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Neuroanatomical Study

Microsurgical anatomy of the sphenoid ostia

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ABSTRACT

We aimed to determine the position, number and variability of the sphenoid sinus ostia. A total of 32 dry skulls were examined under $\times 6$ magnification. The septum and nasal turbinates were removed to expose the anterior wall of the sphenoid sinus. A caliper was used for measurements. We found 2 ostia per skull, except for one (3%), in which the left ostium was absent. The inferior edges of both ostia were found at the same height in only four skulls (12.5%), and the superior edges of both ostia were found at the same height in only one skull (3%). Thus, in 27 skulls (84%) the lower and upper margins of both ostia were at different levels. The distance from the internal edge of the right ostium to the midline was 2.04 mm on average (range: 0.3–5.3 mm). The distance from the internal edge of the left ostium to the midline was 2.18 mm on average (range: 0.2 to 5.1 mm). In most skulls, the sphenoid ostia are located at different heights on each side; also a great variability in the distance from the internal border of the ostia to the midline was found. We found this anatomical knowledge useful when performing a transsphenoidal approach to the sella turcica.

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1. Introduction

The sphenoid bone is situated centrally at the base of the skull. The body of the sphenoid bone is pneumatized to form the sphenoid air sinus. The sphenoid sinus communicates with the posterior aspect of both nostrils through the so-called sphenoid ostia, the two holes located at each side of the midline. Since the sphenoid sinus separates the pituitary gland from the nasal cavity,^{1,2} and the pituitary fossa is separated from the sphenoid sinus only by a thin layer of bone (the floor of the sella turcica), the transsphenoidal approach is the most commonly used surgical route to sellar tumors.³

When performing a transsphenoidal approach and before entering the sphenoid sinus, the surgeon should check the following: (i) that the trajectory is located at or very near to the midline, and (ii) that the trajectory is located at the level of the sella turcica (rather than at the level of the anterior fossa or the clivus). Thus, the surgeon will rely on both sphenoid ostia for orientation. The first author (AC), after performing more than 100 transsphenoidal approaches,⁴ noticed that the left ostium is generally not on the same horizontal plane as the right ostium; in addition, he noted that

although both ostia are often close to the midline, sometimes they are several millimeters away from the midline (Fig. 1).

Many anatomical studies have been performed on the sphenoid sinus and the sphenoid ostia, reporting variable measurements.^{1,2,5–13} To our knowledge, however, none of these anatomical studies has focused on the location of the left ostia compared to the right, or on the location of the ostia relative to the midline. In the present study we attempt to establish the variability of the sphenoid sinus ostia.

2. Materials and methods

We studied 32 dry skulls from adult cadaveric heads. The bone septum and superior, middle and inferior turbinates were excised to reach the anterior aspect of the sphenoid sinus. For measurements, a $\times 6$ magnification microscope (Carl Zeiss, Berlin, Germany) and a caliper (Draper; Tokyo, Japan) were used (Table 1).

3. Results

Of a total of 32 skulls, two ostia per skull were found in 31 (97%), with an absent left ostium (3%) found in only one skull (Fig. 2). Only four skulls (12.5%) had the lower margins of both ostia at the same level (Fig. 3A). In only one skull (3%), the upper margins of both ostia were found at the same level (Fig. 3B). Thus,

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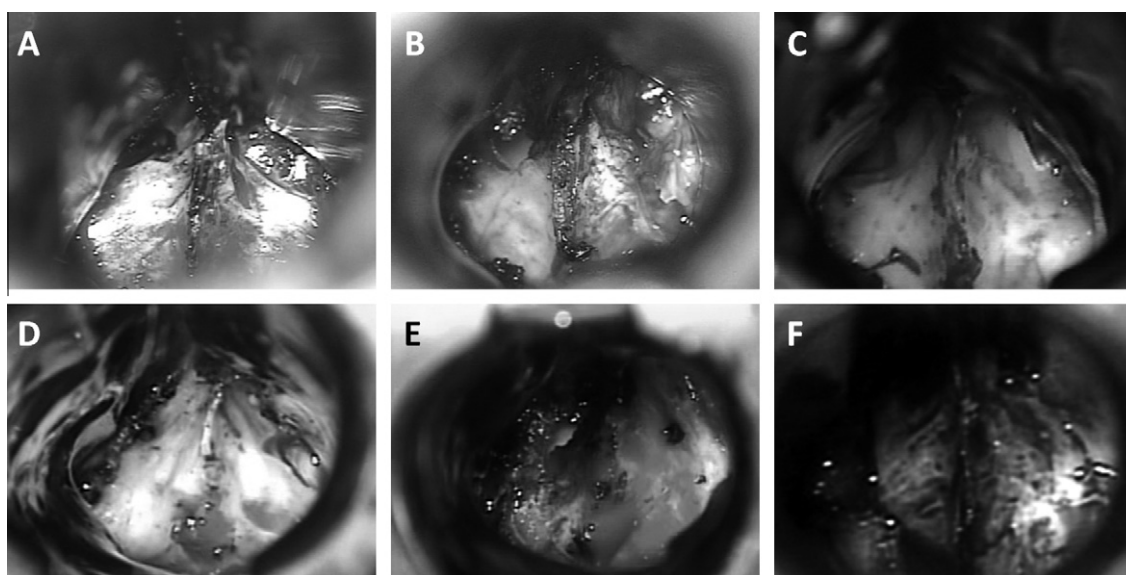


Fig. 1. Surgical photographs showing the great variability of the position of both sphenoid ostia: (A) large left ostium, small right ostium; (B) ostia at different levels; (C) left small ostium far away from midline, right large ostium near midline; (D) ostia at different levels; (E) left ostium is absent; (F) both ostia apparently absent (probably because both ostia are positioned very lateral).

Table 1
Measurements of the sphenoid ostia obtained from cadaveric dissections

Measurements	Average (mm)	Range (mm)
Height difference at inferior border of ostia	1.06	0–3.7
Height difference at superior border of ostia	1.14	0–4.9
Distance from right ostium to the midline	2.04	0.3–5.3
Distance from left ostium to the midline	2.18	0.2–5.1
Major diameter, right ostium	5.61	2–8.9
Minor diameter, right ostium	3.1	1.1–5.7
Major diameter, left ostium	5.63	2–8.92
Minor diameter, left ostium	3.15	1.5–5

27 skulls (84%) had the lower and upper margins of both ostia at different levels (Fig. 3C). The height difference at the level of the lower margin in both ostia averaged 1.06 mm (range: 0–3.7 mm). The height difference at the level of the upper margin in both ostia averaged 1.14 mm (range: 0–4.9 mm). On average, the distance from the inner margin of the right ostium to the midline was 2.04 mm (range: 0.3–5.3 mm), and the distance from the inner margin of the left ostium to the midline was 2.18 mm (range: 0.2–5.1 mm). This shows the great variability seen in the location of the ostia in relation to the midline; in some skulls, the ostia were located far away from the midline (Fig. 4A), but, in others, both ostia were practically abutting (Fig. 4B). The largest diameter of the right ostium averaged 5.61 mm, with a range of 2 mm to 8.9 mm. The largest diameter of the left ostium averaged 5.63 mm, with a range of 2 mm to 8.92 mm. The smallest diameter of the right ostium averaged 3.1 mm, with a range of 1.1 mm to 5.7 mm. The smallest diameter of the left ostium averaged 3.15 mm, with a range of 1.5 mm to 5 mm.

4. Discussion

The location of both ostia of the sphenoid air sinus has implications for the transsphenoidal approach, regardless of whether a microscope^{3,4,14–17} and/or an endoscope is used.^{5,18–24} The ostia are located in the vertical axis approximately at the level of the

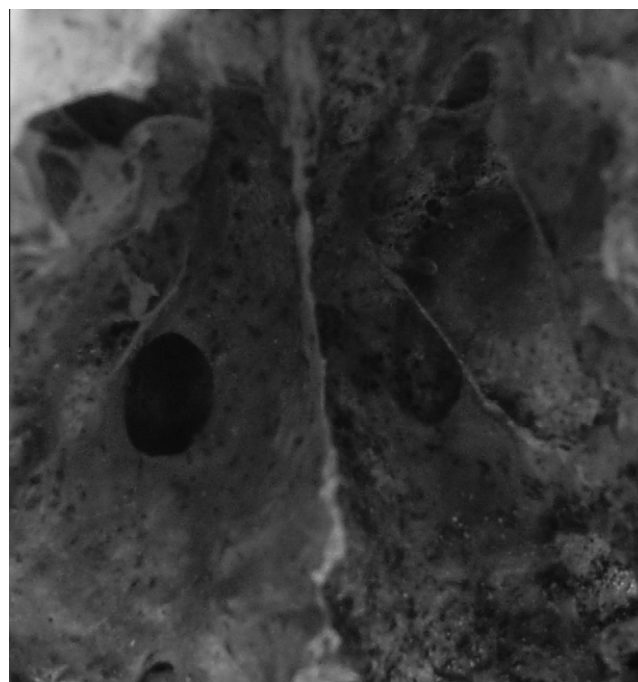


Fig. 2. A dry skull showing the left ostium completely obliterated by bone, appearing to be absent.

floor of the sella turcica, so they are a good landmark for the surgeon to know the orientation of the approach.⁴ Thus, once the ostia are found, the anterior wall of the sphenoid sinus is opened around both ostia, until the sphenoid sinus is exposed totally.

Numerous papers have focused on the anatomy of the sphenoid sinus, including their level of pneumatization and the shape and quantity of their inner septa, or the diameters of their cavities.^{1,2,5–7,9,12} Yet, papers focusing on the anatomy of the sphenoid sinus ostia are scarce. Kim et al.¹⁰ suggested that the best anatomical reference that enables identification of the sphenoid ostia is the posteroinferior end of the superior turbinate, where each cavity

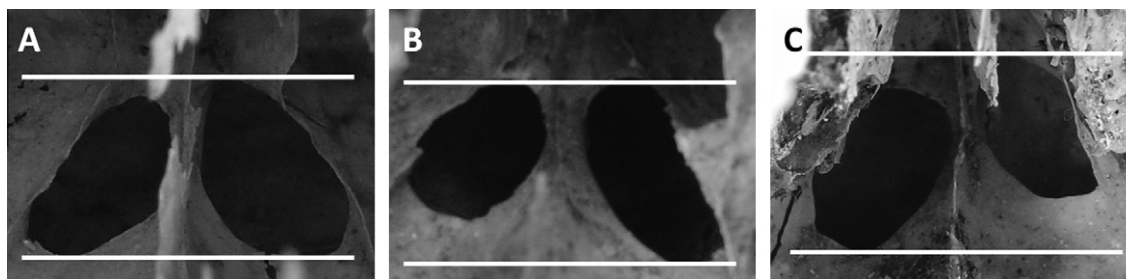


Fig. 3. Photographs of three skulls included in the present study showing: (A) both inferior, but not both superior, margins of the sphenoid ostia located at the same level; (B) both superior, but not both inferior, margins of the sphenoid ostia located at the same level; (C) both superior and inferior margins of the ostia at different heights.

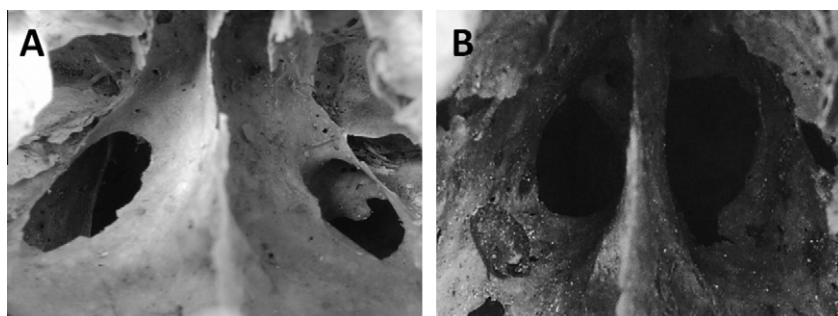


Fig. 4. Two different skulls showing: (A) great distance between both ostia and the midline; and (B) both ostia located almost in the midline.

is located medially and superiorly. In addition, they found that both ostia were located half-way between the superior and inferior margin of the sphenoid sinus anterior wall. Lang¹¹ found that 70% of the ostia were round-shaped, whereas 28% were ovoid-shaped, with the greater diameter usually oriented in the vertical plane. Yanagisawa et al.¹³ showed that the distance from the nasal spine to the sphenoid ostia was 7 cm. Similarly to Lang,¹¹ Enatsu et al.⁸ found that both ostia were located almost half-way on the anterior aspect of the sphenoid bone vertically; they also observed that the spatial orientation of both ostia relative to the carotid artery and the optical nerve showed no remarkable variation in their study. They found, however, that vertical and horizontal measurements of each ostium varied significantly.⁸

The data collected in this anatomical study confirm the great variability of the location of the sphenoid ostia noticed by the authors during transsphenoidal surgery.

5. Conclusion

One of the ostia is generally located at a different level compared to the opposite one; in addition, there is great variability in terms of distance from the inner margin of the ostia to the midline. Awareness of this anatomical variability is very useful when performing a transsphenoidal approach to the sellar region.

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