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Morphometric Analysis of Locations, Shape and Variations of Spine of Sphenoid and its Clinical Importance

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ABSTRACT

The sphenoid bone is the unpaired bone in the cranium.It is present in the middle of the skull and it is an important surgical site. It is butterfly shaped with wings on either side that includes a greater wing and lesser wing of sphenoid. It has various attachments and foramina associated with it.The posterior part of greater wing projects like a triangular process called as sphenoidal spine which is the origin for sphenomandibular ligament.The aim is to study the morphometry of the location, shape, and variations of the spine of sphenoid and its clinical importance in different skulls of the south indian population.For this 30 adult dry human skulls of unknown sex of south indian origin were obtained from the Department of Anatomy, Saveetha Dental College, Chennai, Tamilnadu, India. All skulls were serially numbered from 1 to 30. In each skull, the shape of the spine of the sphenoid was observed and recorded. The distance of the spine from the tip of mastoid process and tip of the articular tubercle were measured on both the right and left sides of the skull using digital Vernier calipers. All data were tabulated and statistically analysed.The range of distance between the spine of sphenoid and the articular tubercle is found to be about 20.17-29.32mm(left) and 20.16-29.19mm(right) and the distance between the spine of the sphenoid and the mastoid process is found to be around 29.17-32.7mm(left) and 29.27-32.79mm(right). It is found that about 6.6% of spine is sharp, 46.6% is rounded in both left and right side, 26.6% is blunt on left side and 23.3% on the right side and about 20% on left and 23.3% on the right side were pointed type. The purpose of this study is to verify the morphometric variations in the location, shape of spine of sphenoid in different dry skulls of south indian and to find out its applications in various surgical procedures.

KEY WORDS: SPINE OF SPHENOID, MASTOID PROCESS, ARTICULAR TUBERCLE, SHAPE OF SPINE OF SPHENOID.

INTRODUCTION

The sphenoid bone is one of the eight bones that are present in the cranium. The sphenoid bone is a complex structure with a complicated embryologic origin. It is centrally located within the base of the skull and articulates with almost every bone in the skull and face. The sphenoid bone contains multiple foramina that includes foramen rotundum, foramen ovale, foramen spinosum, Canaliculus innominatus, emissary sphenoidal foramen and fissures accommodating numerous vessels and nerves (Kuta, John Kuta and Laine, 1993). It is an unpaired pneumatic bone located at the skull base and it is placed between the frontal and ethmoid bones in front basi occiput and petrous part of temporal bone behind and the squamous part of temporal bone on each side and it is butterfly shaped with two wings on either

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sides. Sphenoid bone has both intramembranous and endochondral ossification. Sphenoid bone has a body, a pair of lesser wings, greater wings and pterygoid processes (Yanagi, 1987).

Sphenoid bone has many important foramina in which foramen ovale is one among the largest openings in the skull that transmits nerves through it (Nivethitha, Yuvaraj Babu and Mohanraj, 2018). It transmits various structures like mandibular nerve, emissary vein, accessory middle meningeal artery and lesser petrosal nerve (Kuta, John Kuta and Laine, 1993; Murugan and Saheb, 2014). Sphenoid bone is non pneumatized and contains only red marrow at birth. The sphenoidal air sinus is located at the base of the skull. Many complicated anatomical structures are related to this sinus, like the cavernous sinus, pituitary gland, optic nerve and chiasma, internal carotid artery, pterygoid canal, pterygopalatine ganglion and, sphenopalatine artery. The symptoms are referred to these structures rather than involving the sinus (Wyllie, Kern and Djalilian, 1973), because of its deep-seated anatomy, this sinus does not usually present with nasal symptoms such as nasal obstruction or rhinorrhea (Fooanant et al., 2017)(Yune, Holden and Smith, 1975). The sinus shows variations in size, pneumatization, the pattern of septations. The pneumatization can extend into the greater wing of sphenoid, pterygoid process, clivus (Hewaidi and Omami, 2008).

Spine of the sphenoid bone is a small pointed projection which projects downward from the junction of posterior and squamosal borders of the greater wing. The spine has the following attachments that includes three ligaments, two muscles and the spine is related to important structures on its medial and lateral sides. The three ligaments includes Sphenomandibular, anterior ligament of malleus, pterygospinous and the muscles includes tensor veli palatini, tensor tympani it is related to other important structures which includes chorda tympani nerve and auditory tube, medially and auriculotemporal nerve laterally (Agarwal, Agarwal and Pant, 2018). The anterior ligament of the malleus and the spheno-mandibular ligament are attached to the intervening spine of sphenoid, it may be conjectured that this spine also develops from the Meckel's cartilage the pull of these two ligaments in different directions may lead to different lengths and shapes of spine that can lead to pressure on the important anatomical structures related to both sides of the spine.

With a rich case bank established over 3 decades we have been able to publish extensively in our domain (Abdul Wahab et al., 2017; Eapen, Baig and Avinash, 2017; Patil et al., 2017; Jain and Nazar, 2018; J et al., 2018; Marimuthu et al., 2018; Wahab et al., 2018; Abhinav et al., 2019; Ramadorai, Ravi and Narayanan, 2019; Senthil Kumar et al., 2019; Sweta, Abhinav and Ramesh, 2019). The present study focuses on the morphometric study of shape and location spine of the sphenoid bone from standard anatomical landmarks.

MATERIAL AND METHODS

30 adult dry human skulls of unknown sex of south indian origin were obtained from the Department of Anatomy, Saveetha Dental College, Chennai, Tamilnadu, India. All skulls were serially numbered from 1 to 30.In each skull, the shape of the spine of the sphenoid was observed and recorded. The distance of the spine from the tip of the mastoid process (Figure 1) and tip of the articular tubercle were measured on both right and left sides of the skull using digital Vernier calipers. All data were tabulated and statistically analysed.

Figure 1: Measurement of Distance of Spine of sphenoid from tip of mastoid process

RESULTS AND DISCUSSION

The range of distance between the spine of sphenoid and the articular tubercle is found to be about 20.17-29.32mm(left) and 20.16-29.19mm(right) and the average value and standard deviation for the distance between spine of sphenoid and articular tubercle is about 22.13±2.12 mm on left and 22.07±2.12 mm on right side. The range of distance between the spine of the sphenoid and the mastoid process is found to be around 29.17-32.7mm(left) and 29.27-32.79mm(right) and it was quite distant when compared to articular tubercle and the average and standard deviation is 30.66±1.12 mm on left and 30.56±1.10 mm on right side (Table 1).

The shape of the spine of the sphenoid is tabulated in (table 2). From the obtained data it is found that about 6.6% of the spine is sharp, 46.6% is rounded in both the sides, 26.6% on the left side and 23.3% on the right side are blunt shaped and about 20% on the left and 23.3% on the right side was pointed.

Spine of sphenoid attachment, its location, shape, variations and its clinical importance should be very well known for surgeries from cranial aspect. There were limited information about spine of sphenoid in many articles hence we took interest and in nearly 30 skulls were measured with the distances from articular tubercle and mastoid process were measured from both right and left sides .Its shape was also counted in 30

skulls and was converted into percentage and tabulated. While in a study by Gargs , as there is scarcity of data on the length, shape and direction of spine of sphenoid and to study the variations in shape of the spine as any variations can lead to the compression of the nerves and structures related to it. Garg measured Sixty-six areas of thirty-three dry skulls and the length, shape, direction of the spine was noted (Garg, 2006).

Table 1. Range and average distance of spine of sphenoid from articular tubercle and tip of mastoid process on right and left side

Distance between spine of sphenoid and	LEFT		RIGHT	
	Range(mm)	Average (mm)	Range(mm)	Average (mm)
Articular tubercle	20.17-29.32	22.132.12	20.16-29.19	22.072.12
Mastoid process	29.17-32.7	30.661.12	29.27-32.79	30.561.10

Table 2. Different shape of spine of sphenoid in percentage on right and left side

Shapes	Left	Right
Sharp	6.6%	6.6%
Rounded	46.6%	46.6%
Blunt	26.6%	23.3%
Pointed	20.0%	23.3%

The length of the spine of the sphenoid varied from absence or minimally projecting spine, to a long spine. The shape of the spine of the sphenoid varied from a pointed or rounded structure to a broad plate of bone. The spine was positioned downward but the tilt was in every direction. In Our study the majority of the spine evaluated were rounded 46.6%, followed by blunt spine 26.6%, Pointed spine 20% and 6.6% of the spines were sharp. We were not able to find articles trying to locate the position of spine from anatomical landmarks, so our study was conducted to locate the spine of sphenoid from the articular tubercle and mastoid process on the right and left side. There was no statistical significance in between right and left sides. The sphenoid was located at a distance 22.10 +2.12mm from articular tubercle and 30.61 + 1.11mm from mastoid process.

CONCLUSION

This study helps to determine the location, shape and variations of the spine of sphenoid bone in relation to various anatomical structures like articular tubercle, mastoid process. The landmarks described could be identified and applied in various clinical scenarios thereby decreasing the risk of failures and complications during treatment. Our research provides morphometric data of the sphenoid's spine, its location and shape which could be valuable for surgeons to plan for the cranial base surgeries.

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