

The presence of Accessory maxillary ostium: A Cone-Beam Computed Tomography Study in Malaysians

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Abstract

Accessory maxillary ostium can be a result of maxillary sinus inflammation or congenital anatomic variation. Endoscopic sinus surgeons should be aware of the more anatomical variations in maxillary ostia to perform the surgery effectively and prevent any reinfection or complications to the orbit or nasolacrimal duct. Additionally, consciousness of its presence can be taken advantage of in providing maxillary ventilation if the primary maxillary ostium is blocked.

The aim of the study was to evaluate the occurrences of Accessory Maxillary Ostium among the Mongoloid race in Malaysia. Volumetric CBCT scans of 320 maxillary sinuses from of 160 patients (1:1 sex ratio) consisting of Malays and Chinese (1:1 ethnic ratio) were retrieved from Oral and Maxillofacial Imaging Division in a Faculty of Dentistry facility. Image analysis was performed using the i-CAT Vision Software, employing the multiplanar reconstruction window in which coronal, axial and sagittal planes were visualized in 0.3 mm intervals. AMO was observed in 44.1% of the total sinuses studied. The occurrences of AMO in this study could be a useful predictive estimation of the incidence of maxillary sinusitis in the Malay and Chinese in Malaysia.

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Introduction

Rhinosinusitis is one of the widely spread disease; nevertheless, the role of the anatomical variants in its pathogenesis remains unresolved¹. The presence of Accessory Maxillary Ostium (AMO) alongside with the Primary Maxillary Ostium (PMO) has shown to allow pathogens to enter the maxillary sinus and cause inflammation². Evacuation of mucus happens insignificantly because the accessory ostia do not have any active mucociliary mechanism as the natural ostium³. Thus, prolonging inflammation of the maxillary sinus. At times congenital anatomic variation of the middle meatus could also be a potential cause. In Malaysia, the estimated

prevalence rate of sinusitis is roughly 12.8%. This suggest that about 3 million Malaysians suffer from it at one given time⁴. Awareness of AMO presence helps endoscopic sinus surgeons perform the surgery effectively and prevent any reinfection or complications to the orbit or nasolacrimal duct. However, their presence is beneficial as they could also provide maxillary sinus ventilation when the natural ostium has been blocked⁵.

Rice and Schaeffer (1988) defined the accessory maxillary ostium (AMO) as any other opening other than the single natural maxillary ostium (PMO)⁶. It can be present in different sizes, shapes, and locations. The formation of accessory ostium can also be of iatrogenic in nature due to incorrect manipulation of maxillary sinus puncture through the middle meatus⁷. Kumar et al., (2001) presented a round/oval AMO, 0.5mm – 3.0mm in diameter, along the margin of the middle concha in 30 bisected head specimens of Indian cadavers⁸. Bharathi et al., (2014) revealed the presence of the accessory maxillary ostium in the anterior or posterior

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fontanelle in patients who suffered from the symptoms of maxillary sinusitis for 6 weeks despite medical treatment. They emphasized on the importance of preoperative diagnostic nasal endoscopy to consider the anatomic variations of the lateral nasal wall, including the AMO, to ensure a safe and effective functional endoscopic sinus surgery⁹.

In our previous published study, the variations in the location of the principal maxillary ostium, and its diameter among the Mongoloid (Malay and Chinese) were ascertained¹⁰. However, the presence of an accessory maxillary ostium amongst these ethnic groups, that could allow pathogens to enter the maxillary sinus and cause infections, need to be determined. Considering these complication as well as the surgical importance of knowing the anatomical variations in maxillary ostia, the aim of this study is to identify the presence of the accessory maxillary ostium amongst the Mongoloid race in Malaysia (Malays and Chinese), employing Cone-Beam Computed Tomography scanned data.

Materials and methods

This study was approved by the Institutional Medical Ethics Committee, Faculty of Dentistry, University of Malaya [Ref. No. DF OS1625/0075(P)].

CBCT scan records were retrieved from Oral and Maxillofacial Imaging Division, Faculty of Dentistry, University Malaya, Kuala Lumpur archived server. The CBCT scans of 160 patients of 80 Malays (40 males, 40 females) and 80 Chinese (40 males, 40 females), aged between 18-85 years, were included in the study. The exclusion criteria were patients with polypoidal and other expansive lesions; patient movement noticed on scans; scans that displayed poor image quality.

The investigation was carried out as described in our previous published study by Sanual et al., 2020¹⁰. Occurrences of the AMO were observed either at the anterior or posterior fontanelles in the coronal section (Figure 1) and were recorded accordingly. Their presence was then compared between Malays and Chinese, males and females as well as between the maxillary sinuses on the right and left sides. CBCT scans were obtained using i-CAT cone beam computed tomography system (Imaging

Sciences International, Hatfield, PA, USA) with tomography specifications of Tube Potential (Kv) 120, Current (mA) 5, Voxel Size (mm) 0.3 and scan time (s) 20-40. Observers assessed the reconstructed images in the coronal, axial and sagittal (in 0.3mm intervals) to confirm their presence.

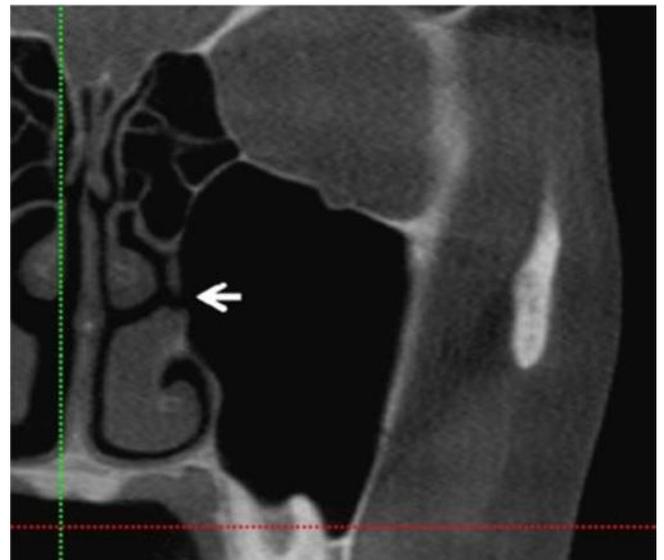


Figure 1. Accessory maxillary ostium at the left maxillary sinus (Arrow).

To ensure the accuracy of the anatomical structure's depictions, all CBCT examinations were reviewed by a trained oral and maxillofacial radiologist. The presence of AMO was identified three times to ensure reproducibility and reduce any subjective bias. The data was recorded and classified according to the ethnic groups and their gender.

Statistical analysis

All data was transferred to an Excel spreadsheet (Microsoft Corp, Redmond, WA, USA), and a descriptive statistical analysis was performed using SPSS version 12.0 (SPSS Inc., Chicago, Illinois, USA). The descriptive statistic was performed using percentages for the presence categorical variables. The chi-square test was used to compare categorical variables (the existence of AMO) among the groups.

Results

Of the 160 patients included in the study, 80 were females and 80 were males, ranging in age from 18-85 years. The occurrences of the AMO were found in 141 (44.1%) of the total 320 maxillary sinus examined (Table 1).

Variable	AMO Present	AMO Absent	X ² - Value	P-Value*
Sides:				
Right (n=160)	68 (48.2)	92 (51.4)	0.317	0.57
Left (n=160)	73 (51.8)	87 (48.6)		
Total:	141 (44.1)	179 (55.9)		

* Chi-square test

Table 1. Comparison of occurrences of accessory maxillary ostium (AMO) between right and left sides (n=320).

Table 2 shows the comparison of total AMO amount between right and left sides among 320 maxillary sinuses. The total unilateral AMO was 14.7% and the total bilateral AMO was at 29.4% of the total sinuses. Concerning the sides of the maxillary sinus, it showed that the AMO occurrences was higher but not significantly (P = 0.57) in the left side [73 (51.8%)] compared to the right side [68 (48.2%)].

Variable	Presence of AMO unilaterally n (%)	Presence of AMO bilaterally n (%)
Gender:		
Male (n=160)	21 (13.1)	23 (14.4)
Female (n=160)	26 (16.3)	24 (15.0)
Ethnicity:		
Malay (n=160)	26 (16.3)	19 (11.9)
Chinese (n=160)	21 (13.1)	28 (17.5)
Total:	47 (14.7)	47 (29.4)

Table 2. Distribution of occurrences of the accessory maxillary ostium (AMO) by gender and ethnicity (n=320).

Variable	Presence of AMO at the right maxillary sinus (n=160)			Presence of AMO at the left maxillary sinus (n=160)			Total AMO on both sides (n=320)		
	n (%)	X ² - value	P value*	n (%)	X ² - value	P value*	n (%)	X ² - value	P value*
Gender:									
Male	28 (35.0)	3.683	0.055	36 (45.0)	0.025	0.875	64 (20.0)	2.14	0.143
Female	40 (50.0)			37 (46.3)			77 (24.1)		
Ethnicity:									
Malay	33 (41.3)	0.102	0.749	34 (42.5)	0.630	0.427	67 (20.9)	0.62	0.431
Chinese	35 (43.8)			39 (48.8)			74 (23.1)		

Table 3. Comparison of occurrences of the accessory maxillary ostium (AMO) between genders and ethnicities.

* Chi-square test.

Authors (Year)	Total Incidence	Right Side	Left Side	Study Material
Schaeffer (1920)	43%	NS	NS	Cadavers
Myerson (1932)	31%	NS	NS	Cadavers
Van Alyea (1936)	23%	NS	NS	Cadavers
Kumar (2001)	31%	NS	NS	Cadavers
Prasanna & Mamatha (2010)	22.5%	NS	NS	Cadavers
Nayak et al., (2014)	18.5%	NS	NS	Cadavers
Singhal & Singhal (2014)	18.5%	60%	40%	Cadavers
Mahajan et al (2016)	21%	69.04%	30.95%	General Population
Yenigun et al (2016)	19.1%	7.2%	3.7%	General Population
Current Study	44.1%	48.2%	51.8%	General Population

Table 4. Incidence of the Accessory Maxillary Ostium (modified from: Mahajan et al., 2016. Anatomical variations of accessory maxillary sinus ostium: an endoscopic study. International Journal of Anatomy and Research, 5(1.2), pp.3484-3490).

* NS – Not Specified.

Amongst the gender, the findings showed that the AMO occurrences were more frequent in the females [74 (24.1%)] than the males [64 (20.0%)]. Interestingly, it showed more in the right side [40 (50.0%)] than the left side [37 (46.3%)] in females and vice versa in male; 28(35.0%) and 36(45.0%) on the right side and left side sequentially.

Between the ethnicities the Chinese [74 (23.1%)] had more AMO presence than the Malays [67 (20.9%)] where the left side showed higher AMO occurrence than right side in both groups. However, all the comparisons mentioned did not produce any statistically significant results (Table 3). The chi-square test demonstrated no significant differences between the ethnicity or the gender in the occurrences of AMO (P > 0.05) (Table 3).

Discussion

The endoscopic sinus surgeons must have a detailed knowledge of AMO existence as it is extremely beneficial for surgical intervention of the functional endoscopic sinus surgery. This surgery is designed to remove the blockage of maxillary sinus ostium and to restore normal sinus ventilation and mucociliary function. Some of the studies reported that enlarging the AMO in the membranous fontanelle may provide maxillary sinus ventilation if the natural ostium is obstructed^{5, 11, 12}.

Moreover, in patients with AMO, mucus recirculation ring was observed causing the

physiological mucociliary drainage to be affected, predisposing a person to long standing maxillary sinusitis¹³. Furthermore, AMO allows easy access of pathogens into the maxillary sinus leading to recurrent sinusitis². In support of the earlier studies, Yenigun et al., (2016) discovered that there is a clear link between sinus mucosal thickening and the presence of AMO. He reported that the occurrences of maxillary sinusitis are twice as often when AMO is present¹⁴.

Accessory maxillary sinus ostium may be either congenital or secondary due to disease process because of obstruction of principle ostium by maxillary sinusitis or even due to anatomical or pathological factors in the middle meatus resulting in the rupture of fontanelle³. The presence of the AMO in this study stood at 141 (44.1%) of the 320 maxillary sinuses we examined. Out of the 141 AMO, 68 (48.2%) was located in the right maxillary sinus and 73 (51.8%) in the left maxillary sinus. Similar results were reported by Schaefer (1920), where he reported that 43% of the samples has AMO¹⁵.

Cone-Beam Computed Tomography (CBCT) is a valuable imaging technique that can be used to detect the accessory canals on the maxillary sinus¹⁶. The present results were compared with studies published in the literature that aimed to detect the incidence of AMO using CT or CBCT examination (Table 4). Total incidence of AMO in current study in general population was more than that found in the literatures. In 2016, Mahajan et al. reported the occurrence of 85.7% unilateral and 14.28 % bilateral AMO in the population¹⁷. This proved similar in the Singhal and Singhal (2014), where it's quoted, AMO present at 80% unilaterally and 20% bilaterally¹². In contrast, our current data revealed that the amount of bilateral presence of AMO was almost twice higher than the unilateral occurrence amongst Mongoloid Malaysian people.

In the present study, the comparisons between genders, sides of the maxillary sinus as well as between the Malay and Chinese populations did not give any statistically significant results. However, it was observed that females have slightly more occurrences of AMO than males, which might potentially be due to the thinner fontanelles in females than males causing easy rupture.

Conclusions

This study clearly shows the occurrence of accessory maxillary ostium (AMO) in the two largest ethnic groups of the Mongoloid race in Malaysia, the Malays and Chinese. Almost half of the maxillary sinuses assessed in the present study population had an AMO, with more occurrence of it in Chinese than Malay and female than male. The higher incidence of AMO suggests higher predictive incidences of the maxillary sinusitis in both Malay and Chinese populations. Cone-Beam Computed Tomography (CBCT) could also be utilized as an inexpensive, rapid scanning pre-operative modality before any intervention on the maxillary sinus as it depicts the osteomeatal unit and the sinus correctly.

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Declaration of Interest

The authors declare that they have no conflict of interest.

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