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Anatomical Variations of Osteomatal Complex: An Endoscopic Study

Anukaran Mahajan[1]*, Anupama Mahajan[2], Karunesh Gupta[3] and Pankaj Verma[3]

[1]*Department of ENT, VMMC and Safdarjung Hospital, India*

[2]*Department of Anatomy, SGRDIMSAR, India*

[3]*ENTConsultant,Chikitsa Hospital, India*

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***Corresponding author:** Anukaran Mahajan, Department of ENT, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi, India Tel: 09582387067; Email: anukaranmahajan@gmail.com

Abstract

Introduction: The prevalence of Anatomical variations of Osteomeatal Complex (OMC) is well documented that can alter the drainage pathways of the sinuses resulting in recurrent or chronic sinusitis. A detailed knowledge of these anatomical variants can help the endoscopic sinus surgeons to restore normal sinus ventilation with minimum trauma and morbidity.

Objective: To study the anatomical variations of OMC (their frequency of occurance).

Material and Methods: Material for the present study consisted of 500 adult patients irrespective of sex in the age group of 22 to 72 years, selected from OPD of Chikitsa ENT hospital, Amritsar. Systematic nasal endoscopy was done in the operation theatre after taking written informed consent from the patient and anatomical variations of OMC were noted.

Results: It was observed that out of 500 patients, 63.3% of cases had one or more anatomical variations. The most common anatomical variation encountered was enlarged bulla ethmoidalis (39%) followed by accessory maxillary ostium (21%), concha bullosa (19%), lateralized uncinate process (18%), Paradoxical middle turbinate (8%), polypoidal uncinate process (4%) , secondary middle turbinte 0.4%.

Conclusion: The Anatomical variations of OMC may be a predisposing factor for the development of sinusitis. Also familiarisation of these anatomical variants is essential for endoscopic sinus surgeons to increase the success and safety of surgery.

Keywords: Osteometal complex; Anatomical variants; Paranasal sinuses; Functional endoscopic sinus surgery

Introduction

The"osteomeatal complex" term is used for a group of anatomical structures that contribute to the final common drainage pathway of maxillary, anterior ethmoidal and frontal sinuses [1]. The sinuses are the spaces in the bones of the face above and to either side of the nose and in the forehead and cheeks [2]. Anatomical variations of Osteomeatal Complex (OMC) such as concha bullosa, paradoxically curved middle turbinate, enlarged bulla ethmoidalis, accessory maxillary ostium etc. Can block the OMC resulting in impaired drainage of paranasal air sinuses which is one of the commonest cause of chronic sinusitis [3] (Figure 1).

Figure 1: Showing Endoscopic Technique

Messerklinger and Wigand introduced Functional Endoscopic Sinus Surgery (FESS) which was popularized by Stammberger in Europe and by Kennedy in North America [4]. The Messerklinger endoscopic sinus surgery approach is from anterior to posterior sinuses while the Wigand approach is from posterior to anterior [5,6] (Figure 2). Complex anatomy of nose and paranasal sinuses as well as its variations may cause technical difficulties during surgery [7].The objective of present study was to find out anatomical variations of osteomeatal complex as they are useful for otorhinolaryngologist in evaluation of patients with nose and paranasal sinus diseases and to avoid complications during endoscopic sinonasal surgery .

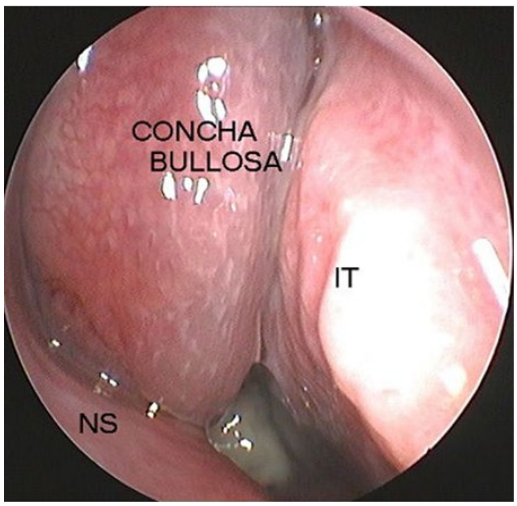

Figure 2: Showing Concha Bullosa

Material and Methods

Material for the present study consisted of 500 adult patients irrespective of sex in the age group of 22 to 72 years were selected from OPD of Chikitsa ENT hospital, Amritsar. Systematic nasal endoscopy was done in the operation theatre after taking written informed consent from the patient. We noted the shape, size, location ,number and laterality (present unilaterally or bilaterally) of accessory maxillary ostium if present, variations of middle turbinate like concha bullosa, accessory or paradoxical middle turbinate, uncinate process , septal deviation and results were expressed in percentage.

Endoscopic Technique

For this study we used Karl Storz rigid endoscopes with deflection angles of 0 and 300. The endoscope was 18cms long with glass rod lenses (Hopkins system) with an outer diameter of 4 mm. Endoscopic pictures were taken by coupling the endoscope with a Stryker High Definition camera and cold light source. No premedication was required. Patient was asked to lie in supine position in the operation theatre. The nose was packed with gauge pack soaked with 4% xylocaine with Adrenaline for topical anaesthesia and decongestant effect. After ten minutes nasal packs were removed and telescope was passed gently along the floor of the nasal cavity between the inferior turbinate and septum without touching either structure (Figure 3).

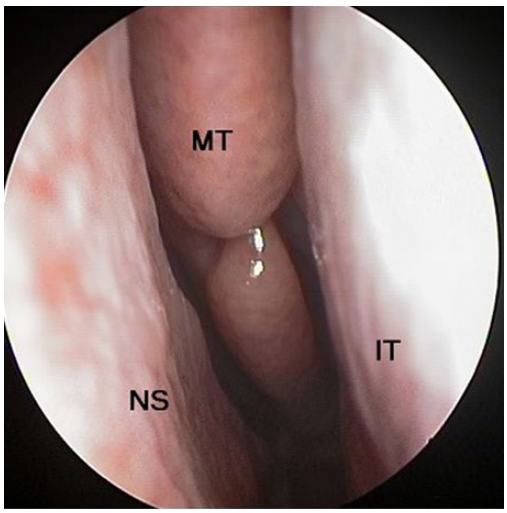

Figure 3: Showing Secondary Middle Turbinate.

The 2nd pass of the scope along the roof of the posterior choana and the anterior surface of the sphenoid was practiced gently without touching any of the turbinates. In the 3rd pass the contents of the middle meatus were examined by gently retracting the middle turbinate medially with the Freer' elevator. In an anterior to posterior direction first examined was the most anterior one third attachment of the middle turbinate to the cribriform plate. Within the meatus most anteriorly was the curved boomerang shaped uncinate process. The bulge of bulla was seen behind the uncinate process. Between the two was observed hiatus semilunaris. As the scope was passed further posteriorly the third or horizontal attachment of middle turbinate was seen. It forms the roof of the middle meatus (Figure 4). Accessory ostia when seen were in the region of anterior fontanelle i.e. anteroinferior to the anterior end of the uncinate process and in the posterior fontanelle i.e. above and behind the posterior end of the uncinate process.

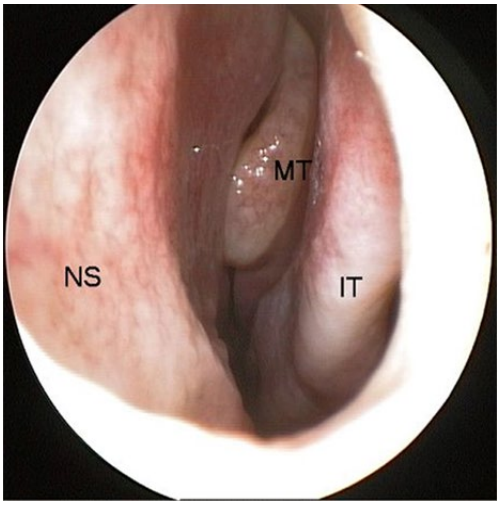

Figure 4: Showing Paradoxical Middle Turbinate.

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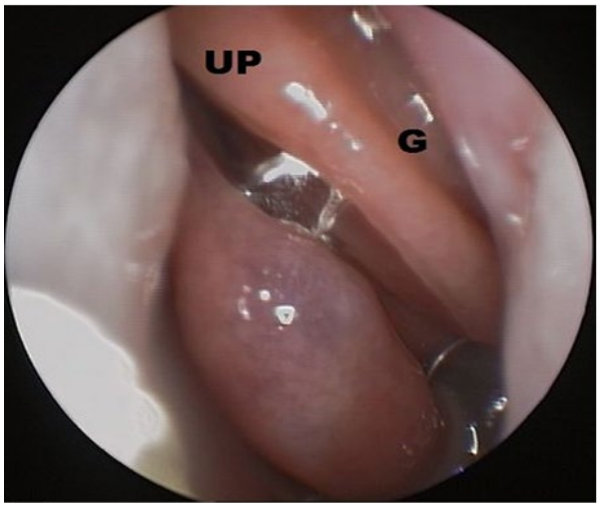

Figure 5: Showing Medialized Uncinate Process.

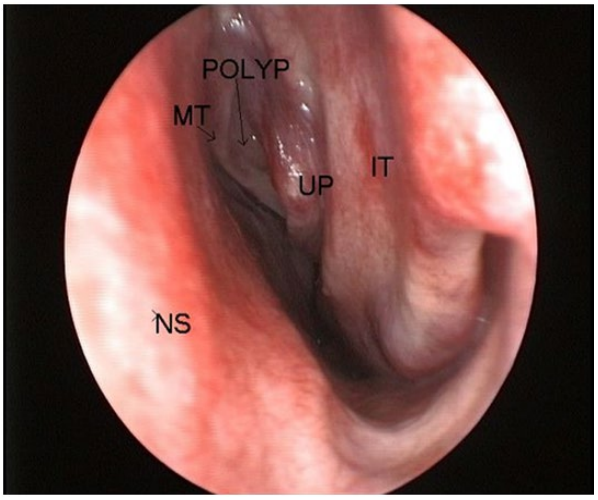

Figure 6: Showing Polypoidal Uncinate Process.

Accessory ostia were mostly circular and were easily seen unlike the normal ostium which is elliptical or tunnel like and are well hidden by the uncinate process. We noted the shape, size, location, number and laterality (present unilaterally or bilaterally) of accessory maxillary ostia (Figure 5). Middle turbinate may show different anatomical variations. Quite commonly it may be ballooned out due to an air cell enclosed within it .This air cell may be pneumatized from the frontal recess, agger nasi cell or anterior ethmoids. In such a case the middle turbinate is called the concha bullosa (Figure 6). This may block the osteometal unit thus affecting the drainage of the anterior group of the sinuses. The vertical lamella of the middle turbinate may also be pneumatized from the superior meatus to form the intralamellar cell of Grunwald. The middle meatus may have a paradoxical curve bending laterally towards the middle meatus. Occasionally it may be bifid.

Results

It was observed that out of 500 patients, 63.3% of cases had one or more anatomical variations.

Concha Bullosa

This is an aerated middle turbinate. When pneumatization involves the bulbous portion of middle turbinate, it is termed concha bullosa. Of the 500 patients, 24% had a unilateral concha and 15% had bilateral concha (Figure 7). Of the patients with bilateral concha, 35% had equal sized concha and 65% had a large, dominant concha. In patients with a left sided unilateral or dominant concha, 63% had right sided nasal septal deviation, 5% had left sided nasal septal deviation and 32% had no nasal septal deviation. In patients with right sided unilateral or dominant concha, 61% had left sided nasal septal deviation, 9% had right sided nasal septal deviation and 29% had no nasal septal deviation. In 62% of cases with unilateral or dominant concha, contralateral nasal septal deviation was observed resulting in sinusitis (Figure 8).

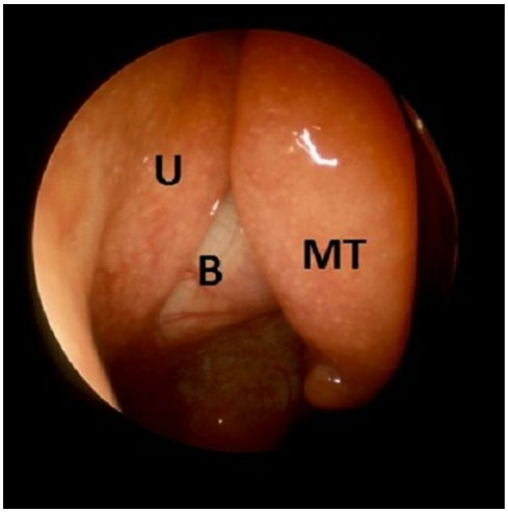

Figure 7: Showing Bulla Ethmoidalis

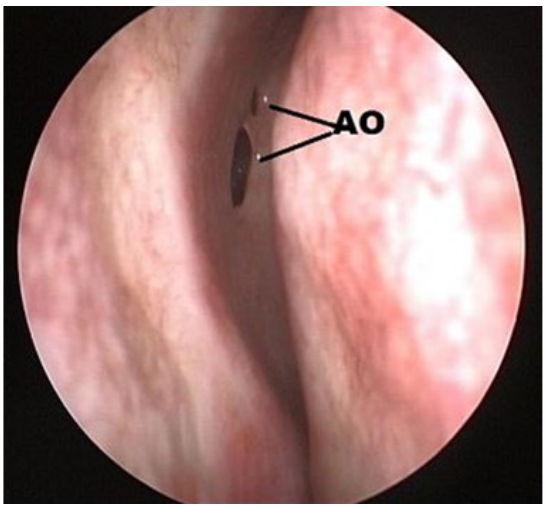

Figure 8: Showing Double Accessory Maxillary Ostium.

Secondary Middle Turbinate

Out of 500 patients, bilateral secondary middle turbinates was detected in two cases (0.4%).

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Paradoxical middle turbinate

Normally the convexity of middle turbinate is directed medially towards nasal septum. When the convexity is directed laterally it is termed a paradoxical middle turbinate. It was reported in 18% of the patients (Figure 9).

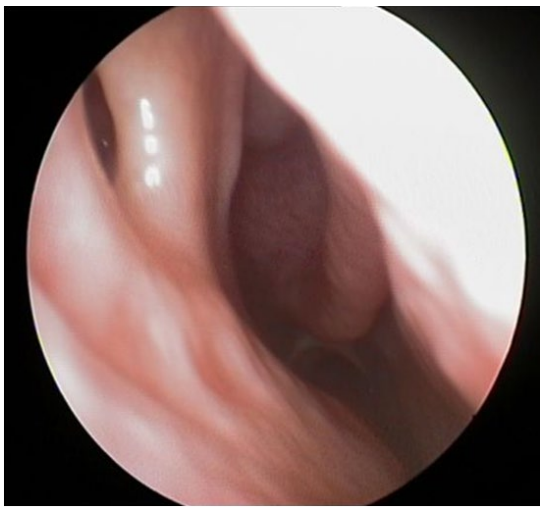

Figure 9: Showing AMO in Anterior Fontanella.

Uncinate process

In our study, medialized uncinate process presented in 52% of cases, of which bilateral presentation was more common and was seen in 58% of cases. Lateralized uncinate presented in 18% of the cases of which 64% presented with unilateral presentation. Polypoid uncinate process presented in 4% of the cases.

Bulla Ethmoidalis

This is the largest and most prominent anterior ethmoidal air cell. We observed hypoplastic bulla (in which the distance between the lateral surface of middle turbinate and summit of bulla was more than 4 to 5 millimetres) in 17%,of the cases, enlarged (that contacts or extends beyond the free margin of the uncinate and middle turbinate) in 24% and typical in 59% of cases (Figure 10).

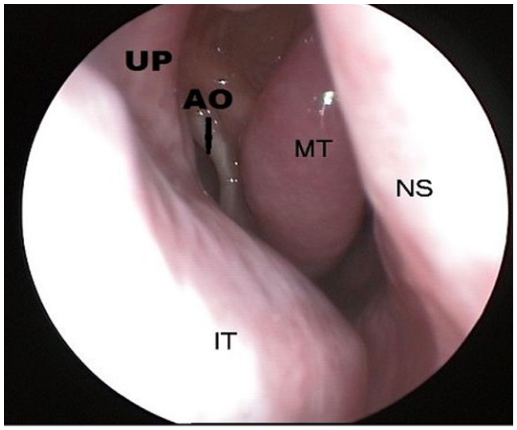

Figure 10: Showing AMO in Posterior Fontanella.

Accessory Maxillary Ostium

Among 500 subjects, Accessory Maxillary Sinus Ostium (AMO) was found in 21% of the cases, 78.57% were found in Anterior Nasal Fontanelle (ANF), 16.66% in Posterior Nasal Fontanelle (PNF) and 4.76% in Hiatus Semilunaris. Double (AMO) were observed in 33.33% and single in 66.66% of the cases.

Discussion

The correlation of anatomical variants of OMC with sinusopathy is well documented. Concha bullosa, an air cell within the middle concha, is one of the most frequent anatomical variations that may obstruct the ethmoid infundibulum [8]. In the present study 15% had bilateral concha out of which 35% had equal sized concha and 65% had a large dominant concha. Alsubael & Hegazy [9] reported the presence of concha bullosa in 38% of total cases of pneumatization. Daghighi & Daryani [10] reported a strong association between the existence of Concha bullosa and septal deviation in the opposite directions in accordance with our study where in patients with a left sided dominant concha, 63% had right sided, 5% had left sided and 32% had no nasal septal deviation. Shin [11] suggested a relationship between presence of a concha bullosa and sinusitis in accordance with our study where 62% of patients with a concha had sinus disease.

The secondary middle turbinate is a rare anatomical nasal cavity variation that was first described by Khanobthamchai et al. [12] in 1.5% of cases. Inferiorly projected secondary middle turbinate if hypertrophied and pneumatized may narrow the osteomeatal unit and predispose to inflammatory sinus disease. In our study, bilateral secondary middle turbinate was detectected in two cases (0.4%) similar to study of Aksungur et al. [13] who detected secondary middle turbinate in 0.8% of cases. The middle turbinate may be paradoxically curved leading to impingement of middle meatus that is a contributing factor to sinusitis. Stammberger [6] accepted paradoxical curvature of the middle turbinate as an etiological factor for chronic sinusitis because it may cause obliteration or alteration in nasal air flow dynamics. It was found in 18% of the cases in our study; the prevalence is similar to that of 18 % by Alqudah et al. [14] , 15% by Llyod et al. [15] and 14.8 % by [16] but less than that reported by Bolger et al. [17] i.e. 27%.

The uncinate process is a key bony structure of the lateral wall of the nasal cavity. Deviation and pneumatization are two main types of variations which are associated with the uncinate process. While uncinate process is normally deviated medially when deviated laterally, it compromises the infundibulum and can impair the ventilation of anterior ethmoidal, frontal and maxillary sinuses. In our study medialized uncinate process was observed in 52% of cases of which bilateral presentation was seen in 58% of the cases, lateralized in 18% similar to the study of Narendrakumar & Subramanian [18] who reported the frequency of medialized uncinate process in 48%, of which

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bilateral presentation was seen in 54.16%, lateralized uncinate process in 15% of cases.

LIyod et al. [15] observed the prevalence of deviation in 16% in chronic rhinosinusitis cases and Mamtha et al. [19] in their study reported the deviation in 65%of cases. Regarding polypoid Uncinate process, Eiji et al. [20] stated that the uncinate process is a shield-like formation that protects the ethmoid infundibulum from direct exposure to airflow. The anterior surface of the uncinate process is the surface that is probably most exposed to airflow. If variations of the uncinate process increase the anterior surface area this situation may result in increased exposure to irritants and create conditions that promote polypoid transformation of the mucosa [20].

The ethmoidal bulla is the largest ethmoidal air cell of the ethmoidal complex. The degree of pneumatization varies and failure to pneumatize is termed torus ethmoidalis. A "Giant Bulla" may fill the entire middle meatus and force its way between uncinate process and middle turbinate. Present study stated that incidence of hypoplastic bulla was 17% in accordance with the study of Lloyd et al. [21] and Lund [22] who reported the incidence of hypoplastic bulla as 17% and 18% respectively. In our study enlarged bulla was reported in 39% of cases similar to the study of Narendrakumar & Subramanian [18] who observed enlarged bulla in 41%. Liu et al. [23] reported enlarged bulla in 30.30%, Mazza et al. [24] in 10%, Alsubael and Hagazy in 7% and Perez-Pinas et al. [25] did not observe this variant in their study.

The Accessory Maxillary Ostium (AMO) is located 5-10mm superior to the attachment point of inferior concha and it opens to lateral nasal wall or infundibulum. In the present study AMO was observed in 21% of the cases that is in accordance with the study of Van Alyea [26] & singal [27] who reported the incidence of AMO in 23% and 22.5% of the specimens respectively. Though most of the authors have not specified the location of the AMO with reference to the fontanelle, (the membranous region of medial sinus wall) Kumar et al. [28] in their dissections on thirty half heads from fifteen adult Indian cadavers reported that AMO was present in 30% being located in ANF in 66.7%, in PNF in 22.2% and at HS1 (11.1)% in accordance with the present study i.e. out of 21% AMO was located in ANF in 78.57%, in PNF 16.66% and in HS 4.76% a finding similar to that of Frank et al. [26]. The present study stated that out of 21%, double AMO was present in 33.33% that includes 57.14% in ANF on right side, 28.57% in PNF on right side, 14.28% in HS on left side and a single AMO in 66.66% that includes 64.28% in ANF on both right and left side, 35.71% in PNF in line with the study of Kumar et al. [25].

Conclusion

Anatomical variations are common in OMC that present a significant challenge even to the most experienced surgeons. In the present study most common anatomical variation encountered was enlarged bulla ethmoidalis followed by accessory maxillary ostium, concha bullosa, lateralized uncinate process, paradoxically bent middle turbinate, polypoidal uncinate process and secondary middle turbinate. These Anatomical variations may be a predisposing factor for the development of sinusitis and thus it becomes necessary for the endoscopic surgeons to recognize the clinical and surgical significance of these variations to decrease the surgical risks during the Functional Endoscopic Sinus Surgery (FESS).

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