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Utility of sphenoid ostium in relation to posterior wall of maxillary sinus in CT scan

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RESEARCH

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ABSTRACT

Background

In the past many rough guides and estimates have been used to localize the face of sphenoid sinus for FESS due to the bony anatomical variations of sphenoid sinus as well as its relationship with adjacent vital structures.

Aims

The current study was performed to find out an easiest fixed bony landmark on computerized tomographic scans for localizing the sphenoid sinus ostium before embarking on to the FESS and Pituitary Surgery.

Methods

It was a retrospective study in which computerized tomographic (CT) scan axial cut of sinuses from 166 patients were reviewed to determine average distance between Posterior Maxillary Wall (PMW) and the Front of Sphenoid (FOS) in both right and left sides.

Results

Mean age of the patients was 41.18±14.75 (95 per cent CI=38.92–43.44) years. Males (n=88, 53.01 per cent) and females (n=78, 46.99 per cent) were almost equally participated in the study. The average anterior-posterior distance from the PMW to the FOS was on the right side 7.1mm and on the left side 7.9mm, the average in both right and left respectively was 7.5mm in the CT scans.

Conclusion

The posterior maxillary sinus wall may act as a concrete and unmistakable bony landmark on CT scan to localize the face of sphenoid sinus for the sinus surgeons performing FESS and pituitary surgery.

Key Words

Sphenoid sinus, posterior maxillary wall, functional endoscopic sinus surgery, pituitary surgery, sinusitis, minimally invasive

What this study adds:

1. What is known about this subject?

Sphenoid sinus surgery is very risky, because of the anatomic variations.

2. What new information is offered in this study?

The observations revealed that the average anterior-posterior distance from the posterior maxillary wall to the face of sphenoid was on both sides was 7.5mm.

3. What are the implications for research, policy, or practice?

To perform FESS with highest level of safety and efficacy, CT should be conducted before the surgery to determine the critical anatomic landmarks.

Background

Functional endoscopic sinus surgery is most commonly performed for inflammatory and infectious sinus disease and is the only minimal invasive technique which provides an effective mode of treatment in sphenoid sinus and pituitary gland diseases with very less incidence of operative and postoperative complications.[1-3] However, the bony anatomic variations of sphenoid sinus as well as its relationship with adjacent vital structures and presence of crucial anatomical structures like internal carotid artery and optic nerve in close proximity to the sphenoid sinus may lead to such complications.[4-6] To avoid this, in past many rough guides and estimates have been used such as it is reported that the face of the sphenoid is approximately 7 cm from the nasal sill (floor of the nasal opening) at a 30° angle from the horizontal.[7-9] Similarly, it is documented and well-known that identifying the superior turbinate may aid in the confirmation of sphenoid position.[10,11] The sphenoid sinus is entered just medial and inferior to its natural ostium.[12,13] Once the sinus is entered safely, care must be taken not to aggressively enter the sinus because dehiscence may be present in the bony coverage of the carotid artery or the optic nerve as an injury to these vital structures may be catastrophic.[14,15]

The current study was performed to find out an easiest fixed bony landmark on computerized tomographic scans for localizing the sphenoid sinus ostium before embarking on to the FESS and Pituitary Surgery.

Method

We retrospectively reviewed 166 paranasal sinus CT scans of Saudi adult patients from Jan 2013 till Dec 2014 at the department of Otorhinology in collaboration with the departments of Diagnostic Radiology, Epidemiology and Internal Medicine, KAMC Riyadh, Kingdom of Saudi Arabia. The subjects were included in the study with the help of non-probability consecutive sampling technique. Adult subjects of both genders undergoing computerized tomography of their paranasal sinuses were included.

Subjects with previous nasal or paranasal surgery or tumours were excluded from the study. Computerized tomographic (CT) scan axial cut of sinuses were reviewed to determine average distance between Posterior Maxillary Wall (PMW) and the Front of Sphenoid (FOS) in both right and left sides.

The demographic information of the subjects (such as age, gender) and the CT scan measurements of distance between PMW and FOS were entered and analysed with the help of Statistical Package for Social Sciences (SPSS) version 17.0 by IBM Inc., (USA). The continuous variables like age and distance between PMW and FOS were represented by mean±standard deviation (SD) with 95 per cent confidence interval (CI). Independent samples t test was used to compare the main variable (distance between PMW and FOS on right and left sides). Any p value less than 0.05 was considered statistically significant.

Results

Mean age of the patients was 41.18±14.75 (95 per cent CI=38.92–43.44) years however the minimum and maximum ages of the subjects were 18 and 79 respectively as shown in Table 1.

Males (n=88, 53.01 per cent) and females (n=78, 46.99 per cent) were almost equally participated in the study as shown in Figure 1.

Current study revealed through the review of CT images that the average anterior- posterior distance from the posterior maxillary wall to the face of sphenoid was on the right side 7.1mm and on the left side 7.9mm, the average in both right and left respectively was 7.5mm. Independent samples t-test was applied which found that the difference in the distance between PMW and FOS on right and left side was not significantly different from each other (t=-1.26509, two sided p value=0.206).

Discussion

The bony anatomical variations of sphenoid sinus as well as its relationship with adjacent vital structures have been reviewed in literature extensively.[4,16-19] These variations are clinically important especially when novice and even expert functional endoscopic sinus surgeons are operating on sphenoid sinus or through this sinus on sellar region e.g., excision of pituitary tumours and alike.[5,15,20] For this reason, surgeons must always remember that they have to spare the optic canal and internal carotid artery which may not be well protected in the area of sphenoid and are liable to injury.

The understanding of the sinuses anatomy need to conduct CT scans, considered as the gold standard investigation in all preoperative cases. This importance come from its ability to show more detailed bony anatomy of the area as it works as a "road map" for the operating surgeon. Diagnostic endoscopy plays an important role to understand the variations of the anatomy, pathological changes and to determine which surgical approach is appropriate.[21]

To perform functional endoscopic sinus surgery (FESS) with highest level of safety and efficacy, Computed Tomographic (CT) scans should be conducted before the surgery to determine the speared of disease and critical anatomic landmarks. Despite these landmarks that have been identified on CT scans may have significant anatomic or pathologic variations. According to that the need for unchanging, visible, easy to find and concrete anatomic landmark are necessary.[22] The posterior maxillary sinus wall represents the infratemporal surface of the maxilla. It is easy to find and used as a consistent landmark to identified the front of sphenoid sinuses.

The using of posteroanterior (PA) approach provides a clear view of the surgical area, credible result and reducing the risk of complications. It used in case of more advance disease of the paranasal sinuses, however is more comprehensive than the AP approach. In this approach, the surgeon will start with a posterior partial resection of the middle turbinate to open the sphenoid sinus. The posterior free body of the middle turbinate will be removed limitedly to open the posterior ethmoid sinus. To enter the sphenoid, we should use a suction tip or probe with gentle pressure 1-2cm above the upper edge of the posterior nasal choanal arch.

The experience is required in some degree to determine the location of sphenoid sinus ostium in the sphenoethmoidal recess. Approximately it will be located at the middle of the sphenoid face as its place not related to the extensive of the sinus disease. However, it is more related to the sphenoid pneumatisation type.[23] The superior and middle turbinate will be difficult to be identified in case of extensive disease due to the anatomical destruction in this area.[24]

After the removing of uncinate process the infundibulum will be exposed. Behind the intermediate attachment of the uncinate process the maxillary ostium will be seen in an oblique or horizontal plane. The widening can be done posteriorly or anteroinferiorly to expose the interior of the sinus with a 30◦ endoscope. The widening of the normal ostium should be in an anteroinferior direction on account the anterior fonteanelle to avoid the nasolacrimal duct injury that lies 5mm anteriorly. To get one large opening the normal ostium will be joined with the accessory ostium that may be appear in 25 per cent of the cases in the anterior and posterior fontanelle. If there is any difficulty to identify the normal ostium, it will be easier to inspect the maxillary sinus ostium quite above the inferior turbinate.[21]

The need to a wide antrostomy is may be required in case of extensive sinus disease or distorted anatomy due to previous surgery. After the making of a wide antrostomy, the surgeon will be able to locate the medial orbital floor along the horizontal bony ridge of the antrostomy, and the posterior maxillary sinus along the vertical bony ridge of the antrostomy.[24]

Current study has reviewed CT scans of paranasal sinuses in an attempt to find an unmistakable bony landmark which can help localize the natural ostium of sphenoid sinus and face of sphenoid bone reliably for FESS and pituitary surgery. The observations revealed that the average anterior-posterior distance from the posterior maxillary wall to the face of sphenoid was on the right side 7.1mm and on the left side 7.9mm, the average in both right and left respectively was 7.5mm. Gupta et al., found that the average distance from the supero-lateral angle of the posterior choana to the sphenoid ostium was 21.21±6.02 mm and the average distance of the sphenoid ostium from the midline was 4.85±2.89 mm. In 93.3 per cent of the specimens, the sphenoid ostium was situated between 5 and 6cm of the inferior end of the limen nasi.[11] Tamakloe et al., found that radiological assessment of paraclinoid area with the help of magnetic resonance imaging is helpful to avoid operative and post-operative complications of surgery in these difficult structures.[25]

Previously, the superior nasal turbinate has been considered a reliable and consistent anatomic marker for localization of the sphenoid sinus, especially, in revision surgeries where middle turbinate has been already removed.[26-29] However, the evaluation of distance between PMW and FOS on CT images in current study provides a reliable indicator of the depth of the face of sphenoid. Moreover, CT scanning is cheaper and easily available option as compared to MR imaging and the fact that the PMW is a relatively unmistakable and concrete landmark will make this a new useful tool for novice sinus surgeons and surgeons operating in difficult sinonasal cavities in future. Nonetheless, future studies using PMW as indicator of the depth of FOS will strengthen the idea floated by the current study.

Conclusion

The posterior maxillary sinus wall may act as a concrete and unmistakable bony landmark on CT scan to localize the face of sphenoid sinus for the sinus surgeons performing FESS and pituitary surgery.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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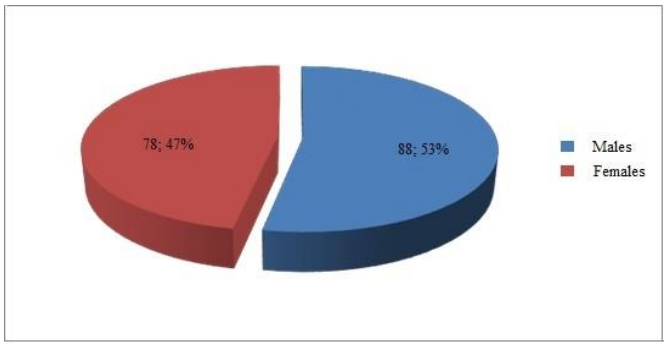
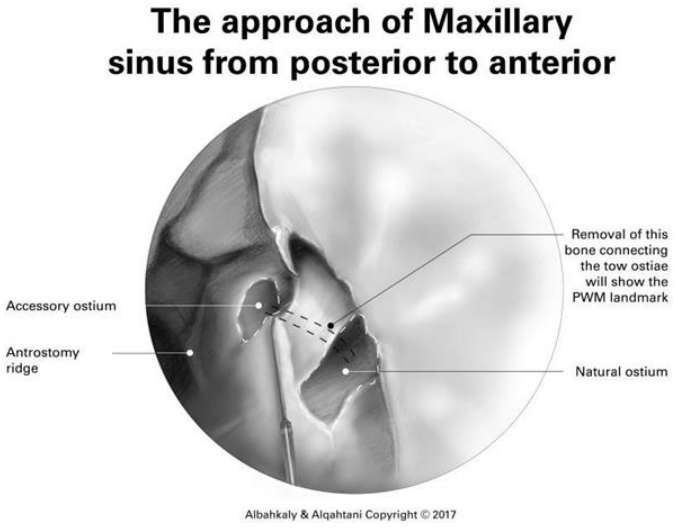
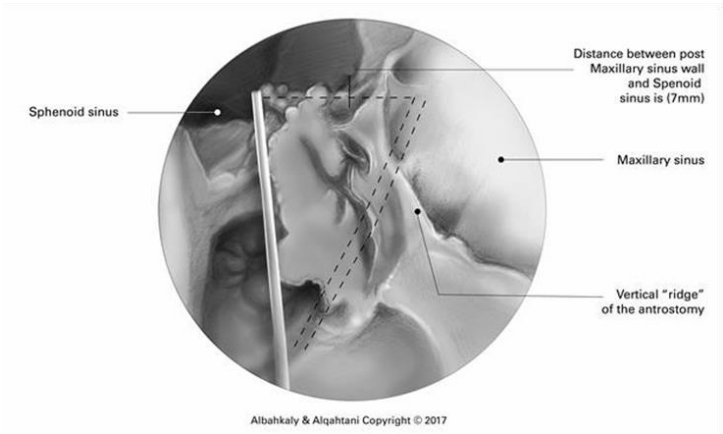
ETHICS COMMITTEE APPROVAL

KAIMRC

Figure 1: Gender distribution in study population







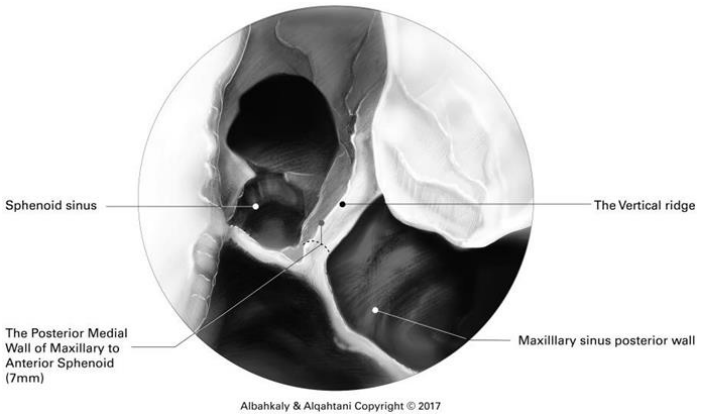


Table 1: Age analysis of the study population

Analysis variable: Age						
N	Mean	Std Dev	Minimum	Maximum	Lower 95% CI for Mean	Upper 95% CI for Mean
166	41.2	14.75	18	79	38.92	43.44