0	3	0
44	Ramanathan	39	M	1	3	3	3	3	1	2	1	1	0	4	0
45	Sharmila	33	F	0	0	0	2	1	0	0	0	0	0	0	0
46	Shyamala	39	F	1	0	0	1	1	1	0	0	0	0	0	0
47	Sherin	36	F	0	0	0	1	1	0	2	0	0	0	0	0
48	Ganga	36	F	1	1	4	4	3	2	3	1	1	0	4	0
49	Uthev	31	M	1	1	3	3	1	3	1	1	0	0	2	0
50	Ramakrishnan	38	M	0	0	0	0	1	3	3	0	0	1	3	0
51	Winny	44	F	0	0	2	2	1	3	2	0	0	0	2	0
52	Naganathan	47	M	0	0	0	0	1	0	2	0	1	0	0	0
53	Neeraj	42	M	0	1	0	3	2	4	4	0	0	0	3	0
54	Harikrishnan	47	M	0	0	3	3	1	0	3	0	1	0	1	0
55	Gajalakshmi	48	F	0	0	0	1	1	3	3	0	0	0	4	0
56	Walter kumaran	41	M	0	0	1	0	0	3	3	0	0	0	3	0
57	Ramnath seth	44	M	1	0	1	1	1	0	3	0	2	1	0	0
58	Helen	46	F	0	0	0	2	0	0	0	0	0	0	0	0
59	Sugapriya	49	F	0	0	0	0	0	1	0	0	3	0	0	0
60	Janani	43	F	0	0	0	2	1	3	3	0	0	0	3	0