Original Research Article

ANATOMICAL VARIATIONS OF ACCESSORY MAXILLARY SINUS OSTIUM: AN ENDOSCOPIC STUDY

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ABSTRACT

Introduction: There has been a significant shift from external and headlight sinus surgery to functional endoscopic sinus surgery (FESS) in the past quarter century. Therefore understanding of anatomical variations of Accessory Maxillary Ostium (AMO) becomes essential for an endoscopic sinus surgeon to differentiate it from the natural ostium for safe and efficacious surgery in this region.

Aim: To note the presence and anatomical variations of AMO that predisposes to recurrent sinusitis and headache.

Materials and Methods: Material for the present study consisted of 100 adult patients (58 males & 42 females) in the age group of 22 to 72 years old, selected from OPD of Chikitsa ENT hospital, Amritsar. Systematic nasal endoscopy was done and the shape, size, location, number and laterality of AMO was noted.

Results: Among 100 subjects (200 half sides) AMO was found in 42 (21%) halves, 33 (78.57%) were found in anterior nasal fontanelle (ANF), 7 (16.66%) in posterior nasal fontanelle (PNF) and 2 (4.76%) in hiatus semilunaris (HS). These ostia were circular in 34 (80.95%) halves and oval in 8 (19.04%) halves. Regarding position, those situated in ANF and HS were placed in horizontally while those lying in PNF were vertically. Out of 42 (21%) halves, unilateral AMO was present in 36 (85.71%) halves, bilateral in 6 (14.28%) halves and double in 14 (33.33%) whereas single in 28 (66.66%) halves.

Conclusions: Each sinus cavity has a specific drainage point/ostium through which normal mucociliary clearance is channeled. The endoscopic sinus surgeons must have a detailed knowledge of anatomical variations of AMO in any interventional maxillary sinus surgery to gain maximum result (restoring normal function) with minimal trauma and morbidity.

KEY WORDS: Paranasal sinuses, Accessory Maxillary ostium, Fontanelle, Sinusitis.

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INTRODUCTION

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 [1]. They are like rooms
that connect to one another and open or drain into the nose [2]. Infection or blockage in the sinuses can block the nose producing infected mucus down the back of the nose into the throat [3]. Knowledge of normal Anatomy is mandatory for accurate diagnosis of sinonasal pathology [4]. The most frequent anatomical variants should be identified to decrease the risks of surgery. The anatomical variations of surgical landmarks represent a significant challenge even to the most experienced surgeon [5].

The"ostomeatal 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 [6]. Recognition of the maxillary ostia is tedious while performing endoscopic procedures which accounts for a high rate of orbital complications for a novice performing surgery in this region [7]. In the live patient the maxillary sinus opening is small and not easily seen. This is because the large opening is closed by the descending process of lacrimal bone anteriorly, the uncinate process of the ethmoid bone anteroinferiorly, the maxillary process of the inferior turbinate inferiorly and the perpendicular plate of palatine bone posteriorly [8]. AMO is one of the anatomical variations that play a role in the development of Chronic maxillary sinusitis. It is not clear whether these ostia are congenital or acquired [9]. A possible mechanism of formation of accessory ostium is obstruction of the main ostium by maxillary sinusitis or due to anatomic and pathologic factors in the middle meatus resulting in the rupture of membranous areas known as fontanelle [10].

The fontanelle are certain regions in the middle meatus located below the uncinate process and above the inferior turbinate, covered by nasal mucous membrane medially and mucosa of maxillary sinus laterally with connective tissue sandwiched between the two. These according to their location in relation to uncinate process are anterior nasal fontanella (ANF) and Posterior nasal fontanelle (PNF) [11]. Maxillary sinus ostium is on the highest part of medial wall of sinus and it doesn’t open directly into nasal cavity but into narrow ethmoidal infundibulum, inflammation of which can further interfere with drainage[12].

Accessory maxillary ostium is located 5-10 mm superior to the attachment of inferior concha and opens to the lateral nasal wall. Two fold increase in the incidence of maxillary sinusitis is observed due to presence of accessory maxillary ostial[13]. While performing endoscopic sinus surgery in middle meatus,it is important to differentiate primary maxillary ostium from accessory maxillary ostium to avoid orbital injuries and to achieve adequate results.

**MATERIALS AND METHODS**

Material for the present study consisted of 100 adult patients (58 males and 42 females) in the age group of 22 to 72 years old were selected from OPD of Chikitsa ENT hospital, Amritsar who visited the hospital in the period of Jan 2016 to July 2016.Systematic nasal endoscopy was done in the operation theatre after taking written consent from the patient. Before taking the consent, procedure was fully explained to the patients. We noted the shape, size, location, number and laterality (present unilaterally or bilaterally)of accessory maxillary ostium.

**Endoscopic Technique:** For this study we used Karl Storz rigid endoscopes with deflection angles of 0 and 300. The endoscope was 18 cms longwith 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. 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. Accessory ostium 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. Accessory ostia were mostly circular and were easily seen unlike the normal ostium which is elliptical or tunnel like andis well hidden by the uncinate process. We noted the shape, size, location, number and laterality (present unilaterally or bilaterally) of accessory maxillary ostia.

**Fig. 1:** Showing set up for nasal endoscopic examination.

**Fig. 2:** Showing amo in anterior fontanelle(left side).

**Fig. 3:** Showing double accessory ostia.

**RESULTS**

**Table 1:** Location, side and number of accessory maxillary ostium in 42 halves.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Location</th>
<th>Right side N=29 (69.04%)</th>
<th>Left side N=13 (30.90%)</th>
<th>Total N=42 (21%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anterior nasal fontanelle</td>
<td>N=29 (66.20%)</td>
<td>N=11 (44.61%)</td>
<td>N=30 (57.14%)</td>
</tr>
<tr>
<td>2</td>
<td>Posterior nasal fontanelle</td>
<td>N=4 (13.79%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Not specified</td>
<td>N=2 (4.76%)</td>
<td>N=2 (4.76%)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2:** Incidence and location of accessory maxillary ostia.

<table>
<thead>
<tr>
<th>S. no</th>
<th>Author’s name</th>
<th>Year</th>
<th>Incidence</th>
<th>Location</th>
<th>Study material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yenguin et al [13]</td>
<td>2016</td>
<td>19.10%</td>
<td>ANF or PNF or HS</td>
<td>General population</td>
</tr>
<tr>
<td>2</td>
<td>Sindel et al [7]</td>
<td>2014</td>
<td>13.80%</td>
<td>Rear middle or rear</td>
<td>Cadavers</td>
</tr>
<tr>
<td>3</td>
<td>Singhal and Singhal [6]</td>
<td>2013</td>
<td>18.50%</td>
<td>ANF or PNF</td>
<td>Cadavers</td>
</tr>
<tr>
<td>5</td>
<td>Van Alvera [14]</td>
<td>1956</td>
<td>2%</td>
<td>Not specified</td>
<td>Cadavers</td>
</tr>
<tr>
<td>6</td>
<td>Neivert [20]</td>
<td>1950</td>
<td>2%</td>
<td>Not specified</td>
<td>Cadavers</td>
</tr>
<tr>
<td>7</td>
<td>Schaeffer [16]</td>
<td>1950</td>
<td>47%</td>
<td>ANF or PNF</td>
<td>Cadavers</td>
</tr>
<tr>
<td>8</td>
<td>May et al [23]</td>
<td>1990</td>
<td>0%</td>
<td>PNF</td>
<td>Cadavers</td>
</tr>
<tr>
<td>10</td>
<td>Lang and Whiting [28]</td>
<td>1991</td>
<td>20%</td>
<td>Not specified</td>
<td>Cadavers</td>
</tr>
<tr>
<td>11</td>
<td>Myerseh [2]</td>
<td>1925</td>
<td>2%</td>
<td>Not specified</td>
<td>Cadavers</td>
</tr>
<tr>
<td>12</td>
<td>Stammberger and Kennedys [27]</td>
<td>1995</td>
<td>4.5%</td>
<td>ANF or PNF</td>
<td>General population</td>
</tr>
<tr>
<td>14</td>
<td>Kumar et al [21]</td>
<td>2001</td>
<td>30%</td>
<td>ANF or PNF or HS</td>
<td>Cadavers</td>
</tr>
<tr>
<td>15</td>
<td>Present study</td>
<td>2016</td>
<td>21%</td>
<td>ANF or PNF or HS</td>
<td>General population</td>
</tr>
</tbody>
</table>

Among 100 subjects (200 half sides) accessory Maxillary sinus ostium (AMO) was found in 42(21%) halves, 33(78.57%) were found in anterior nasal fontanelle(ANF), 7(16.66%) in posterior nasal fontanelle (PNF) and 2 (4.76%) in hiatus semilunarisis(HS), varied in size from 0.5mm to 5mm. Regarding shape, in 34(80.95%) halves accessory Maxillary sinus ostia were circular while in 8 (19.04%) halves these were oval in shape. Out of 42(21%) halves, in 29(69.04%) halves accessory Maxillary sinus ostia were present on right side while in 13(30.95%) halves these were present on left
side, unilateral in 36(85.71%) and bilateral in 6 (14.28%), double in 14(33.33%) and single in 28(66.66%) halves. Out of 14(33.33%) halves having double AMO, in 8(57.14%) these were present in ANF on right side, 4(28.57%) in PNF on right side and in 2 (14.28%) in hiatus semilunaris on left side. Out of 28(66.66%) halves, single AMO was present in ANF on both right and left sides in 18(64.28%) and in 10 (35.71%) halves it was present in PNF.

**DISCUSSION**

The Endoscopic sinus surgeons must have a detailed knowledge of Anatomical variations of Maxillary sinus opening in any interventional maxillary sinus surgeries as it relates to the orbital floor, ethmoid infundibulum and nasolacrimal duct. In the adult the maxillary sinus can be described as triangular in shape, measuring 25 mm along the anterior limb of its base, 34 mm in depth and 33mm in height [14,15].The sinus can be partially compartmentalized by either complete or incomplete septa.Knowledge of the incidence and morphology of maxillary sinus septa has clinical implications especially in sinus lift operations performed preparatory to the placement of dental implants [16].

Presence of separate cavities in posterior part of the sinus can be a source of persistent infection [17]. The primary or natural ostium of this sinus is located in the superior aspect of medial wall of the sinus and drains via its infundibulum into the ethmoidal infundibulum and thus the hiatus semilunaris [18]. Regarding position the ostium is seen in the region of the posterior half of the infundibulum or posterior to the midpoint of the bulla ethmoidalis[2,14,15]. Lang and Papke found that the ostium is located 1.3 to 11.5 mm average 4mm from the nasolacrimal duct and this proximity of the duct to the natural ostium makes it vulnerable to injury during middle meatus antrostomy [19].

The natural ostium differentiates from accessory ostium in the fact that it tends to be elliptical measuring from 1to 20mm in length, located more anteriorly than accessory ostium and has an angle to the vertical plane. The accessory ostium is located 5-10 mm superior to the attachment point of inferior concha and it opens to lateral nasal wall or infundibulum [20]. It is round, parallel to vertical plane and may be seen during direct nasal examination..The incidence of presence and location of accessory maxillary sinus ostium varies according to different workers in studies conducted on cadavers and endoscopic examination of live subjects [Table 2]. The incidence ranges from 0% -43%. In the present study accessory maxillary sinus ostium was observed in42(21%) out of 200 half heads that is in accordance with the study of Van Alyea[15] and sinigal[6] who reported the incidence of accessory maxillary ostia in 23% and 22.5% of the specimens respectively.. Though most of the authors have not specified the location of the accessory maxillary sinus ostium with reference to the fontanelle, (the membranous region of medial sinus wall) Kumar et al[21] in their dissections on thirty half heads from fifteen adult Indian cadavers reported that accessory maxillary ostium was present in 9(30%) half heads being located in ANF in 6(66.7%), in PNF in 2 (22.2%) and at HS 1(11.1%) in accordance with the present study i.e.out of 42(21%) accessory maxillary sinus ostium was located in ANF in (78.57%), in PNF (16.66% ) and at HS (4.76%). However May et al[22] reported that location of accessory maxillary sinus ostium was restricted to the posterior nasal fontanelle, posteroinferior to natural ostium. The present study observed that besides the fontanelle, the accessory maxillary sinus ostium can be sited in HS (4.76%) a finding similar to that of Frank et al[23].

The present study stated that out of 42(21%), double accessory maxillary sinus ostium was present in 14(33.33%) that includes 8(57.14%) in ANF on right side, 4(28.57%) in PNF on right side, 2(14.28%) in HS on left side and a single accessory ostium in 28(66.66%) that includes 18(64.28%) in ANF on both right and left side, 10(35.71%) in PNF in line with the study of kumar et al[21]. However scheaffer[14] recorded double Primary maxillary ostium and does not favour calling one of these accessory to the main. But Rice and schaeffer [24] termed all extra openings other than a single primary maxillary ostium as accessory maxillary ostium irrespective of their location. Prasanna[25] in his study on forty cadavers head & neck specimens cut sagittally through the nose reported accessory...
maxillary ostium in membranous fontanelle of lateral wall in 9 (22.5%) of specimens which opened into the membranous meatus inferior to uncinate process in 3/4 th cases. Sindel et al[7] examined 29 formaldehyde fixed adult cadavers with endoscope and observed natural maxillary ostium in posterior 1/3 of HS in 51.7%, septal deviations in 34.4%, accessory maxillary ostia in 8(13.8%). These findings were in line with current literature.

Presence of accessory maxillary ostia disturbs the mucociliary clearance of maxillary sinus. On endoscopy the mucociliary flow of secretions is frequently found moving through the accessory maxillary sinus ostium into the maxillary sinus and then leaving through primary maxillary ostium. This may be the reason for chronic maxillary sinusitis [26].

So detailed knowledge of anatomic variations in paranasal sinus region is essential for ENT surgeons to increase the success rate of FESS(Functional Endoscopic Sinus Surgery).

CONCLUSION

The accessory maxillary sinus ostium is one of the anatomical variations that plays a very important role in the development of chronic maxillary sinusitis. Presence of accessory maxillary ostium causes mucus to recirculate from sinus to the nasal cavity through the natural ostium and back to the sinus through accessory ostium. Therefore the endoscopic sinus surgeons must have a detailed knowledge of inconsistent situation of accessory maxillary sinus ostium as it is extremely beneficial for surgical intervention of the functional endoscopic sinus surgery (FESS) by joining the separate openings into one larger antrostomy to restore normal sinus ventilation and mucociliary function.

Conflicts of Interests: None

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