"A PROSPECTIVE STUDY OF ANATOMICAL VARIATIONS OF OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS"

By

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Under the guidance of

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is the most common disease for which consultation of otorhinolaryngologist is sought. The approach to patients with chronic rhinosinusitis is endoscopic surgery which aims at removing the obstruction of the main drainage pathway-the osteomeatal complex-based essentially on the concept that such obstruction perpetuates the sinus disease. This in turn requires the surgeons to have detailed knowledge of the anatomy of the lateral nasal wall, paranasal sinuses and surrounding vital structures and of the large number of anatomical variants in the region.

Objective: To assess the role of anatomical variations of osteomeatal complex in chronic sinusitis.

Materials and Methods: Fifty four consecutive cases of chronic rhinosinusitis patients attending the E.N.T. outpatient department, who had chronic sinusitis for more than three months duration not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery satisfying the inclusion criteria were studied.

Results: In our study it was observed that 53.7% of the chronic sinusitis cases had 2 or more anatomical variations and 33.3% of the cases had single anatomical variation. Deviated nasal septum was found to be the most common amongst the anatomical variations in chronic sinusitis cases in the present study which was followed by unilateral concha bullosa and paradoxically bent middle turbinate. Agger nasi cell and Haller cell were seen in one case each. 85.2 % of the subjects had maxillary sinus involvement and the presence of nasal septal deviation and concha bullosa were strongly associated with it out of all the anatomical variations in the osteomeatal complex.

Conclusion: Maxillary sinus was most frequently diseased sinus in our study and bilateral maxillary sinusitis was the most common presentation. Prevalence of multiple anatomical variations was more in our study in comparison to single anatomical variation. Deviated nasal septum was the most common anatomical variation encountered in our study followed by concha bullosa. The presence of nasal septal deviation and concha bullosa were strongly associated with maxillary sinus involvement.

Key words: Chronic rhinosinusitis, osteomeatal complex, FESS, paranasal sinuses.

CONTENTS

ABBREVIATIONS

CRS	Chronic rhinosinusitis
CT	Computed tomography
HRCT	High resolution computed tomography
DNE	Diagnostic nasal endoscopy
OMC	Osteomeatal complex
PNS	Paranasal sinus
OMU	Osteomeatal unit
DNS	Deviated nasal septum
ENT	Ear Nose and Throat
RARS	Recurrent Acute rhinosinusitis
FESS	Functional endoscopic sinus surgery
ESS	Endoscopic sinus surgery
HB	Hemoglobin
BT	Bleeding time
CT	Clotting time
TC	Total count
DC	Differential count
CB	Concha Bullosa

INTRODUCTION

Chronic rhinosinusitis (CRS), with its classical symptoms of nasal obstruction, nasal discharge (anterior and/or posterior), headache and facial pain, and abnormalities of smell is the most common disease for which consultation of otorhinolaryngologist is sought[1]. Chronic rhinosinusitis (CRS), has been classified as occurring in two predominant forms: chronic(persistent) rhinosinusitis and recurrent acute rhinosinusitis[2,3]. Both types of CRS contribute to the substantial disease burden of CRS[4].

The approach to patients with chronic rhinosinusitis has changed after Messerklinger published the first comprehensive account of technique of nasal endoscopy and its application to the diagnosis and treatment of sinonasal diseases[5]. The endoscopic surgery aims at removing the obstruction of the main drainage pathway-the osteomeatal complex-based essentially on the concept that such obstruction perpetuates the sinus disease. The key underlying concept behind minimally invasive functional endoscopic sinus surgery is the ostiomeatal complex – the small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus – represents the key region for drainage of anterior ethmoid, maxillary and frontal sinuses[6,7]. Obstruction of OMC causes a vicious cycle of events that lead to sinusitis. Its obstruction leads to mucosal congestion that decreases air flow and leads to further obstruction[8].

. Surgical clearance of these chronically infected sinuses while maintaining their ventilation and drainage is the treatment of choice[9]. To achieve this goal, there should be some diagnostic modalities which guide us towards exact diagnosis and safe intervention. Over the past few decades, both CT and nasal endoscopy have been used successfully as diagnostic modalities in sinus disease. The purpose of these investigations is to determine the mucosal

abnormalities and bony anatomic variations of paranasal sinus and assess the possible pathogenicity of these findings in patients undergoing evaluation for sinusitis.

The revolutionary changes in the surgical treatment of rhinosinusitis in recent years, particularly in endoscopic surgery, require the surgeons to have detailed knowledge of the anatomy of the lateral nasal wall, paranasal sinuses and surrounding vital structures and of the large number of anatomical variants in the region, many of which are detectable only by the use of CT[10]. Presumably these variations might induce osteomeatal obstruction, preventing mucus drainage and predisposing to chronic rhinosinusitis. However, this concept is still controversial and the presence of any anatomical variant does not necessarily establish as etiology for rhinosinusitis[11,12].

Few studies of Indian origin have examined the putative role of anatomical variations of osteomeatal complex such as concha bullosa, septal deviation, uncinate process variations, agger nasi cells, haller cells and paradoxically curved middle turbinate in the development of traditional CRS. We sought herein to examine the prevalence of these osteomeatal complex variations in the CRS cases through the use of computed tomography and diagnostic nasal endoscopy.

AIMS & OBJECTIVES

- To assess the role of anatomical variations of osteomeatal complex in chronic sinusitis.

REVIEW OF LITERATURE

Numerous anatomical variations can complicate the anatomy of the lateral wall of nose and the conditions of osteomeatal unit. None of the variations is a pathological process per se, i.e. the simple presense of an anatomical variations must not anatomically be interpreted as an indication for a surgical procedure. However such variations may considerably constrict the narrow clefts of osteomeatal unit, especially if multiple variations occur in combination, bringing facing mucosal surfaces in to contact. These variations predispose to more rapid and frequent appearance and persistence of acute and chronic inflammations[13].

In 2004 Kantarci M et al suggested that remarkable anatomic variations of paranasal region and their possible pathologic consequences should be well defined in order to improve success of management strategies, and to avoid potential complications of endoscopic sinonasal surgery[14].

Previously, standard sinus radiographic techniques failed to adequately detect minimal to moderate degrees of mucosal thickening in the ethmoid sinus and middle meatus region. In 1960 Hounsfield and Ambrose devised the computerized tomography[15]**.** Since then the coronal CT scanning has dramatically improved the imaging of paranasal sinuses anatomy as compared to sinus radiograph.

This gives an applied anatomical view of the region and the anatomical variants that are very often found. It proves by far to be the most reliable method of preoperative assessment also. It has the advantage of showing both bony details, using wide window settings, and good soft tissue outline, using narrow window settings. Both axial and coronal views may be of use – although coronal views are more helpful.

Stammberger H recognised that the endoscope enables the examiner to recognize the changes that may remain from the naked eye and even from inspection with the microscope thereby allowing diagnosis to be made, confirmed, expanded or even revised and the effects of the topical and systemic therapy can be seen and evaluated[16].

The endoscopic examination also assists the physician in reaching the decision whether local or systemic medical therapy may be of value or whether surgical intervention is needed. Hence diagnostic Nasal endoscopy has become a routine component of the clinical evaluation of every patient with evident or suspected disease of the nose and paranasal sinuses.

Considerable attention has been directed towards analysis of paranasal sinus anatomy through coronal plane CT imaging and nasal endoscopy after the advent of sinus surgery. The purpose of these investigations is to determine the mucosal abnormalities and bony anatomic variations of paranasal sinuses and assess the possible pathogenecity of these findings in patients undergoing evaluation for sinusitis or sinus surgery.

The Messerklinger technique of functional endoscopic sinus surgery is first and foremost a diagnostic concept that relies on two primary and equally important diagnostic modalities; endoscopic examination of the nasal cavities and tomographic examination of the nasal cavity and paranasal sinuses. Noninvasive diagnostic endoscopy has its limits, and the deeper structures cannot be evaluated by endoscopy alone. Computed tomography (CT) and endoscopy thus compliment each other in the assessment of the individual patient.

The anterior ethmoidal sinuses and the ostiomeatal complex are the primary sites of the mucosal pathologic conditions responsible for chronic infection in the major paranasal sinuses. The ethmoidal infundibulum, the hiatus semilunaris, and the middle meatus are the channels through which the frontal, maxillary and anterior ethmoidal air cells drain. Swelling or

apposition of the adjacent mucociliary surfaces may result in poor ventilation and obstruction to drainage of the larger paranasal sinuses. Any anatomical variants present in this region, trauma, or hyperplasia of the mucosa from previous infections can narrow these critical channels, impairing drainage from and ventilation of the larger paranasal sinuses, there by producing chronic sinusitis.

CT of paranasal sinuses is indispensible in identifying disease that may not be appreciated during routine clinical examination either with nasal speculum or even by detailed endoscopic examination. This is particularly true in disease involving solely the osteomeatal complex or the posterior ethmoidal and sphenoidal sinuses. In these areas CT is extremely valuable because unsuspected advanced mucosal disease can be effectively demonstrated by high-resolution CT (HRCT). CT of the paranasal sinuses should be considered a mandatory investigation for assessing the presence or absence of pathologic conditions of the paranasal sinuses when recurrent medical treatment has failed. In addition, CT examination of the paranasal sinuses will provide an anatomical road map of the paranasal sinuses and identify the presence of significant anatomic abnormalities, the location and severity of the disease and the exact location of obstruction.

Tan H et al observed that the unique development of paranasal sinuses explains for their enormous amount of anatomical variations. They further stated that CT is an excellent means of providing anatomical information of this region and also assist in endoscopic evaluation. The role of MRI is limited and provides no extra information except for differentiating between thickened mucosa from fluid retention[17].

ANATOMICAL CONSIDERATIONS:

Sinus endoscopy and CT sections have helped us to precisely know and understand better, the microarchitectural anatomy of nose and PNSs. Understanding the anatomy of lateral nasal wall is the key for endoscopic sinus surgery. The lateral nasal wall is divided into skin lined vestibule and lateral nasal wall proper which is lined by mucosa, by a ridge "limen nasi or limen veastibuli". Limen nasi is formed by the lower end of the laternal nasal cartilage. The lateral nasal wall proper bears three or four nasal conchae or turbinates, named from below upwards - inferior, middle and superior. The air spaces beneath and lateral to each is the corresponding meatus. The part of the nasal cavity above the uppermost concha and below the body of the sphenoid bone is the "spheno-ethmoid" recess.

The middle meatus is the key area as the frontal, anterior ethmoid cells and maxillary sinuses all drain into this area. The posterior ethmoid drain into the superior or supreme meatus, the sphenoid into the spheno-ethmoid recess. Both inferior and middle conchae begin anteriorly at the level of the vertical plane of the forehead and extend one below the other almost to the choana.

Superior concha, about half the length of the other two, begins at about the middle of these. The three conchae converge somewhat towards each other posteriorly. The remaining part of the nasal cavity behind their posterior ends is the nasopharyngeal isthmus, which opens into the nasopharynx through the choana.

INFERIOR NASAL CONCHA AND INFERIOR MEATUS:

Inferior nasal concha is an independent bone covered by thick mucous membrane containing a vascular “plexus cavernosus”. Inferior meatus is narrow anteriorly and posteriorly, but is wider and higher at the junction of middle and anterior thirds of inferior turbinate. Here the sharp, curved attachment of inferior turbinate to the lateral wall results in “genu” of inferior turbinate.

Nasolacrimal duct opens under the genu, is about 15 - 20mm from the limen nasi, 30 - 40mm from the anterior nares. Its orifice is slit-like, as the duct runs obliquely through the mucous membrane, protected by a fold “plica lacrimalis or valve of Hasner”.

MIDDLE NASAL CONCHA AND MIDDLE MEATUS:

Middle concha is a part of the ethmoid labryinth, which basically forms the lateral nasal wall above the inferior turbinate.

The prominent structures in the middle meatus from are:

1. The uncinate process: a crescent shaped ledge of bone, part of ethmoid.
2. Bulla ethmoidails: a rounded projection in the middle meatus, contains one or more ethmoid cells with their delicate walls. These cells are also known as bullar cells or middle ethmoid cells. Some consider it as part of anterior ethmoid.
3. Hiatus semilunaris: Half moon shaped gap between the posterior free and sharp margin of uncinate process and bulla ethmoidalis.

The semilunar hiatus is a curvilinear opening of the lateral nasal wall that lies above the ethmoid uncinate process and below the ethmodical bulla. The semilunar hiatus is infact, a curved furrow that continues from the infundibulum superiorly in the posterior inferior direction, and pass the natural ostium of the maxillary sinus, to gradually fade away superior to posterior

end of inferior turbinate. Thus purulent secrections from the frontal and anterior ethmoidal air cells drain across the maxillary ostium. The key locations of anterior ethmoidal air cells drain across the maxillary ostium.

The recess above the bulla is called suprabullar recess**.** Part of the middle meatus posterosuperior to bulla and anterior to the posterior part of the middle turbinate is called sinus lateralis.

Ethmoid infundibulum is a groove between the uncinate process and the bulla. From haitus semilunaris it extends downwards and forwards to a varying depth of 0.5-10 mm (average 5mm). This depends upon the height of the uncinate process.

Boundaries of infundibulum:

Antero-medial and antero-inferior –uncinate process

Posterior – bulla ethmoidalis,

Medial – communicates with middle meatus through the hiatus semilunaris,

Lateral: Superiorly – lamina papyracea (separating the orbit)

Inferiorly – maxillary fortanelle (separating the maxillary sinus)

Anteriorly and superiorly- the ethmoid infundibulum may form a blind recess (80%) – the frontoethmoid recess of the infundibulum. In 20% of cases, it communicates freely with the nasofrontal duct.

Thus, the frontal sinus drains either directly into the infundibulum through the nasofrontal duct or indirectly into the infundibulum through the anterior ethmoid cells. The anterior ethmoids open either into infundibulum (at the frontoethmoidal recess) or anterior to it through the uncinate process. The middle ethmoid cells open upon or above the bulla (suprabullar recess).

Ethmoid sinus

This is situated within the ethmoid labyrinth and separates the nasal cavity from the orbit and anterior cranial cavity. The ethmoid labyrinth is roughly pyramid shaped with its base posteriorly in relation to sphenoid and apex anteriorly limited by the frontal process of the maxilla and nasal process of the frontal bone.

It is about 4-5 cms long (anteroposteriorly) - 2.5-3 cms high and about 0.5 cms wide anteriorly and 1.5 cms posteriorly. Thus as a whole, the ethmoid labyrinth forms a thin plate broader posteriorly and thinner anteriorly.

Superiorly, the labyrinthine roof is thicker and is called "fovea ethmoidalis". This is limited anteriorly by the inferior wall of the frontal sinus and posteriorly by the sphenoidal bone.

Lateral wall is formed by several bones:

Anteriorly and above – frontal bone

Anteriorly and below – lacrimal bone (os unguis)

Posterior to these it is formed by the papyraceous lamina (os planum) of ethmoid above and uppersection of maxillary bone (medial wall) and vertical lamina of palatine bone below.

Inferiorly ethmoid has no wall. Its lower limits are marked by the opening of middle meatus and can thus therefore be considered as the horizontal plane passing along the lower margin or middle turbinate.

The medial wall of ethmoid labyrinth consists above of a continuous lamina called turbinate (middle, superior and supreme) and corresponding meati. The medial wall has five principle lamellae, which penetrate the labyrinth towards the lateral wall.

They are:

1. Uncinate process

2. Bulla
3. Middle turbinate
4. Superior turbinate
5. Supreme turbinate

The more delicate secondary lamellae are placed irregularly between the primary ones, giving rise to multiple ethmoid cells. The ethmoids, during development have tendency to grow steadily in all directions beyond the confines of ethmoid until deterred by hard compact bone. The cells, which reside within the ethmoid bone are termed “intramural cells” and those outside are called “extramural cells”. Thus the ethmoid cells may invade the supraorbital plate of frontal bone, infraorbital plate of maxilla, the middle turbinate (concha bullosa), the sphenoid and the lacrimal bone. The extent of pneumatization has definite implication in an endoscopic sinus surgery.

Sphenoid sinus

The degree of pneumatisation of this sinus is highly variable. Its capacity is said to vary from 0.5-30 ml (average 7.5 ml). The anterior wall of the sphenoid sinus is about 7cm from the anterior nares. The sinus may either be limited to body of sphenoid, or it may extend to the other parts of sphenoid namely the greater and lesser wings, anterior clinoid process, pterygoid process etc, and also to the basilar portion of the occipital bone. As the degree of pneumatisation increase, the surrounding vital relations like optic nerve, ICA, maxillary nerve etc. are brought more into the sinus cavity producing corresponding bulges into the cavities. FESS in such state is more dangerous. The sphenoid sinus opens into the sphenoethmoidal recess usually through the posterior wall of the recess. Occasionally it may open through the lateral wall of the recess.

Frontal sinus

Development of this sinus varies markedly. It develops as one of the several outgrowths from the region of the frontal recess similar to the anterior ethmoidal cells. In fact some regard it as an anterior ethmoid cell that has invaded the frontal bone.

Several sinuses may occur on one or both sides, lying one lateral to the other or one behind the other. These sinuses may either drain one into the other or separately.

Two parts:

I. Vertical (in squama of frontal bone)

II. Horizontal (in the orbital roof of the frontal bone).

Important relations of frontal sinus are the anterior cranial fossa and the orbit. The bone separating the sinus from above is usually thin and an operative perforation can easily occur.

ANATOMIC VARIATIONS

Despite the fact that the clinically dominant symptoms may result from the diseased frontal or maxillary sinus, in most cases the underlying causes are not to be found in the infected sinuses but in the clefts of the lateral wall of nose. The function and patency of these normally narrow clefts of the anterior ethmoidal sinus are the keys to the health of larger paranasal sinuses. These clefts act as prechambers to the maxillary and frontal sinuses, providing ventilation and drainage for these larger sinuses. Many anatomic variants can narrow these prechambers even more and there by predispose to recurrent sinus infections. The middle meatus and lateral nasal wall are subject to wide normal variations that must be distinguished from pathologic changes. These variations may, themselves be the underlying cause of recurrent sinus disease. However, there is a lack of consensus among investigators with respect to the prevalence and clinical significance

of these variations, as they have been encountered with similar frequency in patients being scanned for various sinus related problems, as well as those undergoing evaluation for non-sinus related problems[10]. The more common variations can be divided into four groups, depending on the structures involved: Nasal septum, middle turbinate, uncinate process, ethmoidal bulla.

NASAL SEPTUM VARIATIONS

Normally the structures that make up the nasal septum are aligned to form a straight wall, extending from the cribriform plate superiorly to the hard palate inferiorly. At the junction of the nasal cartilage and vomer, acute bowing and deviation of the septum occurs in 20% of the population[18]. When severe, the deviated septum may compress the middle turbinate bone laterally, narrowing the middle meatus and causing obstruction, secondary inflammation, and infection. When it is associated with the swollen membranes, there is additional obstruction to the normal flow of mucus from the sinuses.

MIDDLE TURBINATE VARIATIONS

Concho Bullosa.

Pneumatization of the middle turbinate is known as concha bullosa. Its pneumatization varies and is usually bilateral. A concha bullosa is not a pathologic finding. In the setting of chronic sinus disease, resection of the concha bullosa should be considered to improve paranasal sinus access.

A concha bullosa pneumatised from the frontal recess can communicate with this area. This communication can result in disease affecting both the frontal sinus and the connected

concha bullosa. The concha bullosa interior may be affected by the disease in other sinuses, which ranges from mild edema to mucocele.

Classified into three types, as per Bolger et al[10]:

(a) Lamellar type

Pneumatisation is localized to the vertical lamella of the middle turbinate.

(b) Bulbous type

Pneumatisation of the inferior bulbous part of middle turbinate.

(c) True or Extensive type

Pneumatisation of both the vertical lamella and inferior part of middle turbinate.

Paradoxically bent middle turbinate

Normally, the convexity of the middle turbinate bone is directed medically, towards the nasal septum. When paradoxically curved, the convexity is directed laterally, towards the lateral sinus wall. A 26.1% prevalence of paradoxically curved middle turbinates has been reported[10]. Although no studies relate this variation to sinus disease, it is a presumed etiologic factor because of the deformity and obstruction or alteration of nasal passage air flow dynamics, especially when associated with other variations[11].

UNCINATE VARIATIONS

Deviation of the Uncinate

The superior aspect of the uncinate tip may deviate laterally, medically, or anteriorly out of the meatus, appearing as a second middle turbinate bone[5,11]. When deviated medially, it comes in contact with and compromises the middle meatus. When deviated laterally, it may encroach on

the hiatus semlunaris and infundibulum, impending drainage and ventilation of the anterior ethmoidal, frontal, and maxillary sinuses. The exact prevalence of these variations and their relation to sinus disease has not been determined.

Elongated and enlarged uncinate process

An elongated and enlarged uncinate process may come in close contact with the ethmoidal bulla, significantly narrowing hiatus semilunaris. When concomitant mucosal derangements are present, this narrowing may lead to obstruction.

Pneumatisation of uncinate

The exact mechanism by which uncinate pneumatization occurs is not known. It has been proposed that this process is due to the growth of agger nasi cells into the most anterosuperior region of the uncinate process[10]. Studies reveal a prevalence of 0.4-2.5%. This variation has been implicated in narrowing of the infundibulum, producing impaired sinus ventilation[19].

ETHMOIDAL VARIATIONS

Enlarged ethmoid bulla

Bulla pneumatization can vary. A greatly pneumatized bulla may completely fill the sinus of the middle turbinate bone. Stammberger and Wolf reported that an enlarged ethmoidal bulla may contribute to sinus disease by obstructing the infundibulum or middle meatus or by being primarily diseased and filled with pus, cysts or polyps[11]. The exact prevalence of an enlarged ethmoidal bulla is not known.

Agger Nasi Cells

These are the most constant ethmoidal air cells which lie below the frontal sinus, inferloateral to the lacrimal sinus, and represent pneumatization of the lacrimal bone by extension of the anterior ethmoidal cells[20]. They are located anterior and superior to the insertion of middle turbinate bone, along the lateral nasal wall[11]. In anatomic dissections, the prevalence of the agger nasi cell varies from 10%[21] to 19%[22]. Because of their location near the lacrimal sac, involvement of these cells can lead to ocular symptoms. These cells may provide access to the frontal sinus and recess during endoscopy.

Haller's Cells

Haller's cells are ethmoidal cells that develop into the floor of the orbit (i.e., the roof of the maxillary sinus) adjacent to and above the maxillary sinus ostium, and which if enlarged can significantly constrict the posterior aspect of the ethmoidal infundibulum and the ostium of the maxillary sinus from above.

HISTORICAL REVIEW

In 1987 Bolger et al[10] in their study of coronal plane CT Scans of 202 patients, directed special attention towards bony anatomic variations and mucosal abnormalities. Paradoxical curvature of the middle turbinate was found in 26.1% of patients, Haller's cells in 45.1%, pneumatization of uncinate process in 2.5% and lamellar cell of the middle turbinate was seen in 46.2% of the cases. In 31.2% pneumatization was noted in the bulbous part of the turbinate and 'true' concha bullosa in 15.7% of the patients. The agger nasi cell was present in 98.5% of patients, crista galli pnuematization in 83.7%, bulla galli in 5.4% and deviated nasal septum in 18.8%.

Llyod et al 1991, reported incidence of Haller cells to be 2%, agger nasi cell 3%, concha bullosa 14%, paradoxically curved middle turbinate 17% respectively in chronic rhinosinusitis cases[23].

Scribano et al 1993 reported the prevalence of 24% Haller cells and concha bullosa 67% in chronic rhinosinusitis cases[24].

In 1993 John Earwarker[25] examined the prevalence of anatomic variations of the nose and sinuses as determined with coronal CT in 800 cases. There were 354 cases of septal deviation (44%) with a male to female ratio of 1:1 Of the 354 cases of septal deviation 34% had significant septal spur.135 cases showed large paradoxical middle turbinates Abnormalities of OMU were present in 51% patients. Anterior ethmoid air cells related to the frontal recess were present in 90% cases, agger nasi cells were present in 96% cases. Extra-mural supra orbital cells were present in 8% of the cases. Pneumatisation of middle turbinate was noted in 55% of cases while that of the uncinate process was seen in 6% of cases. Ethmoidal bulla was found in 89% of cases, 34 of which were bilateral. Haller's cells were seen in 20% whereas Onodi cells were present in 24% cases.

Tonai A et al 1996, reported the prevalence of Haller's cell as 36%, concha bullosa 28% and agger nasi cell 86.7% respectively in the patients coming with the sinonasal diseases[26].

Lusk RP et al 1996, in a study on a total of 115 pediatric cases of chronic sinusitis using coronal CT scan, conducted in St. Louis Children's Hospital and Washington University of Medicine, St. Louis, Missouri reported the prevalence of 10% of concha bullosa, 8.5% of paradoxically curved middle turbinate, 10.4% of nasal septal deviation. It was also reported in the study that number of abnormalities were not sufficient to enable statistical assessment of the correlation with sinus disease[27].

Danese M et al 1997 using CT scan, studied the influence of the most important sinonasal anatomic variants on 112 patients aged more than 16 years, suffering from recurrent, persistent or chronic sinusitis. It was reported that there is an association between chronic sinusitis and ipsilateral septal ridges or spurs (33%), unusual ipsilateral deflexions of uncinate process (31%), and contralateral septal watch glass like deviation (42%) but no correlation was observed for the other studied variants(Concha bullosa, paradoxically curved middle turbinate, pnuematized uncinate process, hypertrophic ethmoid bulla, haller cell)[28].

Maru YK et al 1999, examined 150 chronic sinusitis patients in the outpatient department of Otorhinolaryngology, MGM Medical College, Indore. All the patients had coronal CT scan of paranasal sinus. CT scans were carefully analysed for middle turbinate pnuematization and osteomeatal complex disease. Of these patients 41.3% were found to have concha bullosa, but the effect of presence of concha bullosa osteomeatal complex disease was statistically insignificant[29].

Liu X et al 1999, conducted a study at Third Affiliated Hospital Sun Yat Sen university of medical sciences, Guangzhou, to explore the relationship between the anatomic variations in

the osteomeatal complex and chronic sinusitis in 297 individuals statistical analysis were carried out with SPSS 5.0. There were 81.14% of OMC noted to have at least one variation[30].

Paradoxical curvature of the middle turbinate	13.97%
The pneumatized middle turbinate	34.85%
Uncinate hyperplasia	19.36%
Deviation of uncinate	45.27%
Large ethmoidal bulla	30.30%
Large agger nasi	0.70%
Haller cell	1%

Asruddin et al 2000, while assessing the role of low dose CT in 50 patients of chronic sinusitis observed that the commonest anatomical variants was deviated nasal septum (38%),other variants found were concha bullosa in (28%) and Haller cell in 28% cases. The commonest disease pattern was osteomeatal unit pattern in 36% case. Infundibular pattern was seen in 23%, sphenoethmoidal recess pattern in 12% and sino-nasal polypopsis pattern was present in 16% of the cases[31].

Perez Pinas et al 2000[32] conducted a study in 110 spanish subjects regarding anatomical variants observed in nasal fossae and paranasal sinuses using CT in coronal plane. It showed great anatomical variability and a high percentage (67%) presented one or more anatomical variants, the variations most observed were in order:

1. DNS
2. Concha bullosa

3. Bony spur of septum
4. Onodi air cell.

Among three subtypes of concha bullosa only bulbous type seems to be strongly associated with symptoms[33].

Stallman JS et al 2004, retrospectively searched database of Department of radiology the Mount Sinai School of Medicine of New York University for all paranasal sinus CT studies conducted between 2001 and 2002. It was found in the study that 65% of the patients had nasal septal deviation and 44% of the patients had at least one concha bullosa. It was also observed that there was no increased incidence of paranasal sinus disease in patients with concha bullosa or nasal septal deviation[34].

Caughey RJ et al 2005 et al A study was conducted to examine the correlation between anatomic variants and chronic sinusitis. 250 consecutive sinus and orbital CT scans were examined at the university of Virginia over 2 year period. Of the 500 sides 67.2% of sides had some level of mucosal thickening. Concha bullosa and infra orbital ethmoidal cells were present in 27% Concha bullosa was associated with maxillary sinus disease Infra orbital ethmoid cells were associated with both ethmoid and maxillary mucosal disease. Narrow nasal cavities were associated with maxillary sinus disease[35].

Dua et al 2005 evaluated 50 patients and found in majority of patients OMC and anterior ethmoids were involved (88%). Agger nasi (40%) were the most common anatomical variations followed by concha bullosa and haller cell (16%). Apart from this DNS was found in 44% of patients. This study revealed various anatomical variations which were responsible for the primary pathology of the patient[9].

Ameri AA et al 2005 conducted a case control study to see the role of anatomic variants of paransasal sinuses and in causation of chronic sinusitis in Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran. It was observed that septal deviation and concha bullosa of middle turbinate were the anatomic variants significantly associated with chronic sinusitis. Besides agger nasi cell and inverted uncinate process were associated with ethmoid and frontal sinusitis respectively[36].

Wani et al 2009 conducted a study on 150 patients of chronic rhinosinusitis in the Department of ENT, Head and neck Surgery, Government Medical College, Srinagar over a period of 2 years. It was reported form the study that concha bullosa was the commonest anatomic variation and was seen in 45(30%) patients. The other anatomic variations noted included: paradoxical middle turbinate in 9.33% of patients, uncinate process variations in 25% patients, agger nasi cell in 9.33% of patients, Haller cells in 8.66% of patients and postero-septal deviations in 25.33% of patients. The mucosal disease was most commonly seen in anterior ethmoids 87.33%, followed by maxillary sinus ostia 70%, maxillary sinus disease 65.33%, posterior ethmoid disease 38%, frontal sinus disease 15% and sphenoid sinus mucosal disease 8.66% patients[1].

Daghighi MH et al 2007[37], in their study collected 292 CT-scan cliché samples for evaluating the anatomic variations and their prevalence. These patients were between 15-50 years old and they didn't have any pathology in their sinuses. According to the results, the septal deviation (34.24%) was the most common and normal variation and the other cases were sequentially as follow: Agger Nasi cell 36.22%, concha bullosa 15.90%, hypo plastic frontal sinus 6.24%, aerated Septum 2.62%, haller cell1.41%, onodi cell 0.40%.

Mamatha H et al 2010, conducted a CT scan study on the variations of the osteomeatal complex and its applied anatomy. It was observed in the study that the prevalence of nasal septal deviation was 70%, agger nasi cell 50%, Haller's cell 17.5% , Concha bullosa 15%, deviated uncinate process 65% respectively and mucosal thickening was observed in maxillary sinus in 67.5% cases, ethmoidal sinus in 32.5% cases and frontal sinus in 25% cases[40].

Alkire BC et al 2010, made an assessment of sinonasal anatomic variants potentially associated with recurrent acute rhinosinusitis in a case control study approved by Brigham and Womens's Hospital committee. They reported among the various sinonasal anatomic variants, concha bullosa was observed in 41.7% of the patients, impinging septal spur in 27.8% and Haller cells in 39.9% of the patients in the RARS group respectively. But only the presence of Haller cells was significantly associated with the likelihood of RARS compared to non CRS- controls[39].

Mohannad A. Al-Qudah 2010, in a computer tomographic study regarding anatomical variations in sinonasal region analysed 110 consecutive nasal and paranasal sinus CT scans of 110 patients who attended Otolaryngology clinic at King Abdullah University Hospital (Irbid, Jordan). It was reported in the study that agger nasi cell was the most common variation and was observed in 80% of the patients, Concha bullosa was the second most common variant observed in 62% of the patients. A total of 33% patients had nasal septal deviation. Haller's cell and paradoxically curved middle turbinate were seen in 20% and 18% of the patients respectively[40].

Vincent TES et al 2010, conducted a retrospective study of chronic rhinosinusitis patients who underwent FESS in the Department of Otorhinolaryngology, Head and Neck surgery at Hospital University Kebangsaan Malaysia, Kuala lumpur. The prevalence rate of 25.5% of Concha bullosa and 46.7% of nasal septal deviation was observed in the study. It was also reported in the study that the presence of Concha bullosa did not statistically contribute to an

increased incidence of ipsilateral chronic rhinosinusitis cases. Similarly no significant association was seen between the rate of ipsilateral and contralateral side of CRS in relation to the presence or absence of ipsilateral or contralateral DNS[41].

MATERIALS AND METHODS

This present study titled "A prospective study of anatomical variations of the osteomeatal complex in chronic rhinosinusitis patients" using diagnostic endoscopy and computed tomography was conducted in the department of ENT, BLDEU'S Shri B M Patil Medical College Hospital & Research Centre, Bijapur from November 2009 to October 2010.

Source of Data:

All the patients attending the E.N.T. outpatient department, who had chronic sinusitis for more than three months duration not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery.

Sample Size:

Using the statistical formula of $N= 4pq/L^2$ and taking the prevalence of anatomical variations of osteomeatal complex in chronic sinusitis as 65%[33] and 95% confidence intervals and allowable error as 20%, the worked out sample size was 54

Sampling: Consecutive eligible cases.

Inclusion Criteria:

All the consecutive patients undergoing FESS for chronic rhinosinusitis in BLDE University Shri B.M.Patil Medical College Hospital and Research Centre.

Exclusion Criteria

- Polypoidal or other expansive lesions
- Patient's with surgical or traumatic antecedents in nasosinusal region
- Patients with facial disturbances
- Patients with acute infections
- Patients with fungal sinusitis
- Patients with altered ciliary motility like

(a) Immotile cilia syndrome

(b) Kartageners syndrome

(c) Downs syndrome

(d) Cystic fibrosis

Methods of Collection of Data:

1) The cases selected for the study were subjected to detailed history taking and examination.

2) A routine haemogram (HB, BT, CT, TC, DC) and urine examination (albumin, sugar, microscopy), swab from middle meatus for culture sensitivity along with X-ray para nasal sinuses were done for the patients.

3) All the patients in active stage of the disease were treated with course of suitable antibiotic, systemic antihistamines and local decongestants. They were also treated for medical conditions like diabetes mellitus, hypertension, nasal allergy. No patient received steroid therapy or immunotherapy.

4) Each patient underwent a systematic diagnostic nasal endoscopy and computed tomography of nose and para nasal sinuses.

Equipments Used:

- ✓ Nasal endoscope: Karl Storz Hopkins rod optical with cold light source and fibre optic light delivery system. Endoscopes used were with 0^0, 30^0 and 70^0 angles of view of 4mm diameters.
- ✓ Karl Storz Endovision Telecam deluxe camera sytem with monitor.

- ✓ Topical decongestant and anesthetic agent (4% Xylocaine with 1:100.000 adrenaline).
- ✓ Antifog solutions (Savlon).
- ✓ Suction apparatus, Cannula, Ball probe and Freer's elevator.

Position: Supine with head slightly elevated and turned towards the examiner, who is standing at the right side of the patient.

Anaesthesia:

Topical decongestant 4% Xylocaine with 1: 100.000 adrenaline solution using applicators like cottonoid strips.

Procedures: Endoscopy was performed by three passes.

I. First Pass:

Along the floor of nasal cavity towards nasopharynx to visualize the status of inferior turbinate and meatus, Eaustachian tube orifice, nasopharyngeal mucosa, naslacrimal duct orifice and any pathological variations.

II. Second Pass:

Scope was inserted along the superior surface of inferior turbinate. As the endoscope was withdrawn the sphenoid ostium, spheno-ethmoidal recess, and superior nasal meatus visualized.

III. Third Pass:

Examination of the middle meatus in detail.

RESULTS AND OBSERVATIONS

The present study was conducted in the Department of ENT, BLDEU'S Shri B.M. Patil Medical College Hospital and Research Centre, Bijapur. The study subjects included consecutive 54 patients of chronic sinusitis during the period from November 2009 to December 2010; in whom we searched for anatomical variations by means of Diagnostic nasal endoscopy and computed tomography images.

AGE DISTRIBUTION

The age of the patients in our study varied from 13 years to 70 years. 73% of the patients were relatively younger as they were either equal to or less than 40 years of age with equal proportion of the patients in the age groups of 21-30 years and 31-40 years.

Table 1. Age distribution of the study subjects

Age Group	Frequency	Percentage (%)
11-20	12	22.2
21-30	14	25.9
31-40	14	25.9
41-50	7	13.0
51-60	5	9.3
61-70	2	3.7
Total	54	100

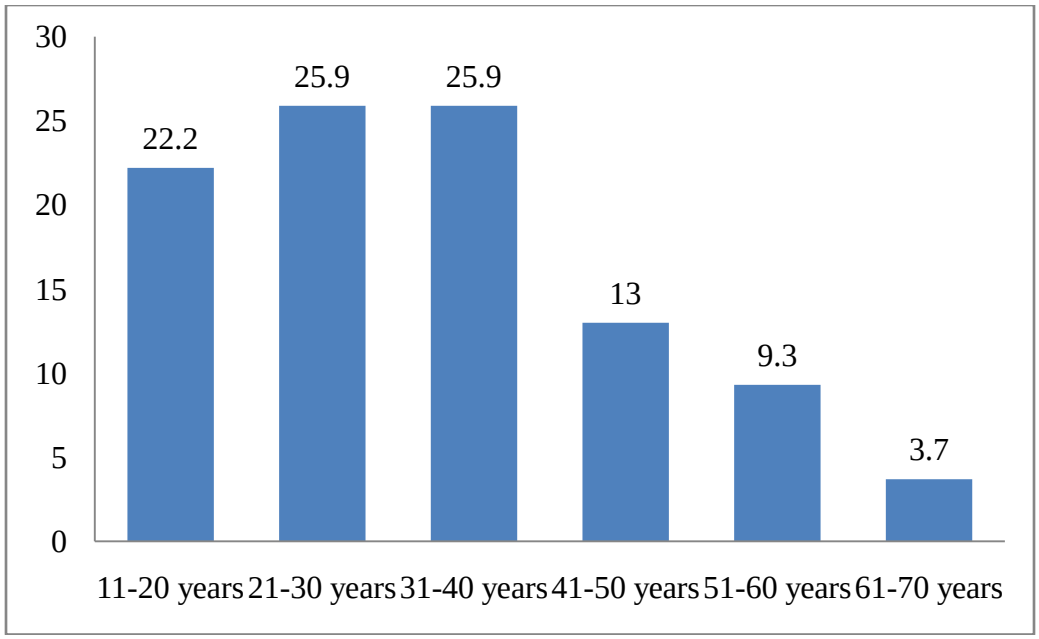


Figure 1. Age distribution of the study subjects

SEX DISTRIBUTION

Our study showed female preponderance i.e. 59.3% female and 40.7% male. Thus male to female ratio was 1: 1.45.

Table 2. Sex distribution of the study subjects

Sex	Frequency	Percentage (%)
Male	22	40.7
Female	32	59.3
Total	54	100

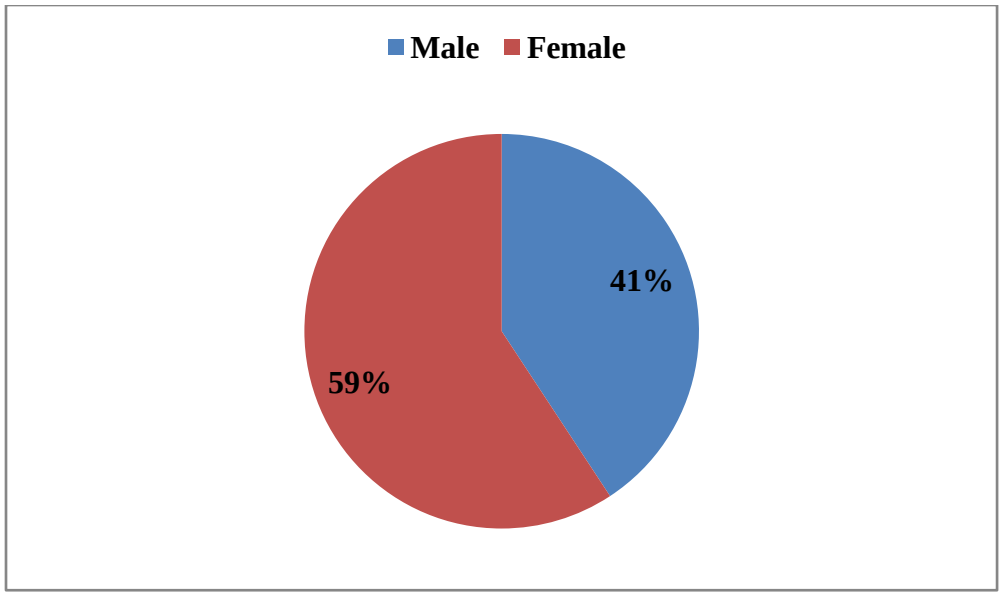


Figure 2. Sex distribution of the study subjects

SYMPTOMS

Majority of the patients in ours study presented with the complaint of nasal obstruction followed by postnasal drip, headache/facial pain and nasal discharge respectively. It was observed that only 9.3% of the study subjects had sneezing as a presenting complaint or as a part of symptom complex of chronic sinusitis.

Table 3. Symptoms presentation of the study subjects

Symptoms	Frequency	Percentage (%)
Nasal obstruction	39	72.2
Nasal discharge	26	48.1
Headache/Facial Pain	36	66.7
Post nasal drip	37	68.5
Sneezing	5	9.3
Total	54	100

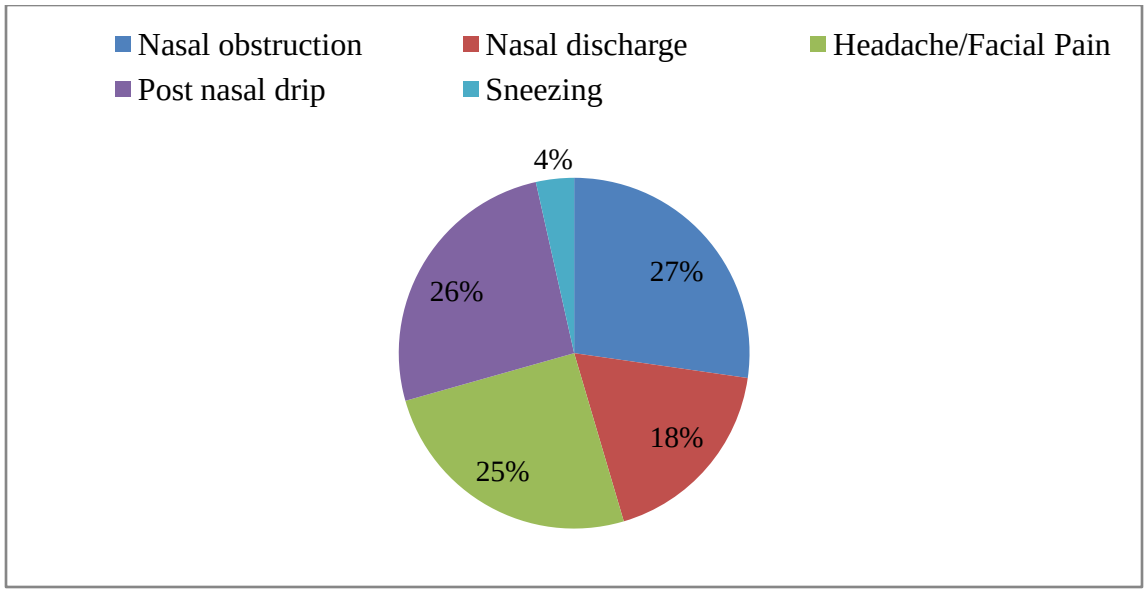


Figure 3. Symptoms presentation of the study subjects

SIGNS

In our study, mucopurulent discharge was observed on clinical examination in 81.5% of the cases. This was followed by deviated nasal septum and the compensatory inferior turbinate hypertrophy respectively. Middle turbinate hypertrophy was seen in 50% of the cases and only 13% of the cases had congested nasal mucosa as the presenting sign either alone or in combination with other signs.

Table 4. Signs presentation of the study subjects

Signs	Frequency	Percentage (%)
Congested nasal mucosa	7	13.0%
Inferior turbinate hypertrophy	31	57.4%
Middle turbinate hypertrophy	27	50.0%
Mucopurulent discharge	44	81.5%
Deviated nasal septum	40	74.1%
Total	54	100%

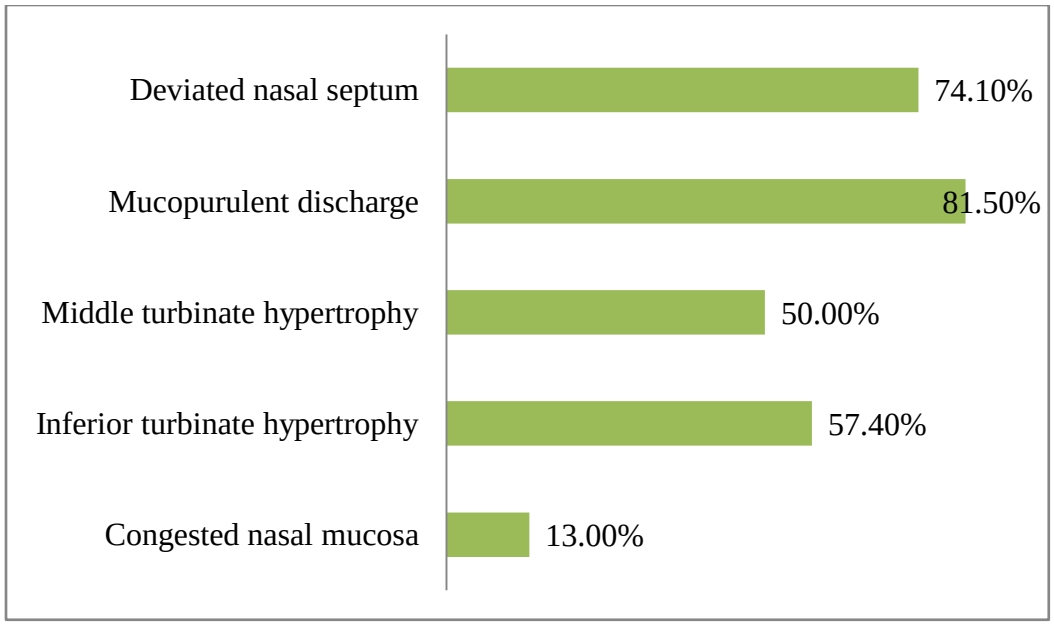


Figure 4. Signs presentation of the study subjects

DIAGNOSIS

57.4% of the cases were diagnosed as Bilateral maxillary sinusitis cases while in 5.6% of the cases multiple sinuses were involved.

Table 5. Distribution of the study subjects by diagnosis

Diagnosis	Frequency	Percentage (%)
Unilateral maxillary sinusitis	4	7.4
Unilateral ethmoid sinsuitis	2	3.7
Bilateral maxillary sinusitis	31	57.4
Bilateral ethmoid sinusitis	4	7.4
Bilateral frontal	2	3.7
Bilateral maxillary and ethmoid sinusitis	8	14.8
Multiple sinus involvement	3	5.6
Total	54	100

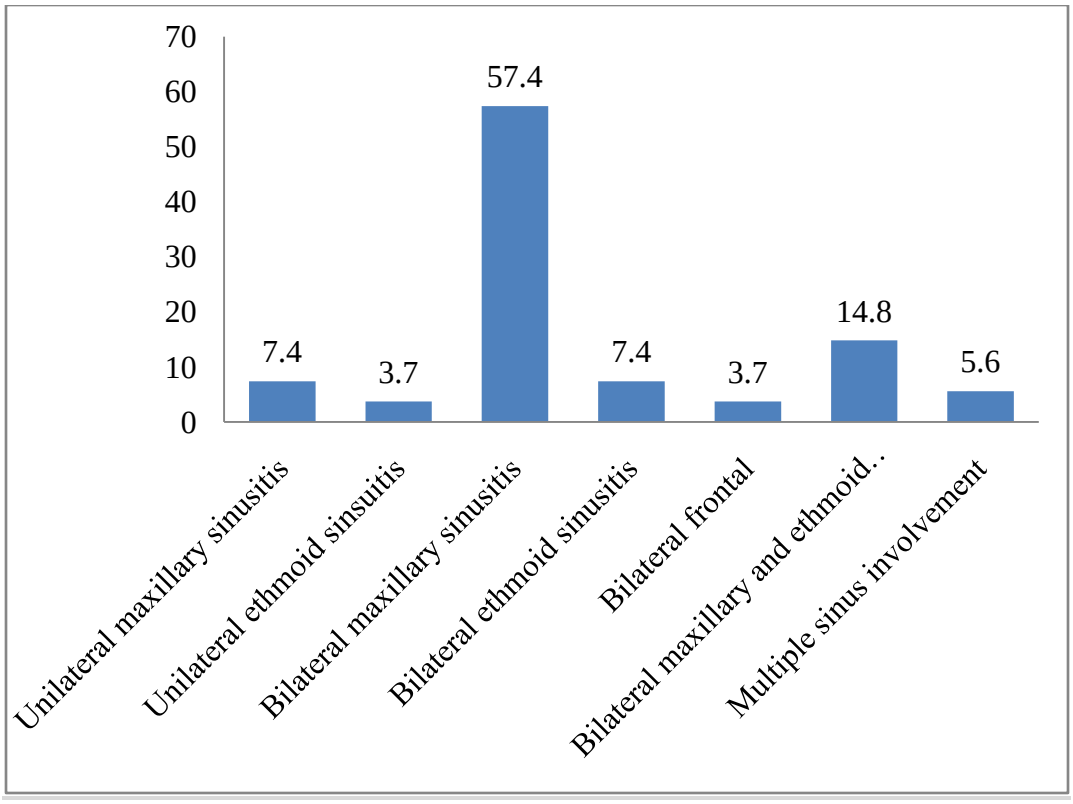


Figure 5. Distribution of the study subjects by diagnosis

ANATOMICAL VARIATIONS

In our study it was observed that 53.7% of the chronic sinusitis cases had 2 or more anatomical variations and 33.3% of the cases had single anatomical variation.

Table 6. Prevalence of anatomical variations in study subjects

Anatomical variations	Frequency	Percentage (%)
Single	18	33.3
Two or more than two	29	53.7
None	7	13.0
Total	54	100

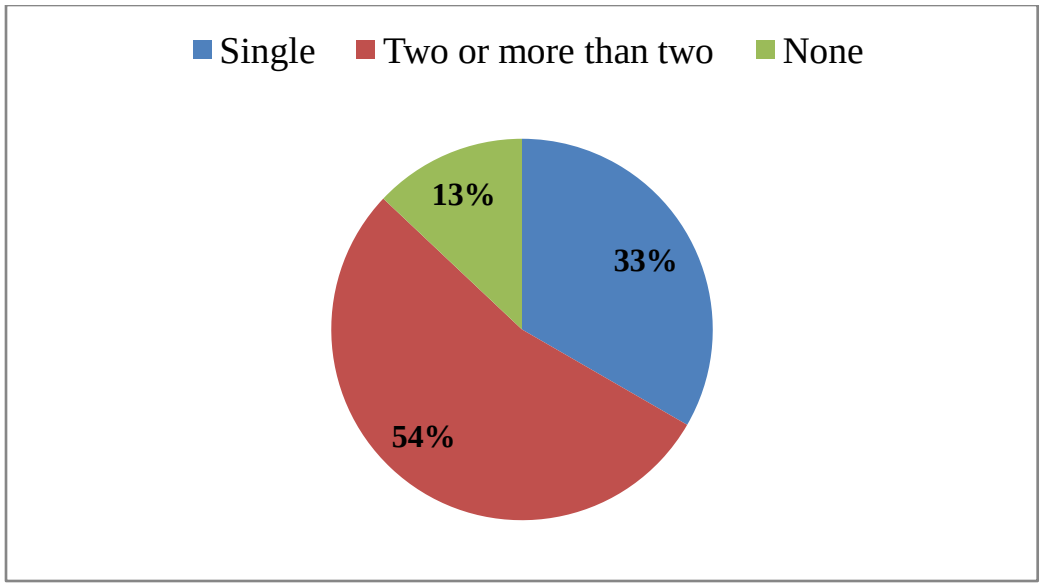


Figure 6. Prevalence of anatomical variations in the study subjects

Deviated nasal septum was found to be the most common amongst the anatomical variations in chronic sinusitis cases in the present study which was followed by unilateral concha bullosa and paradoxically bent middle turbinate. Agger nasi cell and Haller cell were seen in one case each.

Table 7. Distribution of anatomical variations in study subjects

Anatomical variations	Frequency	Percentage (%)
Deviated nasal septum	40	74.1
Unilateral concha bullosa	18	33.3
Bilateral concha bullosa	11	20.4
Paradoxically bent middle turbinate	8	14.8
Uncinate hypertrophy	3	5.6
Uncinate deviation	5	9.3
Agger Nasi Cell	1	1.9
Haller Cell	1	1.9

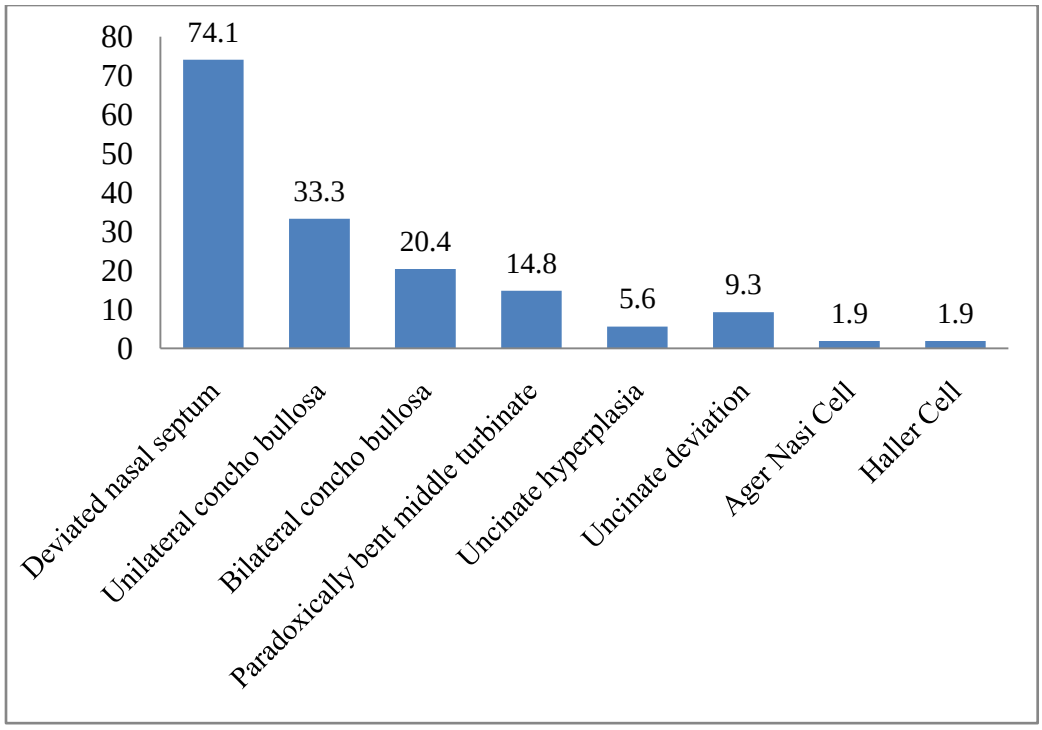


Figure 7. Distribution of anatomical variations in study subjects

SINUS INVOLVED

In our study, we found that 85.2 % of the subjects had maxillary sinus involvement followed by involvement of ethmoid sinus, frontal and sphenoid respectively.

Table 8. Frequency of sinus involvement in the study subjects

Sinus involved	Frequency	Percentage (%)
Maxillary sinus	46	85.2
Ethmoid	19	35.2
Frontal	3	5.6
Sphenoid	3	5.6

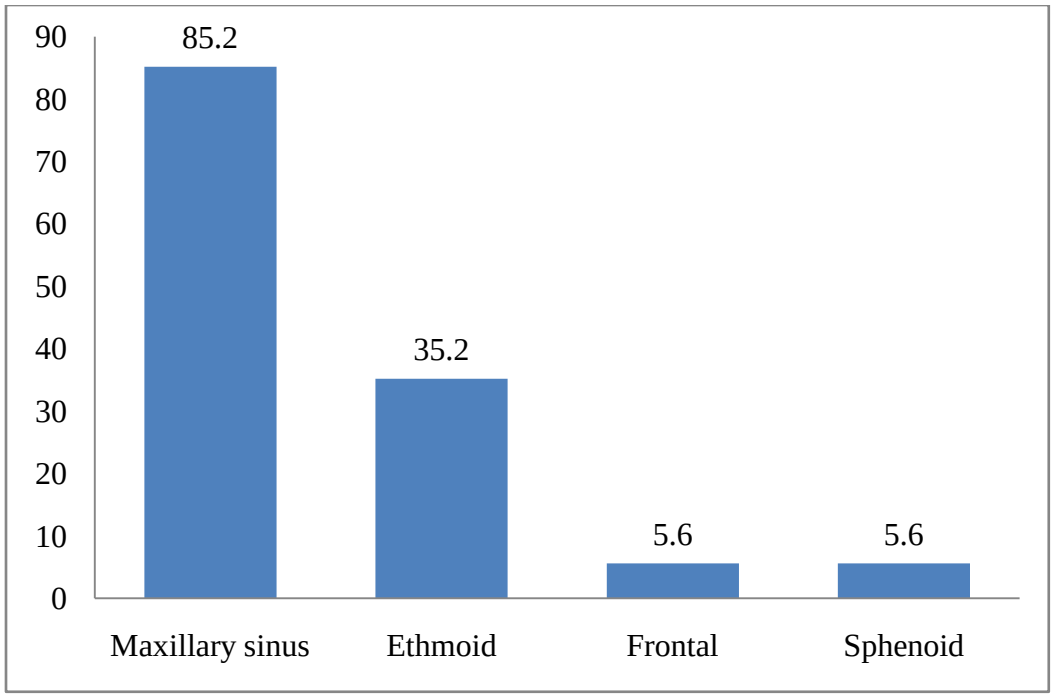


Figure 8. Frequency of sinus involvement in the study subjects

Factors responsible for involvement of a particular sinus:

We observed that though 85.2% of the study subjects had maxillary sinus involvement and the presence of nasal septal deviation and concha bullosa were strongly associated with it out of all the anatomical variations in the osteomeatal complex. (Table 9), But the ethmoid sinus involvement was not found to be associated with presence of deviated nasal septum, concha bullosa, paradoxically curved middle turbinate, uncinate variations, agger nasi cells and haller cell(Table 10). Similar findings were observed for frontal sinus involvement as no factors could be found statistically associated (Table11). But the presence of either of the above mentioned in total was found to be statistically associated with the ethmoid sinus involvement.

Table 9. Association of anatomical variations with maxillary sinus involvement in chronic rhinosinusitis cases

		Maxillary sinus involvement		P value
Factors		Yes	No	
Deviated nasal septum	Present	37	3	0.02*
	Absent	9	5	
Unilateral concha bullosa	Present	27	1	0.02*
	Absent	19	7	
Paradoxically bent middle turbinate	Present	8	0	0.34*
	Absent	38	8	
Uncinate hypertrophy	Present	3	0	> 0.99*
	Absent	43	8	
Uncinate deviation	Present	3	2	0.15*
	Absent	43	6	
Agger nasi cell	Present	1	0	> 0.99*
	Absent	45	8	
Haller cell	Present	1	0	> 0.99*
	Absent	45	8	
Anatomical variations	Present	43	4	0.01*
	Absent	3	4	

* p value calculated using Fisher exact test

Table 10. Association of anatomical variations with ethmoid sinus involvement in chronic rhinosinusitis cases

		Ethmoid sinus involvement		P value
Factors		Yes	No	
Deviated nasal septum	Present	11	29	0.33*
	Absent	6	8	
Concha bullosa	Present	7	21	0.29
	Absent	10	16	
Paradoxically bent middle turbinate	Present	2	6	> 0.99*
	Absent	15	31	
Uncinate hypertrophy	Present	0	3	0.54*
	Absent	17	34	
Uncinate deviation	Present	1	4	> 0.99*
	Absent	16	33	
Agger nasi cell	Present	0	1	> 0.99*
	Absent	17	36	
Haller cell	Present	0	1	> 0.99*
	Absent	17	36	
Variation	Present	12	32	0.03*
	Absent	5	2	

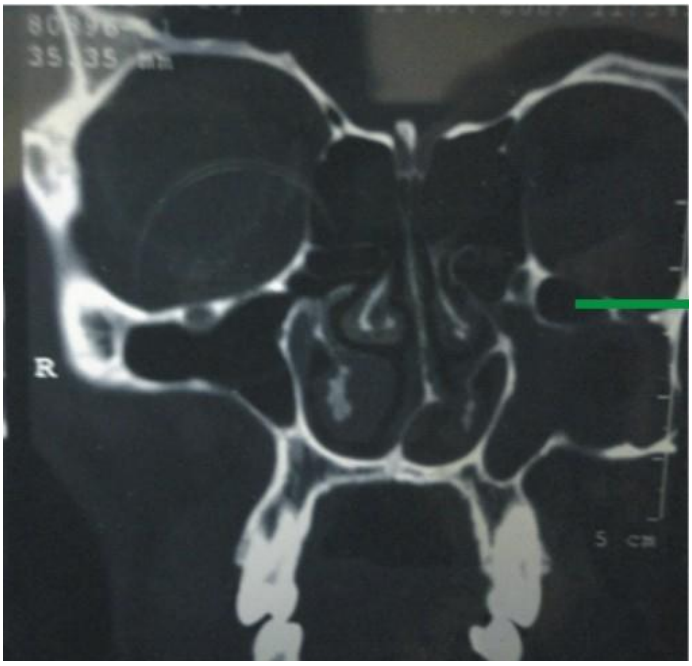
* p value calculated using Fisher exact test
p value calculated using Pearson Chi Square test

Table 11. Association of anatomical variations with frontal sinus involvement in chronic rhinosinusitis cases

		Frontal sinus involvement		P value
Factors		Yes	No	
Deviated nasal septum	Present	3	37	0.60*
	Absent	2	12	
Concha bullosa	Present	1	27	0.18*
	Absent	4	22	
Paradoxically bent middle turbinate	Present	0	8	> 0.99*
	Absent	5	41	
Uncinate hypertrophy	Present	0	3	> 0.99*
	Absent	5	46	
Uncinate deviation	Present	1	4	0.40*
	Absent	4	45	
Agger nasi cell	Present	0	1	> 0.99*
	Absent	5	48	
Haller cell	Present	0	1	> 0.99*
	Absent	5	48	
Anatomical variations	Present	3	44	0.12*
	Absent	2	5	

* p value calculated using Fisher exact test

Figure 9. Paradoxically bent middle turbinate & Haller cell (Arrow Mark)



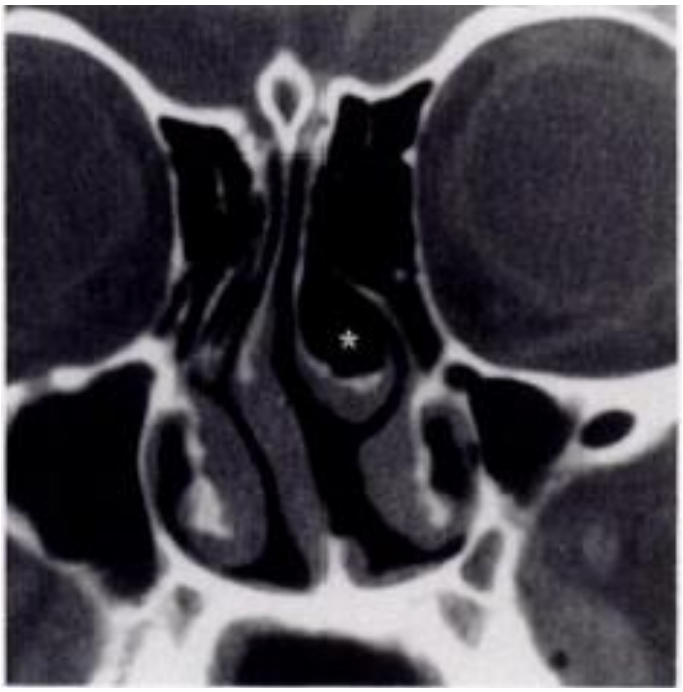


Figure 10. Bilateral concha bullosa with septal deviation to right side

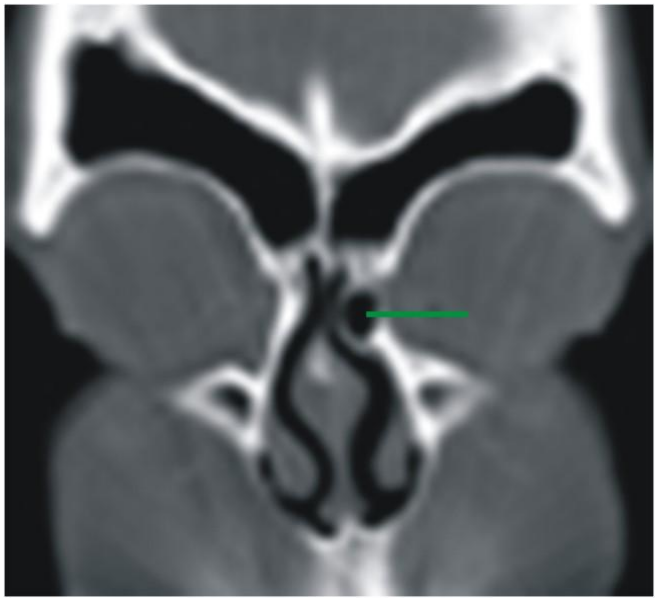


Figure 11. Agger nasi cell (Arrow Mark)

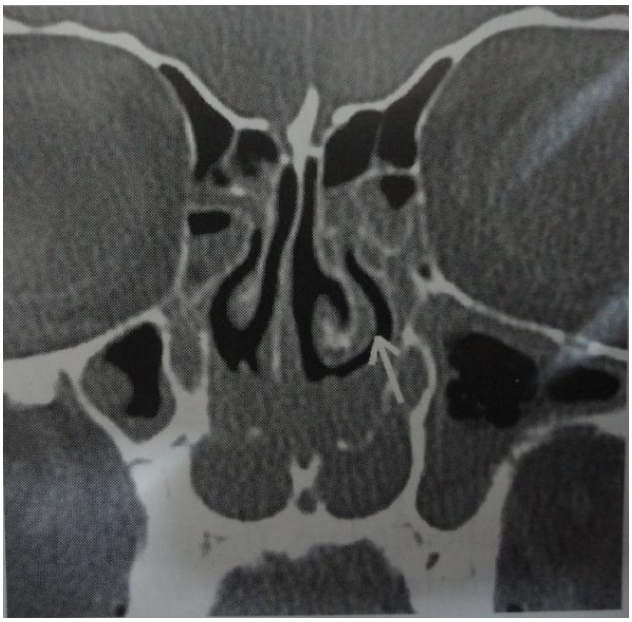


Figure 12. Paradoxically curved middle turbinate

DISCUSSION

The surgical management of CRS has evolved over the years. External facial incisions, extensive nasal packing and prolonged hospital stays have been replaced by minimally invasive surgery. This involves opening the obstructed ostia to provide normal ventilation with preservation of adjacent mucosa[42,43]. While excellent results have been reported in the literature to date[44,45], given the close relation of the paranasal sinuses to important structures such as the orbit and skull base, if complications occur in surgery, they are usually dangerous and harmful.

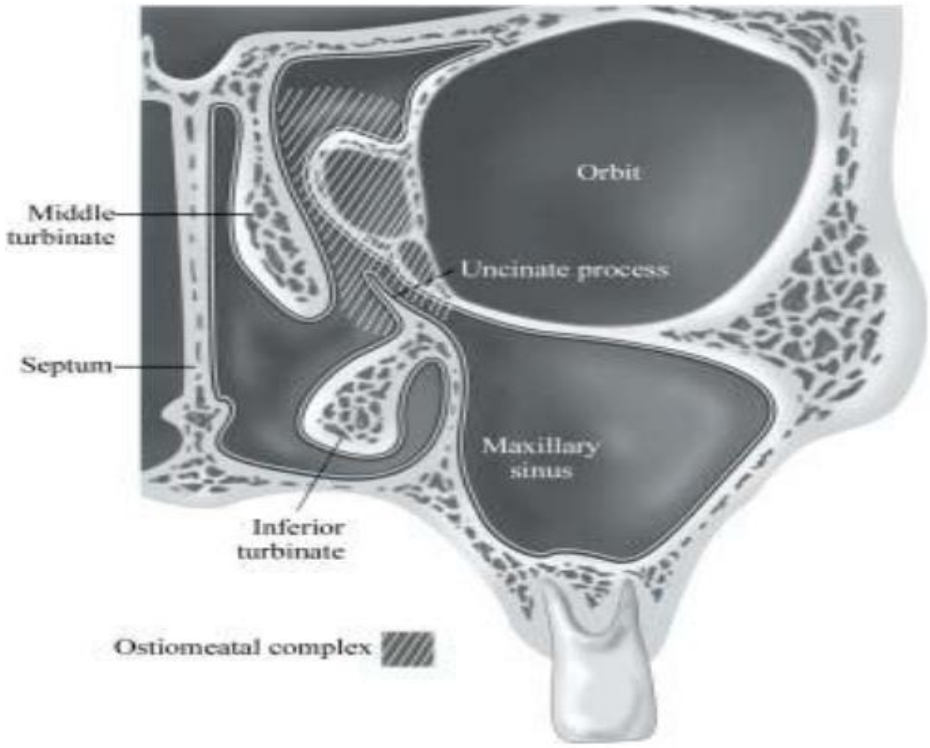


Figure 13. Showing the Osteomeatal complex (OMC)-(a) The OMC-small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus-represents the key region for the drainage for the maxillary, anterior ethmoid and frontal sinuses.

Anatomical variations in the sinonasal region are common. Recent advances in CT scanning and the widespread of ESS, as well as the presence of universal agreement in the

variation nomenclature and terminology has made the extent of these variations apparent. At the focus of interest is the ostiomeatal complex (OMC) in the lateral wall of the nose which is thought to be the key in the pathogenesis of CRS. Local anatomic variations including concha bullosa, deviated nasal septum (DNS), Haller cells, paradoxical middle turbinates, agger nasi cells and many others may be the source of middle meatal obstruction and subsequent rhinosinusitis.

In our study we found anatomical variation in osteomeatal complex of 87 % chronic rhinosinusitis patients, out of which 53.7% had two or more anatomical variations and the remaining 33.3 % had single anatomical variation. Similar findings were reported by Liu X et al who observed prevalence of about 81% anatomical variations in chronic rhinosinuistis cases[30]. Severino Aires de Araujo Neto et al 2004 reported relatively less anatomical variations 65% in the osteomeatal complex of the chronic rhinosinusitis cases[33]. Perez et al also observed similar prevalence of anatomical variations in the chronic sinusitis cases[32].

NASAL SEPTAL DEVIATION

Nasal septum is fundamental in the development of the nose and paranasal sinuses. It is the epiphyseal platform for the development of the facial skeleton[46]. 74.1 % of the patients in our study presented with nasal septal deviation (Table 7). Deviated nasal septum causes a decrease in the critical area of the osteomeatal unit predisposing to obstruction and related complications. Similar finding were observed by Perez et al who reported the prevalence of deviated nasal septum to be about 80%[32]. Infact in various studies the finding of nasal septal deviation ranged from 14.1% to 80%, Dutra and Marchiore et al[47] 14.1%, Arslan et al[48] 36%, Earwaker et al[27] 44%. Dua et al and Asruddin et al found prevalence of 44% and 38% of deviated nasal septum in

their respective studies[9,31]. Stallmann et al and Mamtha et al also reported lesser prevalence of 60% and 65% deviated nasal septum in chronic rhinosinusitis cases respectively[34,38].

CONCHA BULLOSA

Concha bullosa (pneumatised middle turbinate) has been implicated as a possible aetiological factor in the causation of recurrent chronic sinusitis. It is due to its negative influence on paranasal sinus ventilation and mucociliary clearance in the middle meatus region as quoted by Tonai[28]. Concha bullosa was seen in 53.7% of the chronic rhinosinuistis cases (unilateral 33.3%, bilateral 20.4%) which is almost similar to as reported by Bolger et al[10] and Yousem et al[49] respectively. Perez-Pinas et al and Scribano et al reported higher prevalence of concha bullosa i.e. 73% and 67% in chronic rhinosinusitis cases[32,24]. The prevalence of concha bullosa in our study is on the higher side when compared to the findings of Stallmann et al[34], Maru et al[29] and Alkire BC et al[39] who reported it to be 44%, 42.6% and 41.7% respectively.

Zinreich et al, Asruddin et al, Wani et al, Dua et al, Mamtha et al, Llyod et al and Weinberger et al reported further less prevalence of about 36%, 30%, 28%, 16% ,15%, 14% and 15% respectively[50,31,1, 9,38,12,51].

PARADOXICALLY CURVED MIDDLE TURBINATE

The middle turbinate may be paradoxically curved i.e. bent in the reverse direction. This may lead to impingement of the middle meatus and thus to sinusitis. Stammberger and Wolf[11] accepted paradoxical curvature of the middle turbinate as an etiological factor for CRS because it may cause obliteration or alteration in nasal air flow dynamics. It was found in 14.8% of the

patients; the prevalence is similar to that of 12% by Asruddin et al[31] and 15% by Llyod[12]. It is less than that reported by Al-Qudah et al 18% and Bolger et al 27% respectively[40,11]. Lesser prevalence of paradoxically middle turbinate was observed by Wani et al 2009[1].

UNCINATE PROCESS OF THE ETHMOID BONE

We observed that the uncinate process may be deviated or pneumatized. Uncinate deviation can impair sinus ventilation especially in the anterior ethmoid, frontal recess and infundibulum regions. The deviated uncinate was found in 9.3% of cases which is similar to the findings of the study by Maru et al[29] but higher than that reported by Bolger et al[10] 2.5%, Dua et al[9] 6% and Asruddin et al[31] 2%. Llyod et al[12] reported the prevalence of about 16% of deviation of the uncinate process in chronic rhinosinusitis cases and even 65 % prevalence of uncinate process deviation was seen in the study by Mamtha et al[38].

Hypertrophied uncinate process causes narrowing of the hiatus semilunaris and the ethmoid infundibulum. It has also been suggested as a predisposing factor for impaired ventilation of the anterior group of sinuses and frontal sinus. Hypertrophy of the uncinate process was observed in 5.6% of the cases which is very less as compared to the findings of Wani et al who reported it to be 21% in chronic rhinosinusitis cases[1].

AGGER NASI CELL

Agger nasi cells lie just anterior to the anterosuperior attachment of the middle turbinate and frontal recess. These can invade the lacrimal bone or the ascending process of maxilla. These cells were the least observed in our study i.e. about 1.9%. Similar results were observed by Liu X et al[30] and Llyod et al[12] who reported the prevalence of agger nasi cell as 0.7% and 3% in chronic rhinosinuistis cases whereas in the study by Dua et al[9] agger nasi cells were found to be present

in 20 patients (40%). The prevalence is very less as compared to 98.5% by Bolger[10], 88.5% by Maru[29], 86.7% by Tonai and Baba[26] and 48% by Asruddin[31].

In anatomic dissections, Messerklinger[5] encountered the agger nasi cells in 10-15% of the specimens and Davis et al[52] in 65% of specimens and Mosher et al in 40% of specimens[53]. In coronal CT imaging, Kennedy and Zinreich[54] noted the presence of agger nasi cell in nearly all of the patients. The less prevalence of agger nasi cells in our study might be due to firstly, different definitions assigned to this anatomical variant and secondly to the small size of the agger nasi cell which might make its detection difficult.

HALLER'S CELL

Zinreich et al[19] and Kennedy et al[55] described Haller's cells as ethmoid air cells found inferior to the ethmoid bulla adhering to the roof of the maxillary sinus, in continuity with the proximal infundibulum, which formed part of the lateral wall of the infundibulum. They are considered as ethmoid cells that grow into the floor of orbit and may narrow the adjacent ostium of the maxillary sinus especially if they become infected[23]. Davis et al[52] noted the haller cell is thought to cause chronic sinusitis cases by impinging on the ostium of the maxillary sinus and infundibulum by inhibiting the ciliary function, leading to obstruction of the ostium.

The prevalence of Haller's cells in our study was equal to that of agger nasi cell i.e. 1.9%. Similar findings were observed by Liu X et al[30] who reported the prevalence of about 1 % of Haller cells in 297 chronic rhinosinusitis cases in a study conducted in Sun Yat Sen University of Medical Sciences. This is again very less as compared to that reported by Kayalioglu et al[56] 5.5 %, Dua et al[9] 16%, Llyod et al[23] 15%, Perez-Pinas et al[32] 20%, Tonai and Baba[26] 36%, Bolger et al[10] 45.9%, Maru et al[29] 36%, Alkire BC et al[39] 39.9%and Asruddin et al[33] 28% respectively.

Table 12. Prevalence of anatomic variations as reported by various authors.

Authors	Agger nasi cell	Haller's cell	Deviated Uncinate process	Concha Bullosa	Nasal septal deviation
Present study	1.9%	1.9%	9.3%	53.7%	74.1%
Bolger et al	98.5%	45.1%	-	53%	18.8%
Llyod et al	3%	15%	16%	14%	18.8%
Scribano et al	-	24%	-	67%	-
Wanamaker et al	-	20%	45%	30%	20%
Tonai and Baba	86.7%	36%	-	28%	-
Yousem et al	-	10-45%	-	34-53%	-
Pinas et al	Nearly all	3%	4.5%	73%	80%
Mamtha et al	50%	17.5%	65%	15%	65%
Zinreich et al	Nearly all	10%	3%	36%	21%

FACTORS RESPONSIBLE FOR INVOLVEMENT OF A PARTICLAR SINUS

We observed that though 85.2% of the study subjects had maxillary sinus involvement. The presence of deviated nasal septum and concha bullosa was strongly associated with maxillary sinus involvement. Simliar findings were reported by Caughey et al[37] who had observed the association of deviated nasal septum and concha bullosa with maxillary sinus involved. It was also observed in their study that Haller cells were responsible for ethmoid and maxillary sinus disease. Ameri AA et al[36], observed that among all the observed paransal variants, concha bulllosa of middle turbinate and septal deviation were associated with chronic sinusitis. Also,

there was a significant association between presence of anatomic variants and occurrence of chronic sinusits for each paranasal sinus.

But other anatomical variations of the osteomeatal complex observed in our study were not associated with the maxillary sinus involvement. We also observed that ethmoid and frontal sinus involvement had no associated factors.(Table 10,11).

The results in our study further emphasise that most probably, the rhinosinusitis genesis is multifactorial, and the physiological factor (mucociliary clearance disorders) possibly is as much significant as the mechanical obstructive factor[57].

The clinical significance of anatomical variants of the nasal sinus region is controversial. Vincent et al[41] observed no significant association between the rate of ipsilateral and contralateral side of CRS in relation to the presence of ipsilateral or contralateral DNS. Even Yasan H et al[58] also found no statistically significant difference between DNS group and non-DNS group with respect to the CRS. The rates of CRS ipsilateral to and contralateral to the side of the DNS were not statistically different among CRS groups.

Vincent et al[41] further observed that the presence of CB did not statistically contribute to an overall increased incidence of ipsilateral CRS. The etiological role of CB in CRS has been controversial. Zinreich SJ et a[59], Nadas S et al[60], Aktas D et al[61] and Yousem D[49] and Tonai et al[26] also concurred with the findings of Vincent et al. Lusk et al[27] too did not observe any association of concha bullosa with sinus disease in children.

Although Arslan H et al[62] reported otherwise. Milczuk et al[63] had found an association with ipsilateral ethmoid-maxillary sinusopathy in the childhood in 63% of cases studied. Therefore this does not necessarily reflect the natural progression of history of a CB to the genesis of the OMC disease.

Most CT anatomical studies of the sinus region have been made in patients suspected of a clinical syndrome suggesting infammatory sinus pathology. Zinreich[64] found that 62% of his patients presented at least one anatomic variant, against 11% in the normal control group. These findings seem to suggest a possible correlation or clinical significance of anatomical variants regarding the appearance of inflammatory sinus pathology. However, Bolger et al[10], in a series of 202 patients studied by CT, observed 131 anatomical variants, but found the incidence in patients with sinus pathology was similar to that in persons studied for other reasons. Calhoun et al[65] compared 100 CTs carried out to evaluate sinus disease with 82 CTs from a study of orbital pathology. The existence of a concha bullosa was more frequent in the first group, as was septal deviation. However, the existence of a paradoxical middle nasal concha was observed equally in the 2 studies, without association in any case with a sinus anomaly. Of all the anatomical variants of Lloyd's series, Lloyd[12], only the concha bullosa was associated with a high incidence of sinusitis (85%). Bolger et al[66] and Stammberger and Wolf[11] detected the presence of anatomical variants both in patients studied for sinus problems and in those studied for other reasons. They concluded that the simple presence of variants does not mean a predisposition to sinus pathology, except when other associated factors are present. This opinion is not shared by Yousem[49], who claimed that they may be predisposing factors, depending on their size.

Llyod GAS et al[23] observed that the anatomical variations in the middle meatus (concha bullosa, paradoxical middle turbinate, bent uncinate process, over pnuematized bulla ethmoidale, haller cells and agger nasi cells) were not associated with any increased sinus opacity; there was no evidence therefore that these anomalies had any effect on sinus disease by causing middle meatal stenosis.

However Bolger et al[10] have found out that the pneumatization of the bulbous portion of the middle concha presented a prevalence significantly increased in patients with sinusopathy . Liu et al[30] too have demonstrated that the greater the size of the anatomical variant, the higher the frequency of association with paranasal sinus mucosal alterations at CT.

Even disregarding factors like subtype or size, Scribano et al[24] had observed that, if the anatomical variant determines obliteration of the aerial space of the osteomeatal complex drainage paths, the sinusal disease was more frequently detected at CT than when the anatomical variant did not obstruct these pathways.

Some disparities between frequencies in different studies[10,24,26,27,30,47,57,67] can be explained by some controversial factors, definitions and ratings of the anatomical variant[10,68] the utilization of evaluation methods with different sensitivities (anatomical pieces *versus* CT) and also racial or population factors[26]. Also, it is necessary establish the difference between clinical sinusopathy and tomographic sinusopathy, since sinusal alteration at CT does not mean necessarily clinical disease[10,69-72]. Finally, since each variant seems to have a different influence on the development of the sinus disease, it would be convenient to determine the risk of each variant independently. A few studies involve a sufficient number of cases for a statistically satisfactory data analysis, as some anatomical variants present a very low incidence.

There are however limitations to our study. Though there appears a probable association between the high prevalence of anatomical variations (87%) of the osteomeatal complex observed in our study with the chronic rhinosinusitis cases but it cannot be proven statistically as there was no control group and so further studies need to be done in a case control or cohort epidemiological design to find any significant association of anatomical variants with the causation of chronic rhinosinusitis cases.

SUMMARY AND CONCLUSION

The present study was conducted in the Department of Otorhinolaryngology, B.L.D.E.U'S Shri B.M.Patil Medical College Hospital and Research Centre, Bijpaur from November 2009 through October 2010. The study was undertaken with the objective of assessing the role of anatomical variations of osteomeatal complex in chronic rhinosinusitis cases.

Fifty four consecutive cases of chronic rhinosinusitis patients attending the E.N.T. outpatient department, who had chronic sinusitis for more than three months duration not responding to the medical line of treatment and who were willing to undergo Functional Endoscopic Sinus Surgery. satisfying the inclusion criteria were studied.

Data collection instruments included the case sheet proforma (Detailed history and clinical examination), computed tomography of the paranasal sinuses and diagnostic nasal endoscopy findings.

The results were expressed in terms of percentages and association of anatomical variations with sinus involvement was calculated using Pearson Chi Square test and fisher exact test.

In light of the results obtained in our study, it can be concluded that:

1. Majority of the patients were in relatively younger age group i.e. from 11-40 years of age and there was female predominance.
2. The commonest symptom were nasal obstruction, postnasal drip and headache.
3. The commonest signs were mucopurulent discharge followed by deviated nasal septum, inferior turbinate hypertrophy and middle turbinate hypertrophy.
4. Maxillary sinus was most frequently diseased sinus in our study; bilateral maxillary sinusitis was the most common presentation.

5. Prevalence of multiple anatomical variations was more in our study in comparison to single anatomical variation.
6. Deviated nasal septum was the most common anatomical variation encountered in our study followed by concha bullosa.
7. The presence of nasal septal deviation and concha bullosa were strongly associated with maxillary sinus involvement.

Diagnostic endoscopy and CT scan must be done prior to any functional endoscopic sinus surgery. They help in assessing the extent of sinus disease and to know the anatomical variations.

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PROFORMA

Name of the Patients:

Age/Sex	:	Case No:	
Religion	:	Reg. No. IP/OP/No.	:
Occupation	:	Date of Admission	:
Income	:	Date of Discharge	:
Address	:	Diagnosis	:

Chief Complaints:

[A] Present History

1) Nasal Discharge (Rhinorrhoea):

Duration :

Onset & Progress :

Unilateral/ Bilateral :

Diurnal Variation :

Seasonal Variation :

Quality :

Watery / Mucoid/Mucopurulent / Purulent

Colour :

Odour :

Any Other :

2) Nasal Obstruction:

Duration :

Onset & Progress :

Unilateral/ Bilateral :

Diurnal Variation :

Seasonal Variation :

3) Headache / Facial Pain ;

Duration :

Onset & Progress :

Site :

Postural Variation :

Seasonal Variation :

Localized Radiating :

Aggravating :

Relieving Factors :

Any Other :

4) Post-Nasal Discharge;

Quality :

Colour :

Odour :

5) History of Epistaxis :

6) History f Sneezing :

Duration :

Onset & Progress :

Seasonal Variation :

Aggravating factors :

Relieving Factors :

7) H/O Allergy :

8) H/O Fever :

9) H/O Cough :

10) Abnormalities of Smell(If any) :

Hyposmia/Parosmia/Anosmia/Cacosmia.

11) Any Other Symptoms:

[B] Past History:

H/O Similar Complaints in past- Any treatment taken : Medical-Surgical.

H/O TB/HT/DM/ any exposure

[C] Personal History

Diet : Adequate /Inadequate, Veg/Non-Veg

Appetite :

Sleep :

Micturation :

Bowels :

Habits: Smoking, Beedis /Cigarettes since…….. Years/months.

Tabacco Chewing since ……. years

[D] Family History :

H/O Similar complaints in family members-

[I] General Physical Examination:

Built an Nourishment : Good / Moderate / Poor.

Pallor / Cynosis / Clubbing :

Icterus /Lymphadenopathy:

Vital Signs:

Pulse Rate : / mm

Temperature :

Blood Pressure : mm of Hg.

Respiratory rate : Per min.

Examination of Face :

Quality of Voice :

[II] Systemic Examination

1) Respiratory System:

2) Cardio-Vascular System:

3) Per Abdomen:

4) Centeral Nervous System;

[III] E.N.T. Examination

1. Examination of Nose :

a) External Appearance :

b) Cold Spatula Test :

c) Anterior Rhiniscopy :

i) Vestibule :

ii) Mucosa: Pale /Edematous/ Congested / Crusting

iii) Septum:

	Right	Left

iv) Cavity:

v) Turbinates

Inferior

Middle

vi) Meati

Inferior

Middle

Olfactory Cleft

vii) Floor :

viii) Roof :

ix) Any Other abnormality :

d) Examination of Paranasal Sinuses:

	Right	Left

(i) Fontal

(ii) Ethmoidal

(iii) Maxillary

e) Posterior Rhinoscopy:

2. EXAMINATION OF ORAL CAVITY AND OROPHARYNX

a) Oral cavity :

b) Oropharynx :

Pillars :

Tonsils :

Palate :

Uvula :

Posterior Pharyngeal Wall :

c) Indirect Laryngoscopy :

3. EXAMINATION OF EARS ;

Right Left

(i) External Appearance

(ii) External Auditory Canal

(iii) Tympanic Membrane

(iv) Siegelisation Test :

(v) Tunning Fork Tests:

Rinne's

Weber's

ABC ;

(vi) Mastoid tenderness

(vii) Facial Nerve Examination:

INVESTIGATIONS

1) Blood:

a) Haemoglobin :

b) ESR :

c) Total WBC Count :

d) Different WBC Count :

Neutophils : Eosinophils :

Basophils :

Lymphocytes : Monocutes :

e) Absolute Eosinophils Count :

f) Bleeding Time :

g) Clotting Time :

2) Urine : Albumin :

Sugar :

Micro :

3) X-ray PNS :

4) Nasal Swab for Culture and Sensitivity :

5) DIAGNOSTIC ENDOSCOPY:

Nasal endoscopic findings :

1) Floor of the Nose

2) Septum :
3) Inferior meatus:
4) Inferior Turbinate :
5) Middle Turbinate :
6) Nasopharynx :
7) Sphenoid ethmoid recess :
8) Posterior tip of turbinate :
9) Middle Meatus :
10) Hiatus Semilunaris
11) Ethmoidal Bulla
12) Uncinate:
13) Nasal polyps:
14) Frontal Recess:
15) Anatomical Variations:
    i. Agger Nasi Cells :
    ii. Accessory Maxillary ostium:
    iii. Bulla ethmoidalis:
    iv. Uncinate Process
    v. Middle Turbinate:
    vi. Onodi Cells:
    vii. Septal Deviation:

6) COMPUTED TOMOGRAPHIC FINDINGS:
    Plain / Contrast
    Axial / Coronal

i) Frontal Sinus
ii) Nasolacrimal Duct
iii) Anterior ethmoids
iv) Infundibulum
v) Maxillary Sinus
vi) Middle meatus

vii) Frontal recess

viii) Polyps

ix) Posteriors ethmoids

x) Sphenoid ethmoid recess

xi) Sphenoid

xii) Agger nasi Cells

xiii) Haller Cells

xiv) Ethmoid Bulla

xv) Uncinate Process

xvi) Middle Turbinate

xvii) Onodi Cells

xviii) Septal Deviation

xix) Accessory Maxillary ostium.

DIAGNOSIS :

TREATMENT :

Procedures Performed:

SAMPLE INFORMED CONSENT FORM

BLDEA'S SHRI B. M. PATIL MEDICAL COLLEGE AND RESEARCH CENTER, BIJAPUR- 586103

TITLE OF THE PROJECT: A PROSPECTIVE STUDY OF ANATOMICAL VARIATIONS OF THE OSTEOMEATAL COMPLEX IN CHRONIC RHINOSINUSITIS PATIENTS

PG GUIDE: Prof **.** DR.R.N.KARADI

PG STUDENT: DR.ANITA.ARAMANI

PURPOSE OF RESEARCH:

I have been informed that this is a study ,to assess role of anatomical variations of osteomeatal complex in chronic sinusitis patients.I have also been given a free choice of participation in this study.

PROCEDURE:

I am aware that in addition to routine care received ,I will be asked series of questions by the investigator. I have been asked to undergo the necessary investigations and treatment, which will help the investigator in this study.

RISK AND DISCOMFORTS:

I understand there is no risk involved and I will experience some pain and discomfort during my procedures performed. This is mainly the result of my condition and the procedure of this study is not expected to exaggerate these feelings that are associated with the usual course of treatment.

BENEFITS:

I understand that my participation in this study will help the investigator to understand the role of anatomical variations of osteomeatal complex in chronic sinusitis.

CONFIDENTIALITY:

I understand that the medical information produced by this study will become a part of Hospital records and will be subject to the confidentiality and privacy regulation. Information of a sensitive personal nature will not be a part of the medical records, but investigator's research file and identified only by a code number. The code-key connecting name to numbers will be kept in a separate location.

If the data are used for publication in the medical literature or for teaching purpose, no name will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand that I may see the photographs and videotapes and hear the audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at anytime. Dr. Anita Aramani is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study, which might influence my continued participation.

If during the study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful reading.

REFUSAL FOR WITHDRAWAL OF PARTICIPATION:

I understand that my participation is voluntary and that I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my

present or future care at this hospital. I also understand that Dr.Anita Aramani may terminate my participation in the study after she has explained the reasons for doing so and has helped arrange for my continued care by my own physician or physical therapist, if this is appropriate.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, the appropriate treatment would be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

STUDY SUBJECT CONSENT STATEMENT:

I confirm that Dr. Anita Aramani has explained to me the purpose of research, the study procedures that I will undergo, and the possible risks and discomforts as well as benefits that I may experience in my own language. I have read and I understand this consent form. Therefore, I agree to give consent to participate as a subject in this research project.

_____ _____

Participant / Guardian Date

_____ _____

Witness to signature Date

I have explained to _____the purpose of the research, the procedures required and the possible risks and benefits to the best of my ability in patient's own language.

_____ _____

Dr. Anita Aramani Date

(Investigator)

KEY TO MASTER CHART

- NO - Nasal obstruction
- ND - Nasal discharge
- PND - Post nasal drip
- SNZ - Sneezing
- H - Headache
- FP - Facial pain
- NM - Nasal mucosa
- IT - Inferior turbinate
- MT - Middle turbinate
- IM - Inferior meatus
- MM - Middle meatus
- DNS - Deviated nasal septum
- CB - Concha bullosa
- OC - Onodi cell
- MT - Middle turbinate
- U - Uncinate
- AN - Agger nasi cell
- HC - Haller cell
- BE - Bulla ethmoidalis
- MS - Maxillary sinus
- ES - Ethmoidal sinus

- SS - Sphenoid sinus
- FS - Frontal sinus
- N - Normal
- H - Hypertrophied
- MP - Mucopurulent
- D - Deviated
- P - Present
- PB - Paradoxically bent
- H - Hypertrophy
- \+ - Present
- \- - Absent
- 1 - Involved
- 0 - Not involved

	NAME	IP NO	AGE	SEX	SYMPTOMS						SIGNS(DNE)										CT FINDINGS											
					NO	ND	H/FP	PN[	SNZ	NM	IT		MT		IM		MM		DNS(DNE)		DNS		CB		OC		MT		U		AN		HC		BE	
											R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
1	Sara	16376	38y	F	+	-	+	+	+	N	N	H	N	H	N	N	MP	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Dundawwa	16575	60y	F	+	-	-	+	-	N	H	N	N	N	N	N	MP	N	-	D	-	D	-	-	-	-	-	-	-	D	-	-	-	-	-	-
3	**Vasant**	**17303**	**40y**	**M**	**+**	**-**	**+**	**-**	**+**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**MP**	**MP**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
4	Muttawwa	17582	28y	F	+	-	-	+	-	N	N	H	H	N	N	N	N	MP	D	-	D	-	P	-	-	-	-	PB	-	-	-	-	-	-	-	-
5	**Umesh**	**17598**	**21y**	**M**	**+**	**-**	**+**	**-**	**+**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**MP**	**-**	**D**	**-**	**D**	**P**	**P**	**-**	**-**	**PB**	**-**	**-**	**-**	**-**	**-**	**-**	**P**	**-**	**-**
6	**Bhagawant**	**17946**	**35y**	**M**	**+**	**+**	**-**	**+**	**-**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**MP**	**MP**	**D**	**-**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
7	**Sugalamma**	**13082**	**60y**	**F**	**-**	**-**	**+**	**+**	**-**	**N**	**N**	**H**	**H**	**H**	**N**	**N**	**N**	**MP**	**D**	**-**	**D**	**-**	**P**	**P**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
8	Ninganagouda	19535	40y	M	+	-	+	+	-	C	N	N	N	N	N	N	MP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Arati	61	20y	F	+	-	+	+	-	C	N	H	N	H	N	N	MP	N	D	-	D	-	-	P	-	-	-	-	H	-	-	-	-	-	-	-
10	Sharanawwa	188	30y	F	+	-	+	+	-	N	N	N	N	N	N	N	MP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Shridevi	945	20y	F	+	+	+	+	-	N	N	H	N	N	N	N	MP	N	D	-	D	-	P	-	-	-	PB	-	-	-	-	-	-	-	-	-
12	Tayawwa	1069	20y	F	+	-	+	+	-	N	N	H	H	H	N	N	N	MP	D	-	D	-	P	P	-	-	-	-	H	-	-	-	-	-	-	-
13	**Shankaragouda**	**3197**	**70y**	**M**	**-**	**+**	**+**	**+**	**-**	**N**	**N**	**H**	**H**	**N**	**N**	**N**	**N**	**N**	**D**	**-**	**D**	**-**	**P**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
14	**Iranna**	**3478**	**18y**	**M**	**-**	**+**	**+**	**+**	**-**	**N**	**H**	**H**	**N**	**N**	**N**	**N**	**MP**	**MP**	**D**	**-**	**D**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
15	Brahmanand	5017	21y	M	+	+	+	+	-	N	H	N	H	N	N	N	MP	N	-	D	-	D	P	-	-	-	-	PB	-	-	-	-	-	-	-	-
16	Parasuram	5952	21y	M	+	+	-	+	-	N	N	H	H	N	N	N	MP	N	D	-	D	-	P	-	-	-	-	-	-	H	P	-	-	-	-	-
17	Shilpa	6183	25y	F	+	+	-	+	-	N	H	N	N	H	N	N	N	MP	-	D	-	D	-	P	-	-	-	-	-	-	-	-	-	-	-	-
18	Shivanand	6582	21y	M	+	-	-	-	-	N	N	H	H	H	N	N	N	MP	D	-	D	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-
19	Kasturi	6600	35y	F	+	+	-	-	-	N	N	N	H	N	N	N	MP	N	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Meenakshi	6893	27y	F	-	-	+	-	-	C	N	N	N	N	N	N	N	MP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Pradeep	7295	20y	M	-	+	-	-	-	N	N	N	N	N	N	N	MP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Lakashmi	7421	13y	F	-	+	+	-	-	N	N	H	N	N	N	N	N	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Rudraksha	7504	39y	M	+	+	+	-	+	C	H	N	H	H	N	N	MP	N	-	D	-	D	P	P	-	-	-	-	-	-	-	-	-	-	-	-
24	Devendra	7795	33y	M	+	+	-	+	-	N	H	N	H	H	N	N	N	MP	-	D	-	D	P	P	-	-	PB	-	-	-	-	-	-	-	-	-
25	Anupama	8209	47y	F	+	+	-	+	-	N	H	N	H	N	N	N	MP	N	-	D	-	D	P	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Ranjita	8632	18y	F	+	+	+	+	-	N	N	H	N	N	N	N	MP	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	Akash	8976	19y	M	-	-	+	-	-	N	H	N	H	N	N	N	MP	N	-	D	-	D	P	-	-	-	-	-	-	-	-	-	-	-	-	-
28	Padma	9316	34y	F	-	+	+	-	-	N	N	N	N	N	N	N	MP	N	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-	-	-	-
29	Prasad	9526	68y	M	+	+	-	-	-	N	N	H	N	H	N	N	MP	MP	D	-	D	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Heenakousar	9753	19y	F	+	-	+	-	-	N	H	N	H	H	N	N	N	MP	-	D	-	D	P	P	-	-	-	-	-	-	-	-	-	-	-	-

	NAME	IP NO	AGE	SEX	SYMPTOMS						SIGNS(DNE)										CT FINDINGS													
					NO	ND	H/FP	PND	SNZ	NM	IT		MT		IM		MM		DNS(DNE)		DNS		CB		OC		MT		U		-N		HC		BE	
											R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
31	Basavaraj	10323	26y	M	+	-	+	+	-	N	N	N	N	N	N	N	MP	N	-	D	-	D	-	-	-	-	-	-	-	D	-	-	-	-	-	-
32	Kallappa	10583	50y	M	+	-	+	+	-	N	N	N	N	N	N	N	N	MP	-	-	-	-	P	-	-	-	-	PB	-	-	-	-	-	-	-	-
33	Shivayya	10685	50y	M	+	-	+	+	-	N	N	N	N	N	N	N	N	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	Samarth	10683	60y	M	-	-	+	+	-	N	H	N	H	N	N	N	N	MP	-	D	-	D	P	-	-	-	-	-	-	-	-	-	-	-	-	-
35	Mahantesh	11165	24y	M	-	+	+	+	-	C	N	H	H	H	N	N	MP	N	D	-	D	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-
36	Saraswati	11157	47y	F	-	+	+	-	-	C	N	N	N	N	N	N	MP	N		D	-	D	-	-	-	-	-	-	D	-	-	-	-	-	-	-
37	Jayaprakash	11221	40y	M	+	+	+	+	-	C	N	N	N	N	N	N	N	MP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	Prakash	11210	35y	M	+	+	+	+	-	N	N	N	N	N	N	N	N	MP	D	-	D	-	-	-	-	-	-	-	-	D	-	-	-	-	-	-
39	Santosh	11736	43y	M	+	+	+	+	-	N	N	N	H	N	N	N	MP	N	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
40	Geeta	11732	28y	F	+	+	+	-	-	N	H	N	H	H	N	N	MP	MP	-	D	-	D	P	P	-	-	-	-	-	-	-	-	-	-	-	-
41	Parasuram	11875	30y	M	+	+	-	+	-	N	H	N	N	H	N	N	N	MP	-	D	-	D	-	P	-	-	-	-	-	-	-	-	-	-	-	-
42	Dundappa	12183	25y	M	+	-	-	+	-	N	N	N	H	H	N	N	N	N	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-
43	Siddalingappa	12394	56y	M	+	-	-	+	-	N	H	N	N	N	N	N	MP	N	-	D	-	D	-	-	-	-	PB	-	-	-	-	-	-	-	-	-
44	Basavantappa	12678	56y	M	-	-	-	+	-	N	N	N	H	N	N	N	N	N	D	-	D	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
45	Priyanka	12943	38y	F	-	+	-	-	-	N	H	N	N	N	N	N	N	MP	-	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	Vishwanath	13238	22y	M	+	-	-	-	-	N	N	N	H	H	N	N	N	N	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-
47	Ravi	13579	19y	M	+	+	-	-	-	N	H	N	N	N	N	N	MP	N	-	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	Sunanda	15156	26y	F	+	+	+	+	-	N	N	H	N	N	N	N	MP	MP	D	-	D	-	-	-	-	-	-	PB	-	-	-	-	-	-	-	-
49	Nagamma	16977	20y	F	+	-	+	+	-	N	N	N	N	N	N	N	N	N	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
50	Anil	17068	17y	M	-	-	+	+	-	N	N	H	N	N	N	N	MP	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	Vanita	17037	25y	F	-	-	+	+	+	H	N	N	N	N	N	N	N	N	-	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	Jagdish	21359	35y	M	+	-	+	+	-	N	N	H	N	H	N	N	MP	N	D	-	D	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-
53	Rajshekhar	17053		M	+	-	+	+	-	N	N	N	N	N	N	N	N	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	Veer Singh	21733		M	+	-	+	+	-	N	N	N	N	N	N	N	N	N	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Max	Eth	Sphe	Frontal
0	1	0	0
0	0	0	1
1	**1**	**1**	**1**
1	0	0	0
1	**0**	**0**	**0**
1	**1**	**1**	**1**
1	**0**	**0**	**0**
0	0	0	1
1	0	0	0
1	1	0	0
1	1	0	0
1	0	0	0
0	**1**	**0**	**0**
1	**0**	**0**	**0**
1	0	0	0
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1	1	0	0
1	0	0	0
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0	1	0	0
1	0	0	0
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0	1	0	0
1	0	0	0
1	0	0	0

max	Eth	Sphe	Frontal
1	0	0	0
1	0	0	0
1	0	0	0
1	1	0	0
1	0	0	0
1	0	0	0
0	1	0	0
1	0	0	0
1	0	0	0
1	0	0	0
1	1	0	0
1	0	0	0
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1	0	0	0
1	0	0	0
1	0	0	0
1	0	0	0
1	1	0	0
1	0	0	0
1	0	0	0
1	0	0	0
1	**1**	**1**	**1**
1	0	0	0
1	0	0	0