ORIGINAL ARTICLE

Sphenopalatinum Foramen: An Anatomical Study

Silvia Herrera Tolosana\(^a\),*, Rafael Fernández Liesa\(^a\), Juan de Dios Escolar Castellón\(^b\), Laura Pérez Delgado\(^a\), María Pilar Lis bona Alquezar\(^a\), Gloria Tejero-Garcés Galve\(^a\), María Guallar Larpa\(^a\), Alberto Ortiz García\(^a\)

\(^a\) Servicio de Otorrinolaringología, Hospital Universitario Miguel Servet, Zaragoza, Spain
\(^b\) Departamento de Anatomía e Histología Humanas, Facultad de Medicina, Universidad de Zaragoza, Spain

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Abstract

Introduction: The position of the sphenopalatine artery is essential for the endoscopic treatment of severe posterior epistaxis. This artery passes through its own foramen, which has a wide range of locations and anatomic relations.

Objective: To carry out a descriptive osteological study on the sphenopalatine foramen area. Its anatomy, size, position and relations with turbinates and choanae are described, as well as the existence of accessory foramina.

Material and methods: Exploration and anatomical study were carried out in 32 human hemi-skulls.

Results: The area between middle and superior meatus was considered the most common location of the sphenopalatine foramen in 56.24% of the cases (18 specimens), followed by the superior meatus, with 37.5% (12 hemi-skulls). The foramen was located in middle meatus in just two cases. We found accessory foramina in 50% of the cases, most commonly positioned below the middle meatus. The ethmoidal crest appeared in every skull, producing an anterior osseous projection on the sphenopalatine foramen.

Conclusion: There are variations in position, number and anatomic relations that may cause changes in the sphenopalatine artery orifice and its branches into the nasal fossa. The ethmoidal crest, located on the anterior side of the sphenopalatine foramen, can be considered a permanent landmark to find the foramen.

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Corresponding author.
E-mail address: silviaherrera@hotmail.com (S. Herrera Tolosana).


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Introduction

Epistaxis is one of the most common ENT emergencies and can represent a serious medical emergency. Therapeutic intervention will be more effective once a topographic diagnosis has been made, as accurately as possible, identifying the bleeding vessel for its specific treatment. The development of nasal endoscopic surgery in recent years has led it to become the current treatment of choice for posterior epistaxis.1 As this technique has become widespread as a treatment of choice, it has been possible to gauge its effectiveness, the absence of complications compared to other approaches and the significant reduction in hospital stays.2

The current trend is to replace posterior packing with endoscopic arterial ligation. To carry out this technique, it is necessary to have extensive endoscopic experience, as well as precise knowledge of the nasal vasculature and its distribution. Locating the sphenopalatine artery is essential in the endoscopic treatment of severe epistaxis. The sphenopalatine foramen, its exit point, varies in location and anatomical relationships. Located on the side wall of the nasal fossae, it is formed by the joining of 2 bones, the sphenoidin notch of the palatine bone and the body of the sphenoid.3,4 The sphenopalatine foramen has traditionally been located in the superior meatus. This orifice is a communication channel between the nasal cavity and pterygopalatine fossa, through which important anatomical structures pass: the sphenopalatine artery, the terminal branch of the internal maxillary artery (which in turn is a branch of the external carotid artery), nasal veins accompanying the artery, the nasopalatine branch of the maxillary nerve (V2) and the posterior, superior, medial, lateral and inferior nasal branches of the maxillary nerve (V2).5,6

The aim of this study was to carry out a descriptive osteological analysis of the sphenopalatine foramen region, describing its anatomy, the size of the orifice, its location, relationships with neighbouring structures, and the existence of accessory orifices that may be useful during endoscopic sinus surgery.

Material and Methods

We conducted a descriptive osteological study of the sphenopalatine foramen region at the Department of Human Anatomy and Histology of the University of Zaragoza. We conducted an exploration and study of the area in 32 human half skulls, 16 of which comprised 8 complete skulls.

We described the anatomy of the sphenopalatine foramen area by recording the following study variables: the location of the orifice in relation to the lateral insertion of the middle turbinate, exposing the meatus where it was located; the relationship with the turbinates; the existence of the ethmoidal crest, if it was anterior and if it continued in a posterior direction to the sphenopalatine foramen; the size of the orifice in its vertical and horizontal diameters; the relationship of the orifice with the choanal arch, that is, the distance from the most posterior part of the sphenopalatine foramen to the top of the choana; as well as the presence of accessory orifices, with their number, location and distance from the main orifice. Finally, we described the anatomical variations and types of orifice found.

Results

The most frequent location of the sphenopalatine foramen in our study was between the middle and superior meatus,
in 18 of the 32 specimens (56.25%). In these cases, we found the lateral insertion of the middle turbinate (that is, the ethmoidal crest) in the middle of the anterior margin of the sphenopalatine foramen, making a notch in it (Fig. 1). The second most frequent location was in the opening of the orifice of the superior meatus, in 12 half skulls (37.5%), where the middle turbinate appeared at the inferior margin of the orifice, producing a notch in the anteroinferior area of the foramen (Fig. 2). We found only 2 cases (6.25%) where the orifice opened exclusively in the middle meatus, with the middle turbinate being inserted at the superior margin of the orifice (Fig. 3). We found no cases in which the sphenopalatine foramen was located exclusively in the superior meatus (that is, above the superior turbinate).

The ethmoidal crest was present in all skulls studied, being anterior in the 32 cases (100%) and presenting a continuation in a posterior ridge in 20 cases (62.5%) (Fig. 4). In all cases, the ethmoidal crest appeared as an insertion line that projected out over the palatine bone, producing a notch in the middle of the anterior margin of the orifice in 56.25% of the cases studied, or in the inferoanterior area of the orifice in 37.5%; less frequently (6.25%), the notch appeared in the superoanterior area of the orifice. This projection, which appeared in all the specimens studied, may be an important relationship during surgery on the sphenopalatine artery, as it marks the location of the sphenopalatine foramen.

The mean size of the orifice in its vertical diameter was $6.8 \pm 3\text{ mm}$ and its anteroposterior diameter was $7.5 \pm 3\text{ mm}$.

With regard to the relationship with the choana, in 20 (62.5%) of the 32 cases, the sphenopalatine foramen appeared below the height of the choanal arch, with the upper part of the orifice being at the same height as the highest part of the choana. In 10 specimens (31.25%), the orifice was in the middle level of the top of the choana. Only in 2 cases was it above the level of the choanal arc. The distance from the orifice to the highest point of the choana was more or less constant, with a mean value of $11.6 \pm 3\text{ mm}$ in its longest distance, from the anterior edge of the orifice, and of $4.3 \pm 3\text{ mm}$ in its shortest distance, from the posterior limit of the foramen to the choana.
In 16 (50%) of the 32 half skulls, there was at least one accessory orifice, with up to 6 cases having 2 accessory orifices (18.75%), while the remaining 10 have only one accessory orifice (31.25%). The most frequently observed opening of the accessory orifices, in 16 of the 22 cases observed (72.7%), was in the middle meatus, below the main orifice, while in the remaining 6, it was in the inferior meatus (27.3%). With regard to the distance from the accessory orifices to the main orifice, they were grouped according to location. The mean distance of the orifices located in the middle meatus was 3.2±3 mm and for those found in the inferior meatus it was 13.33±2 mm. It should be noted that we observed that in many of the specimens studied, 24 of the 32 (75%), there was an orifice which connected the pterygopalatine fossa with the superior part of the choana, at a mean distance from the main orifice of 6.5±3 mm (Fig. 5).

Discussion

Locating the sphenopalatine artery is essential in endoscopic treatment of severe posterior epistaxis. The sphenopalatine foramen, through which it exits, is variable in location and anatomical relationships, and it is important to know these variations for an appropriate, safe surgical approach to the area.

The sphenopalatine foramen is formed by the joining of two bones, the sphenopalatine notch of the palatine bone and the body of the sphenoid. This orifice is located behind the lateral insertion of the middle turbinate. It can be found quite frequently in the superior meatus, less frequently in the middle meatus and most frequently between the middle and superior meatus, with part of the orifice in the superior meatus and part in the middle meatus8,9 (Fig. 4). In our study, the most frequent location of the sphenopalatine foramen was between the middle meatus and the superior meatus, in 18 of the 32 specimens, which agrees with recent studies on this area. Wareing and Padgham7 conducted an osteological classification of the sphenopalatine foramen after analysing 238 lateral nasal walls from dry skulls. They concluded that, in 35% of cases, the opening is located in the superior meatus (Class I). In our study, the ratio was similar: 12 out of 32 cases (37.5%). The same applies to Class II, in which the opening is located in both meatus, with a frequency of 56% in the study by Wareing and Padgham, and in 18 out of 32 cases (56.25%) in our observations. Padua and Voegels8 analysed 122 nasal fossae and once again found that the most common location of the sphenopalatine foramen was between both meatus, the middle and the superior (86.7%), followed by the superior meatus (13.1%). They did not find any cases in which it was located in the middle meatus. There is a discrepancy between these studies and the observations published in a more recent article by Antunes Scanavine et al.,9 who conducted a study on 54 half skulls and found that the most common location of the sphenopalatine foramen was the superior meatus (81.5%), followed by the transition between the upper and middle meatus (14.8%), and only one case in the middle meatus. This study coincided with the observations of Lee et al.,10 who (after studying 50 half skulls from human cadavers) described the location of the sphenopalatine foramen higher than the previous observations. Our study found that the location was in the superior meatus in 90% of cases.

One anatomical landmark to find this orifice is the lateral insertion of the middle turbinate into the palatine bone, known as the ethmoidal crest. In our observations, it was present in all study subjects, appearing as a projection in the lateral nasal wall, marking the anterior margin of the sphenopalatine foramen. Our study agrees on with recent works. Padua and Voegels8 found it in 100% of the subjects studied, being anterior in 98% of them. Trinidad et al.3 also described it as a constant, it thus constituting an important mark, anterior to the orifice and useful as a surgical reference. The presence of an accessory orifice has been described by several authors, varying from 2.6% to 42%. In our study, there were a large number of specimens with an accessory orifice, 16 out of 32 (50%). We observed that the most frequent location was in the middle meatus. This more frequent observation may be due to the fact that our study was conducted in skulls without soft tissues, allowing better visualisation of the lateral nasal wall. Consequently, in cases of posterior epistaxis, we must bear in mind that in many cases there is more than just a single main trunk of the sphenopalatine artery exiting through the orifice with the same name; in fact, there may be accessory orifices located in the middle meatus and even in the inferior meatus, which could be the source of bleeding. These locations should be examined during surgery for epistaxis. In 24 (75%) of the 32 specimens studied, there was an orifice that connected the pterygopalatine fossa with the superior part of the choana. This orifice could correspond to the palatovaginal or pterygopalatine canal, which opens...
behind the highest part of the choana, in the nasopharynx, and leads into the pterygomaxillary fossa. Through it runs the pterygopalatine artery (which irrigates the superior part of the pharynx), a posterior branch of the internal maxillary artery and a pharyngeal branch of the pterygopalatine node.\textsuperscript{11-13}

In our study, we decided to analyse the relationship of the sphenopalatine foramen with the choana at its highest point, given that it is an easily located point that may constitute a useful reference point for endoscopic surgery. We found it to have a fairly constant location. In 20 out of the 32 cases, it appeared below the choanal arch, with the top of the orifice being at the same height as the highest part of the choana. In 10 of the specimens, the orifice was in the middle level of the top of the choana. Only in 2 cases did it appear above the choanal arc. The distance from the orifice to the highest point of the choana remained more or less constant. Consequently, with reference to the choanal arch, the sphenopalatine foramen can be located in the lateral nasal wall, at about 6 mm from the choana, appearing below it in most cases (62.5%).

Conclusions

The sphenopalatine foramen can be found most frequently in the transition between the middle and superior meatus. However, it can also be located in the superior meatus, and rarely in the inferior meatus.

The ethmoidal crest is an important anatomical reference to locate the sphenopalatine foramen. In this study, it was found in 100% of cases, creating a notch in the anterior edge of the orifice in all specimens.

The presence of accessory orifices is common. The most frequent location is in the middle meatus below the main orifice, but they can also be found in the inferior meatus. These accessory orifices should be taken into account during the approach to posterior epistaxis.

Conflicts of Interest

The authors have no conflicts of interest to declare.

References