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Morphometry of sphenoid bone

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Abstract

The sphenoid bone is unpaired bone that forms the part of middle cranial fossa and the base of the skull and also extends into the lateral wall of the skull and the orbit. It is also known as Wasp bone and resembles a bat having a centrally placed body and greater and lesser wings that are outstretched on each side. The morphometry of sphenoid bone is important clinically as it is related to numerous neural and vascular structures and has the most inaccessible paranasal sinus, the Sphenoidal Air Sinus, which is related to vital structures like optic nerve, internal carotid artery etc. Also, the central part of the sphenoid bone lodges the important Pituitary Gland. So, the study of sphenoid bone is important in skull based surgery.

Keywords: Morphometry, Pituitary Gland, Sphenoid, Sphenoidal Air Sinus

Introduction

The word Sphenoid is derived from Greek word Sphen which means 'a wedge'. It is named so as it is wedged between the Frontal Bone in front and Occipital Bone behind. It is shaped like Butterfly or a Bat. Sphenoid is unpaired and forms the middle cranial fossa and the base of the skull. It is one of the twenty-two bones, that form the skull, which connects the brain with the facial skeleton. It has many fissures and foramina which allow the entry and exit of nerves and vessels to and from the cranial cavity.[1] Sphenoid is placed in the middle of the base of the skull and joins with 12 bones, among them Vomer, Ethmoid, Frontal, Occipital being the single bones and Parietal, Temporal, Zygomatic and Palatine being the paired bones.[2]

Structure and Function

Structure: Sphenoid bone has a body, which is placed centrally, paired greater and lesser wings, which project laterally from the body, and Pterygoid processes, which project downward.[3] The body, greater wings and pterygoid processes are seen in the base of the skull but the lesser wing is not visible. The body of the sphenoid contains the sphenoidal air sinuses[4] and articulates anteriorly with the vomer, ethmoid, and palatine bones, posterolaterally with the temporal bones, and posteriorly with the occipital bone.[3] The cavernous sinus is directly related to the side of the body of the sphenoid.[4] Pterygoid processes extend downward from the junction of the body and the greater wings and consist of medial and lateral plate, separated by the pterygoid fossa. Greater wings of Sphenoid lie lateral to

the lateral plate of the pterygoid process and forms base as well as lateral wall of the skull.[3] The lesser wings of sphenoid protrude laterally from the anterosuperior regions of the body and is connected to the body by anterior and posterior roots, between which lies the optic canal.[5] The medial end of the lesser wing forms the anterior clinoid process. The upper surface of the sphenoid bone forms the sella turcica, which is made up of hypophyseal fossa (a small depression that lodges the Pituitary Gland). Sella Turcica is surrounded by two anterior clinoid processes anteriorly and two posterior clinoid processes posteriorly, which give attachment to the tentorium cerebelli.

Function: The primary function of the Sphenoid bone is to form the base and the sides of the skull and also contribution to the formation of facial skeleton. The central portion of sphenoid also provides rigidity, thereby protecting the brain, nerves and the blood vessels present there. The foramina and the fissures of the sphenoid bone allow passage of important nerves and vessels in and out of the skull. The cavity present in the body of the sphenoid bone, i.e. the Sphenoid Sinus, connects the nasal cavity, helping the skull to be lighter and improves the voice resonance.

Muscle Attachments

The muscles of Mastication, i.e. temporalis, lateral and medial pterygoid muscle, are attached to the temporal surface of the greater wing of sphenoid and to the medial and lateral surface of the lateral pterygoid plate. The medial division of the pterygoid process, called the medial plate, serves as a site of attachment to the superior pharyngeal constrictor muscle. [1]

Ligaments

There are present partially or completely ossified ligaments between the anterior and middle clinoid processes, the anterior and posterior clinoid processes, the middle and posterior clinoid processes and between the petrous bone and posterior clinoid process; namely the caroticoclinoid bar, the anterior interclinoid bar, the posterior interclinoid bar and the posterior petroclinoid bar.[6]

Fissures and Foraminas[4]

The sphenoid bone has many openings and fissures, to allow entry and exit of several nerves and blood vessels, in and out of the cranial cavity. The optic canal transmits the optic nerve and the ophthalmic artery. The superior orbital fissure transmits the lacrimal, frontal, trochlear, oculomotor, nasociliary, and abducent nerves, superior ophthalmic vein. The foramen rotundum transmits the maxillary nerve. The foramen ovale transmits the mandibular nerve. The foramen spinosum transmits the middle meningeal artery. The foramen lacerum lies between the petrous part of the temporal bone and the sphenoid bone. The carotid canal transmits the internal carotid artery.

Sphenoidal Air Sinuses

Sphenoidal air sinuses lie in the body of the sphenoid and communicate with the nasal cavity. They are irregular pneumatic spaces lined with mucous membrane and act as voice resonators. The sphenoid sinuses are the most inaccessible paranasal sinuses. , as they are deep seated and bordered by more vital structures than any other sinus.[7] Their pneumatization ranges from absent to extensive.[8] Computerized tomography is the most précise imaging technique to demonstrate paranasal sinuses. [8] With the expanding role of endoscopic sinus surgery, proper understanding of the anatomy of the sphenoid sinuses has become increasingly important.[7]

Development

Until the 7th or 8th month in utero, the sphenoid bone has a pre sphenoidal part, anterior to tuberculum sella, with which the lesser wings are continuous, and a post sphenoidal part, consisting of the sella turcica and dorsum sellae, and integral with the greater wings and pterygoid processes. Much of the bone is preformed in the cartilage. There are six ossification centres for the presphenoidal part and eight for the postsphenoidal part.[5] The body of the sphenoid develops from four symmetrically placed bony nuclei, two pre-sphenoidal centres in front and two post-sphenoidal centres behind. The cartilage between the pre- and post-sphenoidal portions disappears wither shortly before or soon after birth.[9] The body and lesser wings of the sphenoid bone mature through classic endochondral ossification, whereas the pterygoid processes undergo intramembranous ossification.

The development of the greater wings of the sphenoid bone is exceptional since they are the only bony structures of the skull which go through both endochondral and intramembranous ossification.[10]

Anatomical Variations [11]

There can be a number of congenital variations in the anatomy of Sphenoid Bone. These can be divided into pneumatization (the presence of holes in the bones) and protrusion (extension of the bone), and include the following.

1. Pterygoid process pneumatization
2. Anterior clinoid process pneumatisation
3. Foramen rotundum protrusion
4. Internal carotid artery (ICA) protrusion
5. Pterygoid canal protrusion

Clinical

Sphenoid Sinusitis: Infection of the sphenoid sinuses can lead to acute and chronic sinusitis. The symptoms include fever, weakness, post-nasal drip.[1] The spread of inflammation and/or infection from the sphenoid sinus to the orbit and cavernous sinus causes 5 distinct clinical entities: (1) preseptal cellulitis, (2) orbital cellulitis, (3) subperiosteal abscess, (4) orbital abscess, and (5) cavernous sinus thrombosis. [12] If not treated, it can lead to complications like meningitis, brain abscess and cranial nerve involvement.

Sphenoid Fractures: Fracture of the sphenoid bone occur in cases of trauma of the orbit or the base of the skull.[1] When the sphenoid bone is fractured, it can cause laceration of the optic nerve leading to blindness. There can be damage to the nerves and rupturing of the muscles. The sphenoid sinuses between the eyes can become damaged and can fill with blood. Sphenoid bone injuries are highly associated with damage to other tissues which include damage to the internal carotid artery, which could lead to stroke. It might be related to leakage of cerebrospinal fluid through the nose (cerebrospinal fluid rhinorrhea). There can a syndrome known as the superior orbital fissure syndrome. A few patients might face damage to their brain structures such that they suffer from post-traumatic diabetes insipidus.[13] Battle sign (a bruise on the face that's a sign of skull fracture), hemotympanum (blood in the middle ear), and/or cranial nerve palsy (decreased or complete loss of cranial nerve function) are all signs of this condition, which is considered a medical emergency.[11]

1. Congenital Sphenoid Wing Dysplasia

It is one of the major diagnostic criteria for neurofibromatosis type 1. It manifests as defects of

greater or lesser wings of the sphenoid bone and the sequelae include slow expansion of the orbit and middle cranial fossa; ultimately with progressive herniation of the temporal lobe into the posterior orbit resulting in pulsatile proptosis.[14]

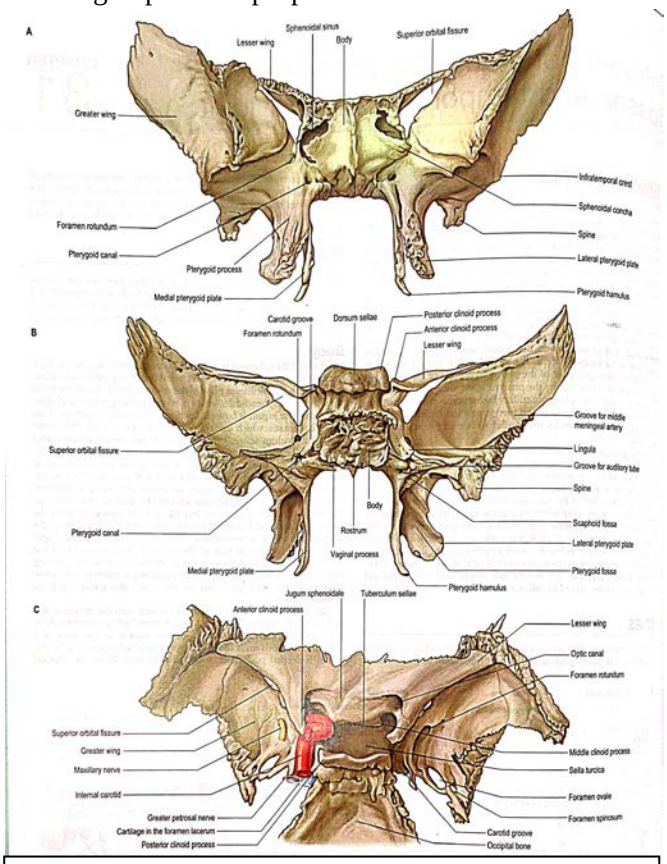

Fig.1[5]

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