

ANATOMY OF THE MAXILLARY SINUS OSTIUM: A CADAVERIC STUDY

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ABSTRACT

Background: Recognition of the maxillary sinus position is tedious as it is small and not easily seen. A detailed knowledge of the anatomical variations of maxillary sinus opening is required for endoscopic surgeons to perform safe surgeries. The aim of the present study is to determine the anatomical location of the maxillary ostium in a cadaveric specimen. The position of the accessory maxillary sinus, if present is also noted to further benefit the surgeons.


Materials and Methods: Thirty bisected halves of the formalin fixed adult head and neck specimens were obtained from the Department of Anatomy. The anterior part of the skull was divided in the midline and then the nasal septum was removed taking care not to damage the osteomeatal components. Probes were used in identifying the location of maxillary sinus ostium. Various other parameters like vertical diameter, transverse diameter, distance between ostium and anatomical landmarks such as inferior concha and hard palate were measured.

Results: In accordance to the parameters considered in the current study, the following results were observed. The maxillary sinus ostium was present in the posterior 1/3rd of the Hiatus semilunaris in 53% of the cadavers. The most common shape of maxillary sinus ostium was oval. The mean vertical and transverse diameters of ostium were 2mm and 2.6mm respectively. The perpendicular distance of the ostium from the lower border of inferior concha was 14.6 mm and from the upper border of the hard palate was 17.5 mm.

Conclusion: The knowledge about the variations in location of the maxillary sinus Ostium and the distances of the ostium from the major anatomical landmarks will help the maxillofacial surgeons and otolaryngologists to perform the surgical procedures safely.

KEY WORDS: hiatus semilunaris, hard palate, inferior concha, maxillary sinus ostium.

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INTRODUCTION

The treatment of any disease is primarily based on the pathophysiology of the particular structure and the physician needs to know how the

basic functioning works but it is invariably related to the anatomy of the structure and therefore in-depth knowledge about the structure is required. Depending on the knowledge

about the anatomy of a structure, the diagnosis and treatment can proceed, right from reading an x-ray to the surgical operation. The paranasal sinuses are an area of special interest for many medical professionals especially the maxillofacial surgeons and otolaryngologists. The particular location of the maxillary sinuses is hidden carefully from the eyes inside the bones of the skull since they are closely related to the vital organs of the body such as the eye, nose and brain which makes it more difficult for the medical professionals to visualize them.

Paranasal sinuses were discovered first by the ancient Egyptians inside the bones of the skull. Certain medical writings provide evidence that Egyptians were familiar with the structure of the maxillary bones which were dated back to the 3700 to 1500 BC. The pyramid shaped maxillary sinus is the largest of the paranasal sinus, first described by Nathaniel Highmore in 1651[1]. The maxillary sinus is the first paranasal sinus to develop. It is pyramidal in shape with its base directed towards the lateral wall of the nose and the apex is directed laterally in the zygomatic process of the maxilla. The roof is formed by the floor of the orbit, it is transverse by the infra-orbital nerve. The floor is formed by the alveolar process of the maxilla and lies about 1cm below the level of floor of the nose [2].

With evolution man has obtained an erect posture which is further associated multiple modifications in the body pattern, higher the location of the maxillary ostium is one among them [3]. The opening of the ostium is into the lower part of the hiatus semilunaris. Any blockage in the pathway of drainage of the ostium can lead to the inflammation of the sinus causing maxillary sinusitis. The ostium of the sinus is on the highest part of the sinus and is therefore poorly placed from the point of free drainage. It opens into the narrow ethmoidal infundibulum, inflammation of which can further interfere with the drainage leading to sinusitis [4]. The surgical intervention of functional endoscopic sinus surgery (FESS) is designed to remove the blockage of the maxillary sinus ostium. During the process of removal of the blockage in sinus there may be many complications. Thus the current study was designed to find and evaluate the various sizes, shapes and

distances from the various landmarks so as to be accustomed about the anatomy of the maxillary sinus ostium for the benefit of those that are dealing with the treatment of ailments of the maxillary sinus [5].

MATERIALS AND METHODS

The current observational study was carried out on 30 sagittal sections of head and neck of Indian origin in the Department of Anatomy of Vydehi Institute of Medical Sciences and research centre, Bangalore. The cadavers used in the current study were not known to have any history of trauma, cancer or any other deformities. The specimens were then cut along the sagittal section to divide them into two equal halves. The nasal septum was then removed to visualize the lateral wall. The middle meatus was then studied for the variations possible in the opening of the maxillary sinus ostium. The following parameters were taken into consideration:

- 1) Position of the ostium (anterior/middle/posterior) in the hiatus semilunaris.
- 2) Shape of the ostium
- 3) Vertical and horizontal diameters of the ostium
- 4) Perpendicular distance from the ostium to the lower border of the inferior concha and upper border of the hard palate. Probes were used in identifying the maxillary ostium.

Dividers were used to measure the vertical and horizontal diameters. The findings were recorded and tabulated. Mean and standard deviation were taken into consideration in the statistical analysis.

RESULTS

In the current study, the maxillary sinus ostium was located in the posterior 1/3rd of the hiatus semilunaris in 53.33% of the cases. The shape of ostium was observed as oval in 60% of cases as shown in table 1. The vertical diameter of the ostium was found to be 2.06mm followed by a horizontal diameter of 2.62 mm. The perpendicular distance from the maxillary ostium to the lower border of the inferior concha was found to be 14.62 mm whereas perpendicular distance from the maxillary ostium to the upper border of hard plate was

found to be 17.5 mm as shown in table 2.

Fig. 1: Illustration showing different measurements of maxillary sinus ostium; Blue arrow – position of ostium, HP - hard palate, HS – hiatus semilunaris IC – inferior concha.



Table 1: Position and shape of maxillary sinus ostium.

Parameter		Number	Percentage
Position of ostium	Anterior 1/3 rd	5	16.67%
	Middle 1/3 rd	9	30%
	Posterior 1/3 rd	16	53.30%
Shape of ostium	Oval	18	60%
	Circular	12	40%

Table 2: Measurements of maxillary sinus ostium.

Parameter		Mean (mm)	SD (mm)	MIN – MAX
Size of ostium	Vertical diameter	2.06	0.52	3.2 – 1.8
	Horizontal diameter	2.62	0.35	03 – 02
Perpendicular Distance from maxillary ostium to	Lower border of inferior concha	14.62	0.84	16 – 12
	Upper border of hard palate	17.5	0.56	19 – 15

DISCUSSION

The maxillary sinus develops from a diverticulum arising from the nasal mucosa within the infundibulum of the ethmoid at 60-70 days of the development. The embryological remnant of the opening of the diverticulum is the ostium of the maxillary sinus [6&7]. Due to the complex embryological determinants during development and the pneumatization of the ethmoid bone, there is a high incidence of variation in the dimensions and position of the maxillary ostium. These variations have been extensively documented in various cadaveric and endoscopic studies. According to these studies, the primary maxillary ostium may be located along the

course of the ethmoidal infundibulum [8].

In the data obtained from the current study, the position of the maxillary ostium was found to be in the posterior 1/3rd of the hiatus semilunaris. This is similar to the findings in the study done by different authors [5,9,10] as represented in Table 3.

Table 3: Comparison of location of maxillary ostium with other studies.

	Anterior 1/3 rd	Middle 1/3 rd	Posterior 1/3 rd
LC Prasanna	16.70%	29.20%	54.10%
Anne D,Souza	14%	27.50%	58.50%
Jyothi N	9.61%	26.90%	63.46%
Current Study	16.67% (5)	30% (9)	53.33% (16)

Pertaining to the various shapes of the ostium such as oval, circular, slit like and others, our study revealed that the shape was oval in 60% of the cases which was similar to the findings in the study done by LC Prasanna et al [10].

The dimensions of the ostium obtained from our study was found to be of a mean vertical diameter of 2.06 mm and a mean horizontal diameter of 2.62 mm. The findings of our study were comparable to the findings in the study done by D Souza A et al [5].

The mean of the perpendicular distance of the maxillary ostium to the inferior concha and to the hard palate were found to be a mean of 14.63 mm and 17.4 mm respectively which is almost similar to the findings in the study D Souza A et al [5].

Due to the variations in the size and location of the osmium, the incidences of the complications in relation to the sinus surgeries such as orbital floor fracture, cerebro spinal fluid (CSF) leak and others are high. Myserson et al noted that the maxillary sinus ostium lies inferiorly to the lamina papycea in the posterior part of the infundibulum and that perforation of the lateral wall of the infundibulum leads to exposure of the orbit and its contents [11]. Hence blind probing of the ostium may result in increased risk of complications. The present study agrees with the same and stresses on the relationship of the maxillary sinus osmium with the major anatomical landmarks such as the distance between the maxillary sinus ostium and the inferior turbinate. This study reveals specific anatomic information that is applicable to the

technique of transnasal maxillary sinus saloon catheter dilatation, which is a revolutionary procedure that helps in the clearance of secretions from the sinus. The data collected allows surgeons to anticipate the direction in which a guide wire must be manipulated in order to correctly enter the ostium, a crucial step in most surgeries involving the sinus.

Limitations: The study was deficient in identifying the various parameters in cadavers between males and females and there were more room for improvement in further identifying the parameters in either side.

CONCLUSION

This study provides data regarding the variations in the dimensions, shape and the distance from the various anatomical landmarks such as inferior turbinate and the hard palate. This adequate anatomical information is crucial to the otorhinolaryngologists performing maxillary sinus drainage procedures such as antrostomy and FESS. With further studies and appropriate implementation, the morbidity due to major complications such as orbital floor fractures can be reduced.

ABBREVIATIONS

FESS – functional endoscopic sinus surgery

CSF – cerebro spinal fluid

Conflicts of Interests: None

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