Original article:

A prospective CT-PNS study of 130 cases of concha bullosa

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ABSTRACT:

Background: Concha bullosa, a common anatomical variation of lateral wall of nose, is the pneumatization of middle and sometimes the superior turbinate and rarely inferior turbinate.[1,2] Concha bullosa is known to cause a variety of complaints namely ,nasal obstruction, post nasal drip, rhinitis, headache[1,3,4].Concha bullosa usually occurs bilaterally, but the degree of pneumatization varies , sometimes so small, it may appear only in one section of CT scan.

Patient and method: 130 patients who had concha bullosa on CT scan were studied . Along with concha bullosa, anatomical variations like paradoxical middle turbinate, enlarged ethmoidal bulla, deviated nasal septum, osteomeatal complex block causing nasal symptoms were also recorded. If concha bullosa was present , it was graded as bulbous, lamellar or extensive. If bilateral conchae were present, sizes were compared and the larger one was identified as dominant. The association of concha bullosa and deviated nasal septum was also recorded.

Result: In the present study, there were 78 males, 52 females. Majority patients were in second and third decade of life. Most common complaint was nasal obstruction. Deviated nasal septum was the most common CT finding and also associated with concha bullosa followed by sinusitis.

Conclusion: Concha bullosa is a common anatomical variant. There is a strong association between type of concha bullosa, deviated nasal septum and sinusitis.

Keywords: concha bullosa, computed tomography, deviated nasal septum, sinusitis.

INTRODUCTION:

Concha bullosa,a common anatomical variation of lateral wall of nose, is the pneumatization of middle and sometimes the superior turbinate [(1 ,2) .]

Concha bullosa was defined as being present when more than 50% of the vertical height (measured from superior to inferior in the coronal plane) of the middle turbinate was pneumatized.[1]Sino nasal disease is a common health problem. A computed tomography(C T scan) is the method of choice for preoperative assessment of the disease [(2)]. Coronal plane is commonly studied as it helps for surgical orientation[(2)]. Messerklinger first introduced Endoscopic sinus surgery in 1978 [(9)]. Various studies have reported the frequency of concha bullosa as 14%-53%[2].Bolger et al. have classified concha bullosa as bulbous concha bullosa(BCB),lamellar concha bullosa(LCB) and extensive concha bullosa(ECB). A concha bullosa is not necessarily a pathologic finding. Other anatomical

variations like paradoxical middle turbinate, enlarged ethmoidal bulla may produce significant narrowing of the osteomeatal complex which is a common drainage pathway for anterior and medial ethmoid cells , frontal sinus and maxillary sinus causing sinusitis. Extensive pneumatization may also cause disturbance in mucocilicary clearance causing unpleasant post nasal drip. Contact point headaches are a sub group of rhinogenic headaches caused by concha bullosa.

PATIENTS AND METHODS:

A CT scan of 130 patients with concha bullosa were studied from 1 september 2011 to 30 august 2014. **Inclusion criteria:** Patients with complaints of nasal obstruction, headache, post nasal discharge and having concha bullosa evident on CT scan were included in the study. **Exclusion criteria:** Patients with history of previous surgery or complications of sinusitis were excluded. CT scan was done by Siemens Somatom Emotion DR 3 scanner equipped with version E software. Intravenous contrast dye was not used. It was our preference to perform the examination with the patient prone on the scanner bed with head in hyperextension. Scanner gantry is angled to be perpendicular to the hard palate.Scanner extends from the frontal sinus anteriorly through the sphenoid sinus posteriorly. Scanning parameters include 1mm thickness, 3mm table incrementation , 5s scan time ,125 kVp and 450mAs.Images were studied in coronal plane. Concha bullosa were classified as bulbous concha bullosa(BCB), lamellar concha bullosa(LCB) and extensive concha bullosa(ECB). If bilateral concha bullosa were present, the one extensively pneumatized was identified as dominant.. **Bulbous concha bullosa**: when the bulbous portion of concha bullosa is pneumatized. **Lamellar concha bullosa:** when only lamellar part of concha bullosa is pneumatized . **Extensive concha bullosa :** when bulbous and extensive part is pneumatized.

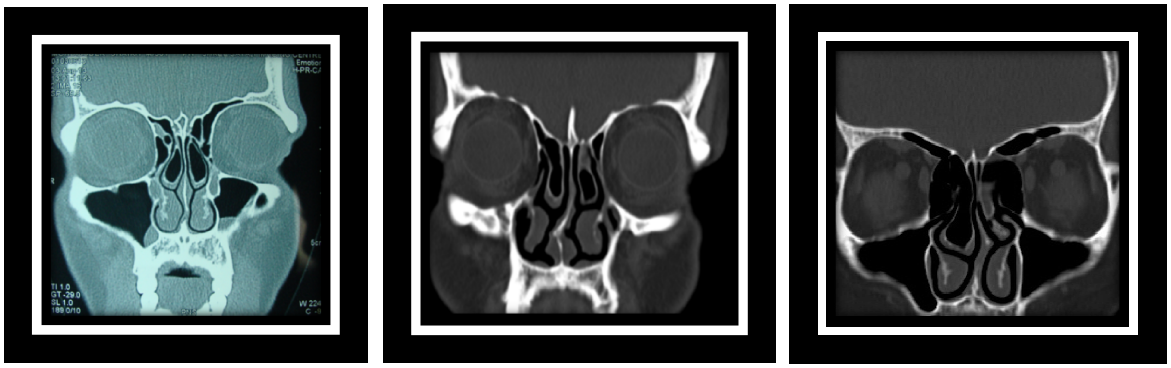

Fig.1 Bulbous concha bullosa Fig.2 Lamellar concha bullosa Fig.3 Extensive concha bullosa

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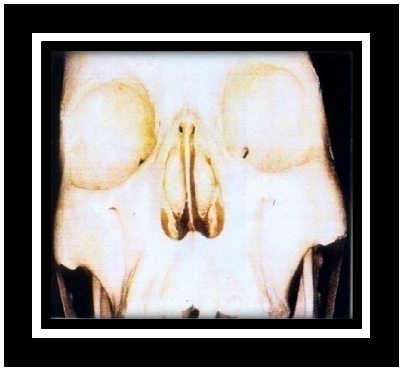

Fig.4 Bulbous concha bullosa

Fig.5 Siemens Somatome Emotion DR 3

Presence of other anatomical variations like, inferior turbinate hypertrophy, deviated nasal septum, osteomeatal complex block, sinusitis were noted.

Fig.6 osteomeatal complex block

Fig .7 left dominant ,DNS to right

Fig.8 Paradoxical turbinate

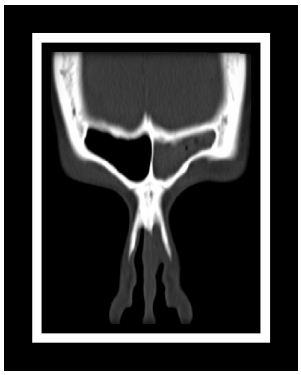

Fig.11 Frontal sinusitis

Fig10.Inferior turbinate pneumatization(Rarest)

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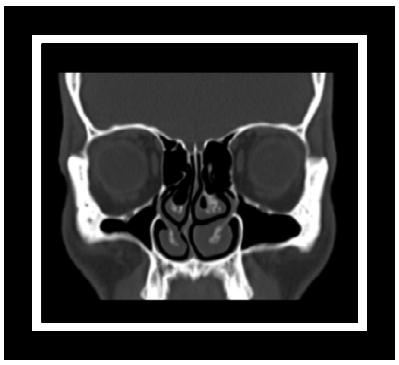
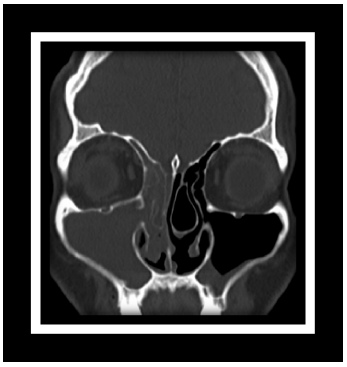
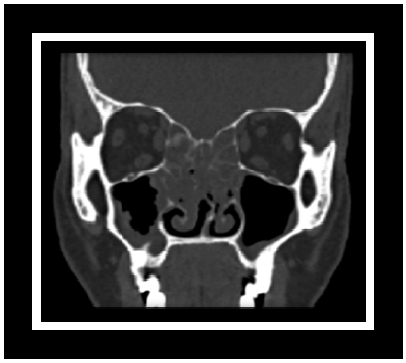

Fig.11 Inferior turbinate hypertrophy Fig.12 Right maxillary sinusitis Fig.13 Ethmoid sinusitis

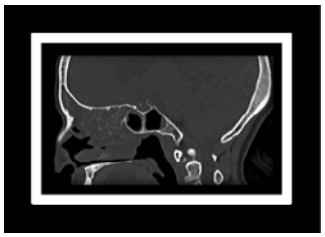

Fig no.13 Sphenoid Sinusitis

All findings were collected, tabulated, analysed.

RESULT:

A CT scan of 130 patients with concha bullosa were studied. There were 78(60%) males and 52(40%) females.

Table No. 1: Gender Distribution

Sex	Total patients	Percentage
Male	78	60%
Female	52	40%

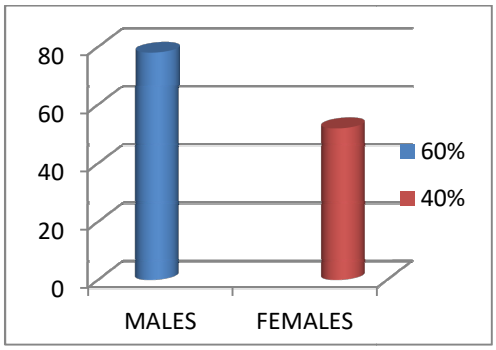

Chart 1: Representing gender distribution

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Table No. 2: Age distribution

Age group	No. of patients	Percentage
11-20	5	3%
21-30	52	40%
31-40	43	33%
41-50	21	17%
51-60	9	7%
TOTAL	130	100%

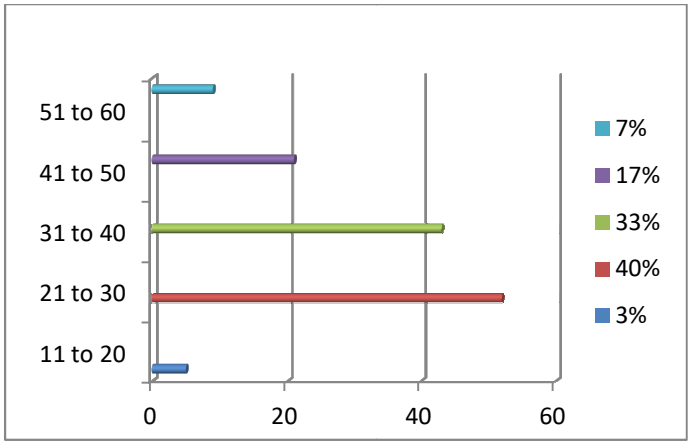

Chart 2: Representing age distribution

Most common age group 21-30 years with 52(40%) patients. .

Following this 43 patients (33%) were in the age group of 31 to 40 years. There were 21 patients in the age group of 41-50 (17%). There were only 9 (7%) patients above 50 years of age and only 5 (3%) patient below 20 years of age. Mean age of the patients was 32.56 ± 9.49.The youngest patient was 19 years old and the oldest patient was 57 years.

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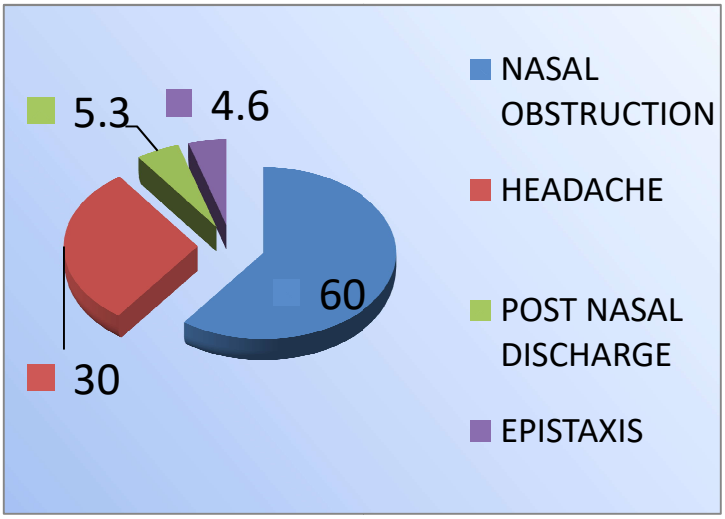
Table No. 3. Predominant presenting symptoms

Presenting symptoms	No. of patients	Percentage
Nasal obstruction	78	60%
Headache	39	30%
Post Nasal discharge	7	5.3%
Epistaxis	6	4.6%
Total	130	100



In the present study of 130 cases of concha bullosa, the commonest presenting symptom was nasal obstruction present in 78 (60%) patients. This was followed by headache which was presenting symptom in 39 (30%) patients. Nasal discharge was the third common symptom reported in 7 (5.3%) patients. Similarly other complains like epistaxis were observed in 6(4.6%) patients .

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Table No. 4. CT scan paranasal sinuses (PNS)

Type of concha	**No. of Patients**	**Percentage**
Bulbous	66	51%
Lamellar	42	32%
Extensive	22	17%
Total	130	100%

In the present study of 130 cases of concha bullosa, there were 66(51%) Bulbous type, 42(32%) lamellar type and 22(17%) extensive type.

Table no.5 Unilateral/Bilateral concha bullosa

CT scan findings	No. of patients	Percentage
Unilateral concha bullosa	75	58%
Bilateral concha bullosa	55	42%

In the present study 75(58%) had unilateral concha bullosa and 55(42%) had bilateral concha bullosa.

Table no.6 Dominant in bilateral concha Bullosa

Type of concha bullosa	Left dominant	Right dominant	Total
Bulbous	21	14	35
Lamellar	6	4	10
Extensive	8	2	10
Total	35	20	55

It was also observed in the 55 cases of bilateral concha bullosa that, 35 cases were left dominant and 20 were right dominant.

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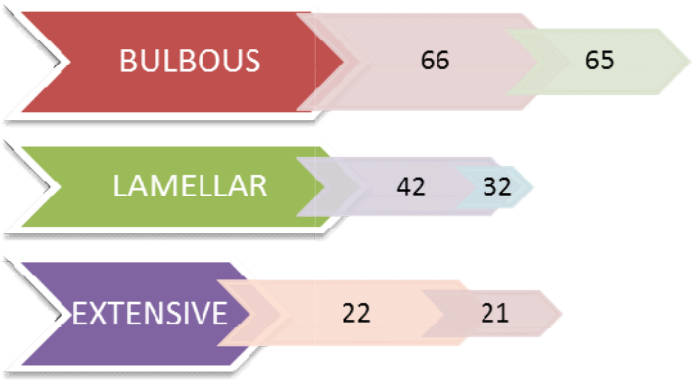
Table no.7 Other Variations

Variation	No. of Patients	Percentage
Deviated nasal septum	118	90%
Bilateral osteomeatal complex block	98	75%
Sinusitis	77	59%
Paradoxical turbinate	6	5%
Pneumatization of inferior turbinate	1	0.7%

Other variations studied showed that 118(90%) had deviated nasal septum, 98(75%) had bilateral osteomeatal complex block, 77(59%) had sinusitis,6(5%) had paradoxical turbinate and 1(0.7%) case had inferior turbinate pneumatization which is a rare finding.

Table no.8 Concha bullosa and Deviated nasal Septum



Concha Bullosa	No.of Patients	Deviated Nasal Septum
Bulbous	66	65 (55%)
Lamellar	42	32 (27%)
Extensive	22	21 (18%)
Total	130	118

Deviated nasal septum (55%) was associated with bulbous concha bullosa, second most common association was 27% associated with lamellar concha bullosa and 18% cases associated with extensive type of concha bullosa .

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Table no.9 Ostiomeatal complex disease

Concha bullosa	No.of patients	Ostiomeatal disease (98 patients)	No.of patients
Bulbous	66	Yes	58 (59%)
Extensive	22	Yes	21 (22%)
Lamellar	42	Yes	19 (19%)
Total	130		98

Out of 66 patients with bulbous concha bullosa, 58 (59%) had Ostiomeatal disease.In 22 patients with extensive concha bullosa 021(22%) had osteomeatal disease and out of 42 patients with lamellar concha bullosa, 19(19%) had osteomeatal disease.

Table no.10 Sinus affected

Sinus	No.of Patients	Percentage
Maxillary	43	56%
Ethmoid	16	20%
Frontal	12	15%
Sphenoid	6	9%
Total	77	100%

Out of 130 cases of concha bullosa, 77 had sinusitis. 43(56%) had maxillary sinusitis, 16(20%) had ethmoid sinus disease, frontal and sphenoid disease was seen in 12(15%) and 6(9%) respectively.

Table no 11 Concha bullosa and Sinus affected

Concha Bullosa	No.of Patients	Sinus affected	No.of patients
Bulbous	61	Maxillary	43 (55%)
Lamellar	42	Frontal	12 (15%)
Extensive	17	Ethmoid	16 (20%)
Bulbous/Extensive	10	Sphenoid	6 (9%)
Total	130		77

Out of 77 cases with sinusitis, 43 (55%) were present in bulbous type ,16 (20%) ethmoidal sinus were present in extensive type, 12(15%) were present in lamellar type. 6(9%) cases of sphenoidal sinusitis were present in 10 patients of bulbous or extensive sinusitis.

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DISCUSSION:

The anatomy of the lateral wall of the nose became more evident due to computerized tomography. Concha bullosa gained importance as common cause of osteomeatal complex block responsible for chronic headache, nasal obstruction and chronic sinusitis.

Concha bullosa was defined as being present when more than 50% of the vertical height (measured from superior to inferior in the coronal plane) of the middle turbinate was pneumatized [1,2,3].

In the present study of 130 cases of concha bullosa, there were 78(60%) males and 52(40%) females, the male to female ratio being 1.5:1, showing slight male preponderance. Observations of the present study are consistent with the studies Bhandary et.al [2] in which there were 97 (57.3%) male and 72 (42.6%) were to females, the male to female ratio being 1.2: 1. In the study by Albirmawy OA et al [3] there were 18 (60%) males and 12 (40%) were females, the male to female ratio being 1.5 : 1, however the patients in study were in the paediatric (9 to 16 years) age group. In the study by Winters R and Worley NK [4] there were 19 (57.5%) males and 14 (42.5%) females, the male to female ratio being 1.35: 1. The male preponderance in these studies is probably due to male dominance in the society.

The most common age group in the present study was 21-30 years with 52(40%) patients suggesting the disease presentation being common in this age group. .

Following this 43 patients (33%) were in the age group of 31 to 40 years. There were 21 patients in the age group of 41-50 (17%). There were only 9 (7%) patients above 50 years of age and only 5 (3%) patient below 20 years of age. Mean age of the patients was 32.56 $\pm$ 9.49.The youngest patient was 19 years old and the oldest patient was 57 years.

In this respect present study is comparable with the study by Badran et al [5] the range of age in their study was 18 to 57 years with mean 30 $\pm$ 19. Our study in relation to age group cannot be compared with the other studies as concha bullosa was studied in varied age groups by different authors. Youngest patient was 8 years in the study by Zandi et al the range in this study was 8 to 63 years [6]. In the study of Kumar R et al patients age ranged from 8 to 72 years. [7] In the study by Albirmawy OA et al [3] the patients were in the age group of 9 to 16 years. This suggests that the patients in the pediatric age group also present with symptoms due to concha bullosa. Patients in the 2nd and 3rd decade probably themselves seek medical advice.

In the present study of 130 cases of concha bullosa, the commonest presenting symptom was nasal obstruction present in 78 (60%) patients.Badran et al in his study comments that the degree of pneumatization determines the severity of symptoms.The lamellar type usually does not cause severe symptoms, whereas the bulbous and extensive forms typically are symptomatic. The most common symptoms are nasal obstruction[5].

The next most common complain was headache which was presenting symptom in 39 (30%) patients. Badran et al in his study comments that swelling of the nasal turbinates particularly in the middle part of the nasal cavity may result in contact with the nasal septum or lateral nasal wall in especially sensitive area creating a “trigger” for development of headache. This type of headache is called: Middle turbinate headache syndrome and is characterized by intermittent pain located in the periorbital area, between the eyes, or in the cheeks and frontal bone. The occurrence of such pain is accompanied by the congestion and feeling of the pressure deep inside the nasal cavity.

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Mostly the pain is unilateral lasting between few hours up toseveral days. The intensity of pain varies from an individual to the other but it is more of dull, boring character and typically unresponsive to common pain relieving medications Yarmohammadi et.al conducted similar study on 44 patients with headache of rhinogenic origin and conduced surgical intervention in one group[8].

Contact point headaches are one of a sub group of rhinogenic headaches. Dr. Commas (1960) was one of the pioneers who described the rhinogenic headache. Headache not related to sinus problems like polyps, sinusitis, tumours, foreign bodies and the nasal cavity is considered as normal on routine examinations. There is evidence of mucosal contact point by nasal endoscopy and/or CT imaging. Mucosal contact points between two mucosal surfaces result in stimulation of C fibres that transmit an orthodromic impulse by triggering substance P(SP). The released SP induces vasodilatation, hyper secretion, spasm of smooth muscles and extravasations of plasma from vessels. Modulation of pain transmission in the central nervous system (CNS) may also occur via an action of Enkephalin(EK).[8]

Nasal discharge was the third common symptom reported in 7 (5.3%) patients. Similarly other complains like epistaxis were observed in 6(4.6%) patients .

In the present study of 130 cases of concha bullosa, there were 66(51%) Bulbous type, 42(32%) lamellar type and 22(17%) extensive type. Bolger et al. have divided the pneumatization of the middle concha into three groups: lamellar type is the pneumatization of the vertical lamella of the concha; bulbous type is the pneumatization of the bulbous segment (Figures 1, 2 and 3); pneumatization of both the lamellar and bulbous parts is called extensive concha bullosa[9] .Hatipoglu et.al[9] reports 24(20.86%) lamellar type, 37 (32.17%) were bulbous type and 54 (46.95%) were extensive type. Badran et al[5] reports 8 (17%) patients had lamellar type,22 (46.8%) had bulbous type and 17(36.2%) had extensive type. This variances may be due to differences between the study groups, pneumatization parameters and the analytical methods used. In the present study 75(58%) had unilateral concha bullosa and 55(42%) had bilateral concha bullosa.In the study of Stallman[10] et al unilateral concha bullosa was seen in 80.5% cases, Aktas[11] et al reported in 68.5%, in study by Vincent [12] et al it was in 62.85%, Zandi B [6] et al reported as 60.2%, Kim[13] et al reports 34(14.6%) were bilateral cases and 50(21.6%) were unilateral .Zinreich[14] et al in group A 55% and in group B 50%. In the study by Stallman [10] et al [18] the incidence of unilateral concha bullosa was observed as high 80.5%.

In our study it was also observed that in 55 cases of bilateral concha bullosa that, 35 cases were left dominant and 20 were right dominant. In bilateral cases, larger one was identified as dominant.

Other variations studied showed that 118(90%) had deviated nasal septum, 98(75%) had bilateral osteomeatal complex block, 77(59%) had sinusitis,6(5%) had paradoxical turbinate and 1(0.7%) case had inferior turbinate pneumatization which is a rare finding.

Zinreich[14] reported the paradoxical middle concha (15%).

Although inferior and superior conchae bullosa have been reported in the literature, this entity is quite rare[17].

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In relation to concha bullosa and DNS our study matches with the study carried out by Bhandary SK et al [2] in their study the incidence of DNS was 87.5%. Slightly lesser incidence is reported by Stallman et al [10] in 78.63%, Kumar R et al [7] in 75.78%, Aktas et al [11] in 75.92%.

For correlation of DNS and concha bullosa Stammberger et al [18] proposed two hypotheses for development of concha bullosa. Firstly the DNS provides a large contralateral concave nasal space for expansion of the middle turbinate therefore resulting in concha bullosa. Alternatively both concha bullosa and DNS are two incidental co-existing pathogenesis.

Caughey et.al studied 250 CT scans and concluded that concha bullosa contribute to the narrowing of osteomeatal complex [19].

In the present study it was observed that osteomeatal disease was present in 59% cases of bulbous type of concha bullosa, 22% were present in extensive concha bullosa and 19 % were present in lamellar concha bullosa.Pneumatiszation of the inferior portion has a role in osteomeatal disease[9].

Out of 130 cases of concha bullosa, 77 had sinusitis. 43(56%) had maxillary sinusitis, 16(20%) had ethmoid sinus disease, frontal and sphenoid disease was seen in 12(15%) and 6(9%) respectively.

In the study by Kumar R et al [7] bilateral concha bullosa was present in 44.97%, it is concluded that there is a strong statistical correlation between concha bullosa and sinusitis.

Kim[13] et al correlated the findings of 232 patients and concluded that, looking at the relationship between the severity of sinusitis and degree of concha bullosa, a slightly high incidence of concha bullosa of 37.9% in Stage I can be noticed, but this did not show a statistically significant difference.

In the study by Zinreich [14] et al, out of 13 patients with concha bullosa 11 (84.61) had ipsilateral sinusitis. In the study by Bhandary [2] et al 69.2% patients with concha bullosa had ipsilateral sinusitis. The incidence is comparable with our study. However the incidence of ipsilateral sinusitis in patients with concha bullosa in our study is contradictory to the other studies

Vincent et al [12] studied 137 patients with concha bullosa concluded that the presence of concha bullosa did not statistically contribute to an overall increased incidence of sinusitis.Subramanian S et al [15] studied concha bullosa on right side in 34 (33.7%) and left side in 35 (34.7%). From the study of these 69 cases they concluded that there was no association between presence of concha bullosa and side of occurrence.

If pneumatization is extensive, a large concha bullosa may cause disturbance of the transportation of secretions that may cause unpleasant post nasal drip.

A concha bullosa is a classic example of the potential of an anatomical variant to predispose to a sinus disease. Relatively minor stimuli can cause sufficient mucosal swelling to produce complete obstruction of key sites in the ethmoidal sinus thereby causing appearance or persistence of major symptoms. In our study bulbous and extensive concha bullosa show increased incidence of maxillary(55%) and ethmoidal sinusitis(20%) and sphenoidal sinusitis(9%).Lamellar is more associated with frontal sinusitis(15%). Our study is comparable with that of Hatipoglu et.al which shows frontal recess disease as 14% in extensive,18% in bulbous and 12% in lamellar concha bullosa.70 % extensive, 58%lamellar and 54% bulbous were positive for sinus disease. However the types of sinusitis is not mentioned. In an extensive study carried out by Unlu et .al[16] there is no significant correlation found. Although there

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are similar studies, there is no study in literature to our knowledge that evaluates the relationship between types of sinusitis and concha bullosa .

Conclusion:

Extensive and bulbous concha bullosa can cause significant nasal obstruction and sinusitis. Although we have selected only symptomatic cases, the statistical interpretation should not be generalized for whole population .

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