Significance of accessory opening of maxillary air sinus

Shashikant Mane*1, Ashwini Desai2, Rajiv Desai2, Priya Roy1

1Department of Anatomy, Krishna Institute of Medical Sciences Deemed to be University, Karad, Maharashtra, India
2Department of Anatomy, Rural Medical College, Pravara Institute of Medical Sciences Deemed to be University, Loni, Ahmednagar, Maharashtra, India

ABSTRACT

Maxillary air sinus opens in hiatus semilunaris of middle meatus of the nasal cavity. Drainage of sinus should happen through a natural orifice. That is mandatory because there are cases where there is an additional opening of sinus posterior to the hiatus semilunaris. In this case, there may be recirculation of mucus between natural and accessory opening leading to complications and recurrence of the patient’s problem during various endoscopic procedures. So noting this high significance of accessory opening, the present study was conducted. Total of 50 specimens (27 were from the right side, and 23 were from the left side) was studied. Presence of accessory opening of maxillary air sinus was noted. Position of the opening was noted. The shape of the opening was noted. The diameter of the accessory opening was measured using Sliding Vernier Caliper. Observations on the above parameters show the accessory opening of maxillary air sinus was present in 21 specimens out of a total of 50 specimens (42%). Typical Shape of the opening on the left side was Circular and on the right side was Oval. The average diameter of the opening on the right side was 24mm and on the left side was 46mm. So definitely significance of the accessory opening of maxillary air sinus was found. That's why surgeons, especially, Otorhinolaryngologists, should note and explore the exact position of the accessory opening of maxillary air sinus, during various sinus surgeries.

INTRODUCTION

Maxillary air sinus opens into hiatus semilunaris of middle meatus of the nasal cavity. Usually, an opening is in the posterior part of hiatus semilunaris. However, there are incidences of additional openings, apart from usual opening. So we feel, this area should be explored in detail, to check out for the accessory opening of the sinus. Because, it is found that, despite the endoscopic surgeries on the usual opening of maxillary air sinus has been done. Still, the problem persists in some patients. And that’s why there is a need to study the accessory opening of maxillary air sinus. So we decided to work on this topic.

Maxillary air sinus is developed around 2-3 months in the Maxilla bone. Maxillary air sinus drains into Middle meatus of Nasal cavity (Figure 1). Middle meatus and hiatus semilunaris are areas, where variations can occur which predispose patients to recurring sinusitis. Length of hiatus semilunaris was found to be shorter on the left side and in
Females. Knowing the discrepancy of hiatus semilunaris lengths between Right and left sides and Males versus Females may guide the advancement of endoscopic instruments into the nasal cavity (Dahistrom, 2014). Anatomical variations have been suggested to play a role in the pathogenesis of chronic rhinosinusitis (Sahin et al., 2015). Recirculation of nasal mucus occurs when secretions that have been transported out of natural maxillary ostium return to sinus via a surgically created or accessory ostium (Gutman and Houser, 2003). Computed tomography (C.T.) revealed a recirculating mucus ring between the two Ostia of the maxillary sinus (Chung, 1999). Maxillary sinoscopy via the canine fossa revealed a left maxillary sinus recirculation phenomenon. There was thick mucus coming back into the maxillary sinus through an accessory ostium, which ascended and transported into left natural ostium (Yanagisawa and Yanagisawa, 1997).

Accessory Ostia of the sinus is present in anterior and posterior nasal fontanelles, the bone deficient areas in the lateral nasal wall behind and below uncinate process (Bajaj et al., 2015). Functional endoscopic sinus surgery may be indicated when certain anatomic variations impede normal drainage of paranasal sinuses through ostiomeatal complex (Derjac-Arama et al., 2015). Management of Anatomic variations surrounding the Ostia is very important in the treatment of maxillary ostium (Tan, 1998). Paranasal sinuses are maintained in a healthy state by ventilation through individual Ostia and by a mucociliary transport mechanism that keeps a continuous protective layer of mucus flowing out of sinuses (Slack and Bates, 1998). Performing a smooth and clean sinus surgery goes hand in hand with a perfect understanding of nasal and paranasal anatomy. Any maxillary sinus opening outside the hiatus semilunaris is considered an accessory ostium. Clinical significance of the presence of an accessory ostium is that occasionally a circular flow of mucus between the natural and the accessory Ostia could occur, leading to recurrent sinusitis (Abdulmalik and Alsaied, 2017).

Normal drainage of paranasal sinuses depends on sufficient mucociliary clearance; this is dependant on the condition of the sinus Ostia (Scott-Brown et al., 1997). Anatomy of the maxillary Ostia should be well understood by an endoscopic sinus surgeon to perform middle meatal antrostomy (Anne and Souza, 2016).

So to understand the significance of the accessory opening of maxillary air sinus this study was done.

MATERIALS AND METHODS

Study Design
Observational Study

Study Settings
Study was conducted in the Department of Anatomy of our Institute. Total 50 specimens were studied (27 were of Right and 23 of left side). Formalin preserved cadaveric specimens were taken and washed thoroughly. Then by using Dissection instruments, Lateral Wall of the Nasal cavity was nicely exposed. Middle Nasal Choncha was dissected. Middle Meatus was explored. Accessory openings of Maxillary air sinus were noted in the Middle meatus. The shape of the opening was noted. The diameter of the opening was measured. The Sliding Vernier Caliper took measurements.

Statistical analysis
Quantitative data were summarized into maximum, minimum, mean and Standard Deviation; while Qualitative data was summarized into number & percentages. Comparison of quantitative data was made by applying unpaired ‘t’ test while the chi-square test was used for qualitative data comparison. The difference was said to be significant if p was equal to or less than 0.05.

RESULTS AND DISCUSSION

Accessory opening of maxillary air sinus was located in the middle meatus of the nasal cavity, just posterior to the main opening of maxillary air sinus (Figure 2).

The accessory opening was present in 21 out of a total of 50 specimens. So presence is 42%. Out of 21, on the Right side were 12 (57.1%) and on Left side were 9 (42.8%) (Figure 3).

The shape of the accessory opening is mainly Oval on the Right side (Table 1) and Circular on the Left side (Table 2).

The average diameter of the accessory opening on Right was 24mm. and on Left was 46mm (Table 3).

According to our study, Accessory Maxillary Ostium (AMO) was present in the posterior part of the middle meatus, behind the main opening of maxillary air sinus. As noted by Abdulmalik S. Alsaied, it is located in posterior fontanelle, posterior to the natural ostium (Abdulmalik and Alsaied, 2017). According to Gray’s Anatomy, maxillary sinus communicates with the lower part of hiatus semilunaris through an opening in anterosuperior part of its base; a second orifice is frequently seen in, or immediately below, the hiatus. Both are nearer the roof...
Table 1: Shape of Accessory opening of Maxillary air sinus - Right side

| Type     | Number | Total | Percentage |
|----------|--------|-------|------------|
| Circular | 5      | 12    | 41.7       |
| Oval     | 7      | 12    | 58.3       |

Table 2: Shape of Accessory opening of Maxillary air sinus - Left side

| Type     | Number | Total | Percentage |
|----------|--------|-------|------------|
| Circular | 9      | 9     | 100        |
| Oval     | 0      | 0     | 0          |

Table 3: Diameter of Accessory Opening of Maxillary air sinus (mm)

| Side     | Right | Left |
|----------|-------|------|
| Minimum  | 19    | 23   |
| Maximum  | 44    | 143  |
| Mean     | 24    | 46   |
| Std Deviation | 11 | 37   |

Unpaired "t" test value = 1.951
P value = 0.0660

According to our study, Accessory Opening of Maxillary Air Sinus was present in 21 out of a total of 50 specimens. So presence is 42%. Out of 21, on Right side were 12 (57.1%) and on Left were 9 (42.8%). As per the study of Kumar H et al., AMO was present in 9 out of 30 half heads studied. In 6 half-heads, these were present on the right side while in 3, they were on the left side (Kumar and Choudhry, 2001). As mentioned by Manju Singhal et al., AMO was found in 20 out of 108 half heads (18.5%). Out of these 20 half heads, in 12 (60%) half heads AMO was present on the right side while in remain-
ing 8(40%) half heads, it is on the left side (Singhal and Singhal, 2014). As studied by M.Jog and G.W.McGarry, it occurred in four per cent (Jog and McGarry, 2003). As Cappello ZJ noted, there is typically only one ostium per maxillary sinus; however, cadaver studies have shown 10% to 30% have an accessory ostium (Cappello and Dublin, 2018). As per the study done by L.C.Prasanna, the incidence of AMO has been recorded to range from 0 to 43%. Prevalence of AMO was 14% in rhinosinusitis group (Sahin et al., 2015). O.E.Van Alyea states, presence in 23% of specimens (Alyea, 1936). AMO was found within membranous fontanelle of the lateral nasal wall in 9(22.5%) specimens (Prasanna and Mamatha, 2010). As noted by Abdulmalik, its incidence is about 10-16% (Abdulmalik and Alsaied, 2017).

According to our study, Shape of the Accessory Opening of Maxillary air sinus is mainly Circular on the Left side and Oval on Right side. As per the study of Kumar H et al., AMO were round or oval (Kumar and Choudhry, 2001). As mentioned by Manju Singhal et al., the shape is round or oval (Singhal and Singhal, 2014). So our findings correlate with the above authors.

According to our study, Average Diameter of the Accessory Opening of Maxillary air sinus on Right was 24mm and on Left was 46mm. As per the study of Kumar H et al., AMO diameter being 0.5mm to 3mm. (Kumar and Choudhry, 2001). As noted by Abdulmalik, the average diameter is 1.5mm (Abdulmalik and Alsaied, 2017). As mentioned by Manju Singhal et al., the diameter is 0.5 to 5mm (Singhal and Singhal, 2014). So as compared to these author’s findings, our study got a comparatively large diameter of the accessory opening of maxillary air sinus.

As diameter range is more, ENT surgeons need to explore Maxillary Accessory Opening properly before heading for surgery. In our study, Diameter of Accessory Opening of Maxillary Air Sinus, as compared with Right and Left side, was Moderately Statistically Significant. (p= 0.06).

AMO was variation seen in nearly three-fourths of the cases (Prasanna and Mamatha, 2010). Anatomical variations of the lateral wall of the nasal cavity may create technical difficulties during endoscopic sinus surgeries (Souza et al., 2014). So these variations need to be kept in mind by OtoRhinoLaryngologists during Endoscopic interventions and Sinus Surgeries. Primarily, when Main Maxillary Ostium is obstructed, then, enlarging the Maxillary Accessory Ostium may provide Maxillary sinus aeration.

CONCLUSION
Accessory opening of maxillary air sinus was located in middle meatus of the nasal cavity, just posterior to the main opening of maxillary air sinus. The shape of the accessory opening was mainly Oval on Right side and Circular on Left side. The average diameter of the accessory opening on Right was 24mm and on Left was 46mm. The accessory opening was present in 21 out of a total of 50 specimens. So presence is 42%. As the presence of accessory opening is 42%, it indicates a high prevalence of accessory opening. And that may create a problem for normal drainage of mucus through natural ostium. Because mucus might recirculate from natural ostium towards accessory opening leading to reentering of mucus into the maxillary sinus, causing maxillary sinusitis. Considering this high significance of accessory opening, Our study put one step ahead in attracting the attention of ENT (Ear, Nose and Throat) surgeons where one needs to be very careful during endoscopic sinus surgeries.

ACKNOWLEDGEMENT
We acknowledge the great help given by the Department of Preventive and Social Medicine.

Conflict of Interest
The authors declare that they have no conflict of interest for this study.

Funding Support
The authors declare that they have no funding support for this study.

REFERENCES
Abdulmalik, S., Alsaied 2017. Paranasal Sinus Anatomy: What the Surgeon Needs to Know. inte-chopen, pages 1–36.
Alyea, O. E. V. 1936. The Ostium Maxillare- Anatomic study of its surgical accessibility. Archives of Otolar-ynngology - Head and Neck Surgery, 24(5):553–569.
Anne, D., Souza 2016. Anatomy of maxillary sinus and its ostium: A radiological study using computed tomography. CHRISMED Journal of Health and Research, 3(1):37–40.
Bajaj, V., Singh, B., P. P. J. 2015. Prevalence of Anatomical variations of lateral wall of Nose in chronic sinusitis patients. Journal of Evolution of Medical and Dental Sciences, 4(32):5492–5505.
Cappello, Z. J., Dublin, A. B. 2018. Anatomy, Head and Neck, Nose Paranasal Sinuses. Treasure Island (FL), United States. StatPearls Publishing.
Chung, S. K. 1999. Mucus Circulation Between Accessory Ostium and Natural Ostium of Maxillary Sinus. *J Laryngol Otol*, 113(9):865–872.

Dahistrom, K. 2014. Anatomic description of the middle meatus and classification of the hiatus semilunaris into five types based upon morphological characteristics. *Clin Anat*, 27(2):176–181.

Derjac-Arama, A. I., Mihai, S. A., Sandulescu, M., Rusu, M. C. 2015. Anatomic patterns of maxillary sinus drainage. *Romanian Journal of Rhinology*, 5(20):209–214.

Gutman, M., Houser, S. 2003. Iatrogenic Maxillary Sinus Recirculation and Beyond. *Ear, Nose & Throat Journal*, 82(1):61–63.

Jog, M., McGarry, G. W. 2003. How frequent are accessory sinus ostia? *The Journal of Laryngology & Otology*, 117(4):270–272.

Kumar, H., Choudhry, R. 2001. Accessory Maxillary Ostia: Topography and Clinical Application. *Journal of Anatomical Society of India*, 50(1):3–5.

Prasanna, L. C., Mamatha, H. 2010. The Location of Maxillary Sinus Ostium and Its Clinical Application. *Indian Journal of Otolaryngology and Head & Neck Surgery*, 62(4):335–337.

Sahin, C., Ozcan, M., Unal, A. 2015. Relationship between development of accessory maxillary sinus and chronic sinusitis. *Medical Journal of Dr. D.Y. Patil University*, 8(5):606–608.

Scott-Brown, W. G., Mackay, I. S., Bull, T. R., Kerr, A. G. 1997. Scott-Brown’s Otolaryngology. In *Rhinology*, volume 4. Butterworth-Heinemann. Sixth Edition. ISBN: 9780750619356.

Singhal, M., Singhal, D. 2014. Anatomy of accessory maxillary sinus ostium with clinical application. *International Journal of Medical Science and Public Health*, 3(3):327–329.

Slack, R., Bates, G. 1998. Functional Endoscopic Sinus Surgery. *American Family Physician*, 58(3):707–718.

Souza, D., Anne, Ankolekar 2014. Anatomical study of the Middle meatus with emphasis to the maxillary ostium and their clinical relevance. *International Journal of Health Sciences & Research*, 4(2):35–39.

Tan, G. 1998. Ostium of Maxillary Sinus in Endoscopic Sinus Surgery. *Zhonghua Er bi Yan Hou Ke Za Zhi*, 33(3):146–154.

Williams, L. P., Warwick, R. 1980. Gray’s Anatomy. pages 1149–1150. 36th Edition.