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Pneumatization of the Sphenoid Sinus: A Computed Tomographic Study

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Abstract
Aim: *The present study was done with a purpose to find out variations of sphenoid sinus and its related structure and compare these findings with other studies to note any racial differences among them.*
Material & Methods: *The study was conducted on 120 North Indian patients using 64 slice MDCT, with slice thickness of 0.625mm in the Department of Radiodiagnosis who were advised MDCT for various indications.*
Results: *Anterior clinoid process pneumatisation was seen in 20.83% cases, Greater wing of sphenoid pneumatisation was seen in 30.83% cases and Pneumatisation of the pterygoid process was observed in 42.5 % of the patients in our study.*
Conclusion: *A comprehensive knowledge of the variability of the pneumatisation of sphenoid sinus will undoubtedly reduce the surgical complications associated with transsphenoidal and functional endoscopic sinus surgery.*
Keywords: *Sphenoid sinus; transsphenoidal surgery.*

Introduction

The sphenoid sinus is deeply seated in the skull and is most inaccessible paranasal sinus.[1-4]It is in close association with vital structures, such as the internal carotid artery, optic nerve and cavernous sinus. The variability in the anatomy of the sphenoid sinus is well documented.[5,6] A comprehensive knowledge of the variable regional anatomy of the sphenoid sinus will undoubtedly reduce the surgical complications associated with trans sphenoidal and functional endoscopic sinus surgery.[1-4]

The advantage of the coronal sections of CT scan over the axial ones is that they show the progressively deeper structures as they are encountered by the surgeon during functional endoscopic sinus surgeries. Not only is the knowledge on the anatomic variations of the sphenoid sinus and its related structures important because the surgical complications may be avoided, but also such knowledge can help in explaining the unusual symptoms that arise from the sphenoid sinus disease.[7] In spite of the complex anatomy and important surgical

relationships of the sphenoid sinus, to our knowledge only a few relevant studies have been done in India especially in Northern part of our country.

Material and Methods

The study was conducted by the Department of Anatomy in collaboration with the Department of Radio-Diagnosis, Indira Gandhi Medical College, Shimla after the approval by the hospital ethics committee on 120 CT (PNS) scans using GE light speed 64 slice CT scanner in supine position with angulation parallel to the infraorbitomeatal line.

The subjects of 18 years and above were included. Pregnant or lactating women, Patients with known past history of significant allergic reaction to the contrast media, Patients with history of previous para nasal sinus surgery or intervention and Patients having carcinoma paranasal sinus or other pathology resulting in erosion and destruction of bone were excluded from the study. The images were acquired in the axial plane and then reconstructed in axial, coronal and sagittal plane. The images were reconstructed with 0.625 mm thickness and transferred to Advantage Window workstation. The reconstructed images were viewed in axial, sagittal and coronal planes.

The criteria for defining pneumatisation were according to as per Hewaidi et al.

1. Pneumatisation of the pterygoid process was recognised if it extended beyond the horizontal plane and crossed the vidian canal.
2. Greater wing of sphenoid pneumatisation was considered when it extended beyond the vertical plane and crossed the maxillary canal.

Results

In our study, patients in 18-20 years were5 (4.2%), 21-40 years' agegroup44 (36.7%), 41-60 years' group38 (31.7%), 61-80 years' group were 33 (27.5%), and commonest age group was between 21-40 years. Out of 120 patient 'smales were 71(59.2%) and females were 49(40.8%). Male preponderance was seen. In our study, anterior clinoid process pneumatisation was seen in 21.7% patients, it was 6.7% unilateral in both right and left side and was bilateral in 8.3% patients (Fig. 1).Greater wing of Sphenoid was pneumatised in 30.8% patients; it was bilaterally pneumatised in 18.3% patients. It was pneumatised in 8.3% patients on the right and 4.2% patients on left side. had Pterygoid Processes was pneumatised in 42.5% patients. 20.8% had bilaterally pneumatised Pterygoid Process (Fig. 2). 12.5 % on right and 9.2% on left side had pneumatised Pterygoid Process.

Table 1 Prevalence of Pneumatisation

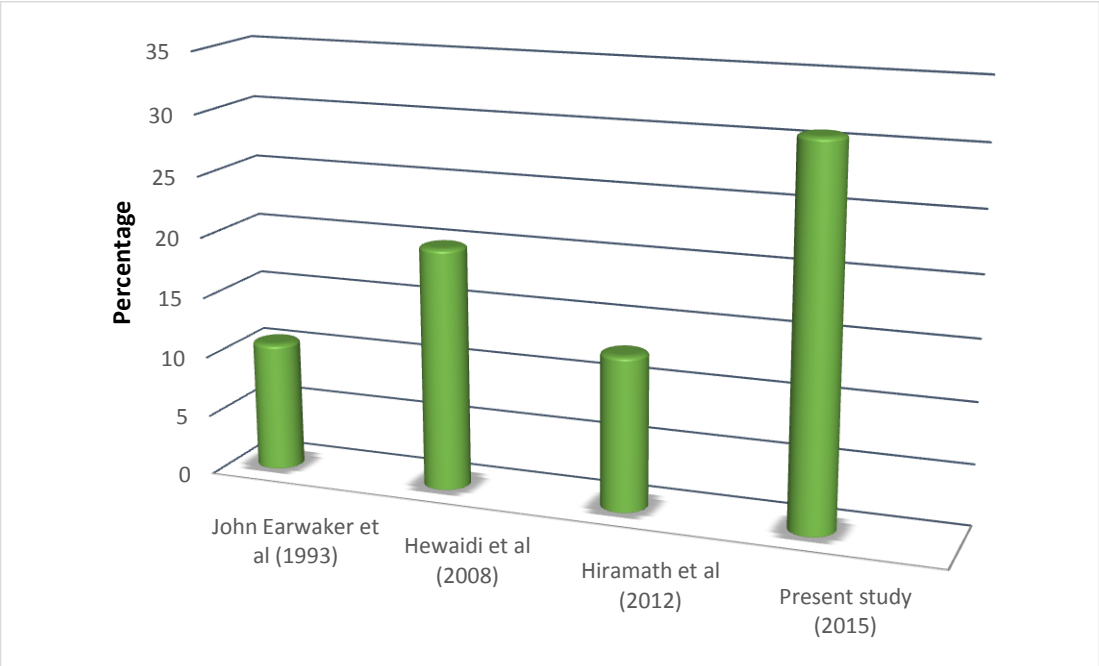
	Bilateral	Right	Left	Total
Anterior Clinoid Process	8.3	6.7	6.7	21.7
Greater Wing of Sphenoid	18.3	8.3	4.2	30.83
Pterygoid Process	20.8	12.5	9.2	42.5

Table 2 Comparison of pneumatisation of Anterior Clinoid process

Authors	Sample size	CT scan slice thickness (mm)	Pneumatisation of Ant. Clinoid process (%)
Bolger et al[8] (1991)	202	3	13
De Lano et al[9](1996)	150	4	4
Sirikci et al[10](1999)	92	2.5	2.3
Birsen et al[11](2006)	260	3	24.1
Present study	120	0.625	20.83

Table 3 Comparison of pneumatisation of Pterygoid process

Authors	Sample size	CT scan slice thickness (mm)	Pneumatisation of pterygoid process (%)
Bolger et al[8] (1991)	202	3	43.6
Sirikci et al[10](1999)	92	2.5	29.3
Hewaidi et al[13] (2008)	300	3	29
Hiremathei al[16] (2012)	400	3	31
Present study	120	0.625	42.5



Graph 1 Comparison of pneumatisation of Greater wing of sphenoid.

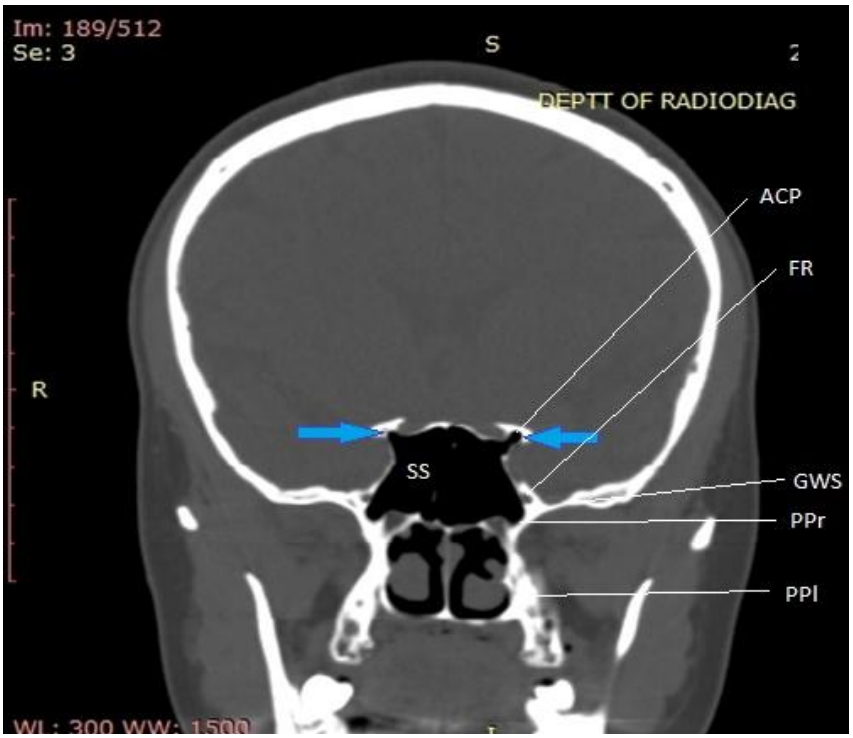


Fig. 1 Bilateral pneumatisation of Anterior clinoid process.

(ACP- Anterior clinoid process, FR- Foramen rotundum, GWS-Greater wing of sphenoid, PPr-Pterygoid process, PPl-Pterygoid plates, SS-Sphenoid sinus)

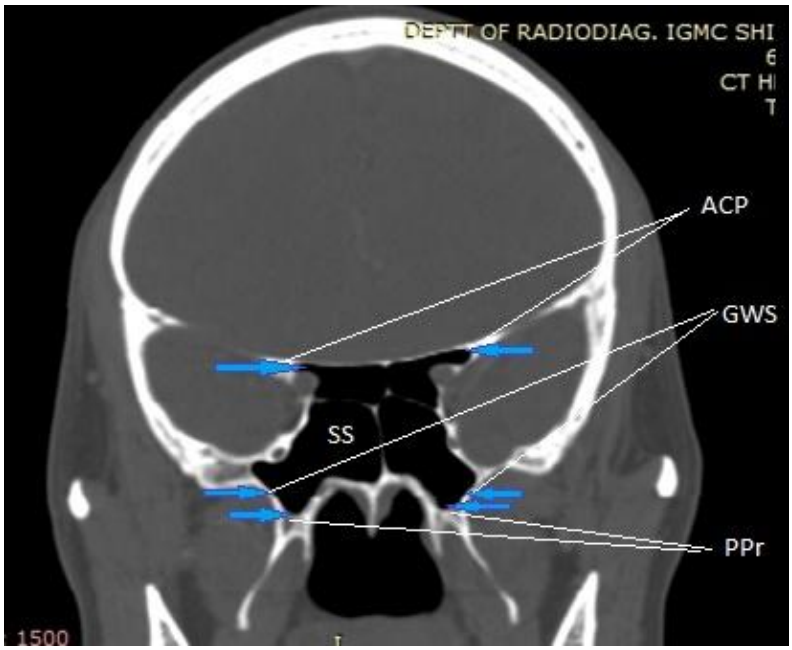


Fig. 2: Bilateral pneumatisation of Anterior clinoid process, Greater wing of sphenoid and pterygoid process.
(ACP- Anterior clinoid process, GWS-Greater wing of sphenoid, SS-Sphenoid sinus, PPr-Pterygoid process)

Discussion

Not only is the knowledge on the anatomic variations of the sphenoid sinus and its related structures important because the surgical complications may be avoided, but also such knowledge can help in explaining the unusual symptoms that arise from the sphenoid sinus disease.

1a. Anterior Clinoid Process

In the literature, the prevalence of anterior clinoid process pneumatisation is well documented. In our study, anterior clinoid process pneumatisation was seen in 20.83%. In the study by Bolger et al, anterior clinoid process pneumatisation was seen in 13% of 202 paranasal sinus CT scans.[8]But these authors reviewed coronal sinus CT scans with a slice thickness of 3 mm. De Lano et al in his study, reviewed 150 paranasal sinus CT scans, he observed 4% of anterior clinoid process pneumatisation.[9] And these CT scans included only coronal images obtained at a slice thickness of 4 mm.

In the study by Sirikci et al, anterior clinoid process pneumatisation was seen in 2.3% of 92 paranasal sinus coronal CT scans studied at 2.5 mm slice thickness.[10] In the study by Birsen etal, pneumatisation of anterior clinoid process was seen in 24.1% of 260 patients, forwhom coronal sinonasal CT cuts were obtained at 3 mm slice thickness.[11]

The reported prevalence rates vary considerably. It can be due to geographical and racial differences among the studied populations; or it can be due to use of thin CT scan sections, that are substantially more precise. In our study we have used helical thickness of 0.625 mm.

Thus, the previous reports of prevalence of anterior clinoid process pneumatisation based on thick-cut CT scan which might had underestimated the prevalence of this anatomic variant. Pneumatisation of anterior clinoid process forms recess in lateral wall, optico-carotid recess, which is the recess between the optic canal superiorly, and the carotid prominence inferiorly. The optico-carotid recess is more prominent in presence of ipsilateral optic nerve and or internal carotid artery protrusion into the sphenoid sinus. We also observed these findings in our study as well.

In studies by Sirikci et al and Birsen et al, they found a statistically significant relationship between the pneumatisation of anterior clinoid process and the protrusion of optic nerve,[10,11]inpresence of hypertrophic mucosa or

presence of polyps in the sphenoid sinus, optic nerve and internal carotid artery protrusion may not be clearly distinguished by aroutine sinus CT scan. By radiological experience, carefully tracing the course of theoptic nerve and internal carotid artery seems to underestimate the presence of protrusion. Therefore, as a rule, ipsilateral anterior clinoid process pneumatisation is agood indicator of nerve and internal carotid artery protrusion.

1b. Greater Wing of Sphenoid

In a study by John Earwaker pneumatisation of greater wing of sphenoid wasseen in 10.7% of patients.[12] In a study by Hewaidi et al[13] 20% patients had pneumatisation of greater wing of sphenoid, whereas in a study by Hiremath et al,[9] pneumatisation of greater wing of sphenoid was seen in12.75% of the patients. In our study, pneumatisation of greater wing of sphenoidwas seen in 30.83%.

The difference in the percentage of patients having pneumatisation in greater wing of sphenoid in our patients and studies quoted above can be due to the different criteria used by the different authors as well as the differences due to geographical and racial variations.

In presence of pneumatisation of the floor of the middle cranial fossa, where greater wing of sphenoid forms anterior wall of middle cranial fossa and in the presence of ara chnoid granulations along its inner surface, these granulations forms "pit-holes" in the floor of the middle cranial fossa, which themselves are not pathologic, but enlargement of these pits has been casually implicated in the development of non-traumatic cerebrospinal leaks.[14]

1c. Pneumatisation of the Pterygoid Process

Pneumatisation of pterygoid process thins the bony floor of the scaphoid fossa, producing an intimate relation between the sinus and the auditory tube. In presence of pterygoid process pneumatisation, access to the central skull base can be an important pathway. For instance, extended transnasal endoscopic approaches may reach the pterygoid process through the medial part of the posterior maxillary wall. Thus, provide an important route for endoscopic repair of cerebrospinal fluid leaks and endoscopic biopsy of skull base lesions. And thus this information is important in preoperative planning for skull base surgery.[13]

In our study, pneumatised pterygoid process was in 42.5% of the patients. In the study by Bolger et al, pterygoid process pneumatisation was seen in 43.6% of patients,[8] but they had not explained their criteria.

In the study by Sirikciet al,[15] pneumatisation of the pterygoid process was reported in 29.3%. Sirikci et al defined pterygoid process pneumatisation, if it extended beyond a plane tangential to the most inferolateral aspect of the maxillary division of the trigeminal and vidian nerves. The difference in the results in our study and study by Sirikci et al can be due to different criterion used to define pneumatisation of the pterygoid process.

In a study by Hiremath etal,[16] 31% patients showed the pneumatisation of the pterygoid process whereas Hewaidi GH et al[13] identified pterygoid process pneumatisation in 29% of the patients. Though we had also used the same criteria for pneumatisation of pterygoid process as by Hewaidi et al and Hiremath et al, but the difference can be due to the geological and race variation

Conclusion

A comprehensive knowledge of the variability of the pneumatisation of sphenoid sinus will undoubtedly reduce the surgical complications associated with transsphenoidal and functional endoscopic sinus surgery.

Conflict of Interest

Authors have none to declare

Bibliography

1. Janskowkia R, Auque J, Simonc. Endoscopic pituitary tumour surgery. Laryngoscope 1992; 102: 198-202.

2. Stankiewicz J. Complications of endoscopic nasal surgery occurrences and Treatment. Am J Rhinol 1987; 1: 45-49.
3. Buus D, Tse A, Farris B. Ophthalmic complications of sinus surgery. Ophthalmology 1990; 97: 612-621.
4. Cappabianca P, Cavalloa CC. Endoscopic endonasal trans sphenoidal approach: outcome analysis of 100 consecutive procedures. Minim InvasNeurosurg 2002; 45: 193-200.
5. Cheung D, Attia E, Kirkpatrick D. An anatomic and CT scan study of the lateral wall of the sphenoid sinus as related to the transnasaltransethmoid endoscopic approach. J Otolaryngol 1993; 22: 63-68.
6. Mafee M, Chow J, Meyers R. Functional endoscopic sinus surgery: anatomy, CT screening indications and complications. Am J Roentgenol 1993; 160: 735-744.
7. Standring S, Ellis H, Healy CH, Johnson D, Williams A, Collins P, et al editor(s). Gray's Anatomy. The Anatomical Basis of Clinical Practice. 40th ed. London: Elsevier Churchill Livingstone; 2013: 527-530.
8. Bolger WE, Butzin LA, Pardsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. Laryngoscope 1991; 101: 56-64.
9. Delano M, Fun F, Zinrich S. Relationship of the optic nerve to the posterior paranasal sinuses act anatomy study. Am J Neuroradiol 1996; 17: 669-675.
10. Sirikci A, Bayazit YA, Bayram M, et al. Variations of sphenoid sinus and related structures. EurRadiol 2000; 10: 844-848.
11. Birsen U, Gulsah B, Yasemin K. The risky anatomic variations of the sphenoid sinus for surgery. Surg Radio Anat2006; 28: 195-201.
12. Earwaker J. Anatomic variants in sinonasal CT. Radiographics 1993; 13: 381-415.
13. Hewaidi G, Omani G, anatomic variation of sphenoid sinus and related structures in Libyan production: CT scan study. Libyan J Med 2008; 3(3): 128-133.
14. Lauri C, Carter LC, Pfaffenbach A, et al. Hyperaeration of the sphenoid sinus: cause for concern? Oral Surg Oral Med Oral Pathol Oral RadiolEndod 1999; 88: 506-510.