Asian Journal of Biology

16(1): 1-6, 2022; Article no.AJOB.92081
ISSN: 2456-7124

The Pterygopalatine Fossa: Skeletal Framework, Communications and Content

Georges Aoun [a*#] and Wissam Sharrouf [a]

[a] Department of Oral Medicine and Maxillofacial Radiology, Faculty of Dental Medicine, Lebanese University, Beirut, Lebanon.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJOB/2022/v16i130249

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/92081

Review Article

Received 09 July 2022
Accepted 16 September 2022
Published 16 September 2022

ABSTRACT

The pterygopalatine fossa, located on both sides of the skull, is a neurovascular crossroad between the middle cranial fossa, the orbit, the nasopharynx, the nasal and oral cavities, and the infratemporal fossa. It is considered a strategically complex region given its small size and the numerous structures that pass through it. This review aims to describe its skeletal framework, content, and communications with other regions.

Keywords: Pterygopalatine fossa; pterygopalatine ganglion; vidian nerve; maxillary nerve; maxillary artery.

1. INTRODUCTION

The pterygopalatine fossa (PPF) is a depression located on both sides of the skull. It is a main neurovascular crossroad between the middle cranial fossa, the orbit, the nasopharynx, the nasal and oral cavities, and the infratemporal fossa. Given its small size and the numerous structures that pass through it, the PPF is considered a strategically complex region with important clinical significance. In fact, due to its location and connections, the PPF can act as a natural conduit for the spread of inflammatory and neoplastic diseases in the head and neck. Additionally, several potential complications can result from surgeries performed in the region with a risk of damaging one or more anatomic elements lying within it. This review aims to

**Corresponding author: E-mail: aoungeorges@yahoo.com;*
[#] https://orcid.org/0000-0001-5073-6882

describe the skeletal framework, the content, and how the PPF constitutes access to other regions of the skull [1-3].

2. ANATOMY

2.1 Skeletal Framework

The PPF is a paired, inverted pyramidal-shaped space, located between the pterygoid process and the maxillary tuberosity, close to the orbital apex [2]. It is surrounded by the sphenoid, maxillary, and palatine bones. The posterior wall of the maxillary sinus forms the anterior border and the palatine bone its floor and antero-medial wall. The roof is formed by the sphenoid bone. More specifically, the sphenoid body and the orbital process of the palatine bone form the superior boundary. The posterior wall of the maxillary sinus constitutes the anterior boundary. The pterygoid process and greater wing of the sphenoid form the posterior boundary. The medial boundary is made up of the palatine bone and nasal mucoperiosteum. Finally, the temporalis muscle, through the pterygomaxillary fissure, constitutes its lateral boundary [1].

The PPF communicates with the middle cranial fossa, the nasopharynx, the nasal cavity, the orbit, the infratemporal fossa, and the oral cavity through the foramen rotundum and the vidian canal, also known as the pterygoid canal, the sphenopalatine foramen, the palatovaginal canal, the inferior orbital fissure, the pterygomaxillary fissure, and the greater palatine canal [3,4].

2.2 Communications and Content

The PPF contains fat, the pterygopalatine ganglion (PPG), the maxillary division of the trigeminal nerve (CN V2) and its branches, the vidian nerve, the terminal third segment of the maxillary artery, and a few veins. These anatomic elements arrive at the PPF through different passageways (fissures, foramina, and canals) that communicate the PPF with many other regions [1-3,5].

The communications between the PPF and other regions and the nerves and vessels passing through them are summarized in Table 1.

2.2.1 The pterygopalatine ganglion

Located within the PPF, the PPG, also referred to as the sphenopalatine ganglion is the largest parasympathetic ganglion among four ganglia located within the head region [6,7]. Roots from the maxillary nerve suspend this ganglion near the sphenopalatine foramen, anterior to the vidian canal. The PPG includes parasympathetic, sympathetic, and somatosensory nerve fibers [3,6]. It receives pre-ganglionic parasympathetic fibers from the vidian nerve, houses post-ganglionic parasympathetic fibers, and acts as a pathway for post-ganglionic sympathetic and sensory axonal fibers. It is to be noted that the post-ganglionic sympathetic and the somatic sensory fibers pass without synapse through the PPG [8]. The fibers that arise from the PPG regulate secretomotor functions and provide sensation from many structures that include the lacrimal glands, the mucous membranes of the oropharynx, nasopharynx, nasal cavity, and upper part of the oral cavity [6].

2.2.2 The maxillary nerve

After leaving the skull through the foramen rotundum, the maxillary nerve crosses the superior part of the PPF and swings laterally to traverse the inferior orbital fissure toward the maxillary sinus, which it supplies along with the anterior teeth of the upper jaw via the anterior and middle superior alveolar nerves. The nerve then exits through the infraorbital foramen where it becomes the infraorbital nerve, a terminal branch, which provides sensory innervation to the skin of the face and the underlying mucosa extending from the lower eyelid to the upper lip [7-9].

While in the PPF, the maxillary nerve is connected to the PPG, through which it gives off branches to the nasal cavity, pharynx, and palate. Additionally, the nerve gives off the zygomatic nerve and the posterior superior alveolar nerve.

The branches of the maxillary nerve/PPG in the PPF, their pathways, and destinations are summarized in Table 2.

2.2.3 The vidian nerve

The vidian nerve, also known as the nerve of the pterygoid canal, is formed by the junction of the greater petrosal and deep petrosal nerves. It reaches the PPF through the vidian canal.

Table 1. The communications between the PPF and other regions and the nerves and vessels passing through

Opening	Communication with	Passing nerves	Passing vessels
Pterygomaxillary fissure	Infratemporal fossa	Posterior superior alveolar nerve	Third segment of the maxillary artery
Foramen rotundum	Middle cranial fossa	Maxillary nerve	-
Vidian canal	Middle cranial fossa	Vidian nerve	Vidian artery and vein
Palatovaginal canal	Nasopharynx	Pharyngeal branch of the maxillary nerve	Pharyngeal branch of the maxillary artery
Inferior orbital fissure	Orbit	Zygomatic branch of the maxillary nerve	Infraorbital artery and vein
Greater palatine canal	Oral cavity	Greater and lesser palatine nerves	Superior palatine artery (Greater)
Sphenopalatine foramen	Nasal cavity	Nasopalatine nerve	Sphenopalatine vein and artery

Table 2. The branches of the maxillary nerve/PPG in the PPF, their pathways, and destinations

Branch	Passage through	Destination
Pterygopalatine nerves	-	PPG
Zygomatic nerve	Inferior orbital fissure	The skin over the temporal and the zygomatic bones
Nasopalatine nerve	Sphenopalatine foramen	The nasal septum and the anterior part of the palate
Posterior superior alveolar nerve	Descends on the tuberosity of the maxilla	The maxillary sinus, the posterior maxillary oral mucosa, and the maxillary molar teeth
Pharyngeal nerve	Palatovaginal canal	The mucous membrane of the nasal part of the pharynx
Greater palatine nerve	Greater palatine canal (greater palatine foramen)	The hard palate
Lesser palatine nerve	Greater palatine canal (lesser palatine foramina)	The soft palate, the tonsil, and the uvula.

Table 3. The branches of the third segment of the maxillary artery, their pathways, and destinations

Branch	Passage Through	Destination
Pharyngeal artery	Palatovaginal canal	Pharynx
Sphenopalatine artery	Sphenopalatine foramen	Nasal cavity
Vidian artery	Pterygoid canal	Participates in two major vascular networks located in the PPF and oropharyngeal mucosa.
Descending palatine artery gives rise to the greater and lesser palatine arteries)	Greater palatine canal Lesser palatine foramina	Hard palate Soft palate and tonsils
Posterior superior alveolar artery	Descends on the tuberosity and the posterior surface of the maxilla	It devides into numerous branches that supply the upper molars and premolars, their alveolar process, and the lining of the maxillary sinus
Infraorbital artery	Infraorbital groove, canal, and foramen	Lower eyelid and upper lip

The greater petrosal nerve, also referred to as the superficial petrosal nerve, is a branch of the intermediate nerve (nerve of Wrisberg; nervus intermedius). It conveys presynaptic parasympathetic fibers from the superior salivatory nucleus located in the pons of the brainstem to the PPG and sensory fibers proximally to the geniculate ganglion [9,10]. The greater petrosal nerve branches from the intermediate nerve at the anterior aspect of the geniculate ganlion, enters the middle cranial fossa extradurally, runs anteromedially inferior to the trigeminal ganglion, and arrives at the foramen lacerum [11,12]. The parasympathetic fibers do not synapse before reaching the PPG [11]; within the PPG, they synapse with post-ganglionic fibers.

The deep petrosal nerve, a branch from the internal carotid plexus located on the lateral side of the internal carotid as it courses superiorly, consists of postsynaptic sympathetic fibers derived from neuronal cell bodies found in the superior cervical ganglion located around the level of C2-C3. It enters the skull through the carotid canal with the internal carotid artery and heads towards the foramen lacerum, where it joins the greater petrosal nerve to form the vidian nerve [11,12].

2.2.4 The maxillary artery

The maxillary artery is a terminal branch of the external carotid artery**.** It presents a tortuous course and *is divided into three* distinct *segments* (mandibular, pterygoid, and pterygopalatine) depending on its location relative to the lateral pterygoid muscle. The pterygopalatine segment lies within the PPF where it gives rise to the pharyngeal artery, the sphenopalatine artery, the vidian artery, the greater palatine artery, which gives rise to the lesser palatine artery branches, the posterior superior alveolar artery, and the infraorbital artery [13,14].

The branches of the third segment of the maxillary artery, their pathways, and destinations are summarized in Table 3.

3. CONCLUSION

The PPF is a strategic region in the deep face where a variety of neurovascular crossroads meet. Its complexity lies in its relevant anatomy, including its bony landmarks, communications, and content.

DISCLAIMER

This paper is an extended version of a preprint document of the same author.

The preprint document is available in this link: https://www.authorea.com/doi/full/10.22541/au.166082132.25886645

[As per journal policy, pre-print article can be published as a journal article, provided it is not published in any other journal].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Cappello ZJ, Potts KL. Anatomy, Pterygopalatine Fossa. [Updated 2021 Sep 20]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022. Available:https://www.ncbi.nlm.nih.gov/books/NBK513269/
2. Tashi S, Purohit BS, Becker M, Mundana P. The pterygopalatine fossa: imaging anatomy, communications, and pathology revisited. Insights into Imaging. 2016; 7(4):589-599
3. Aoun G, Zaarour I, Sokhn S, Nasseh I. Maxillary nerve block via the greater palatine canal: An old technique revisited. J Int Soc Prev Community Dent. 2015;5(5): 359-364. DOI: 10.4103/2231-0762.165930.
4. Derinkuyu BE, Boyunaga O, Oztunali C, Alimli AG, Ucar M. Pterygopalatine fossa: not a mystery! Can Assoc Radiol J. 2017;68(2):122-130. DOI: 10.1016/j.carj.2016.08.001
5. Daniels DL, Mark LP, Ulmer JL, Mafee MF, McDaniel J, Shah NC, et al. Osseous anatomy of the pterygopalatine fossa. AJNR Am J Neuroradiol. 1998;19(8): 1423-1432.
6. Robbins MS, Robertson CE, Kaplan E, Ailani J, Charleston L 4th, Kuruvilla D, et al. The sphenopalatine ganglion: anatomy, pathophysiology, and therapeutic targeting in headache. Headache. 2016;56(2):240-258. DOI: 10.1111/head.12729
7. Khonsary SA, Ma Q, Villablanca P, Emerson J, Malkasian D. Clinical functional anatomy of the pterygopalatine

ganglion, cephalgia and related dysautonomias: A review. Surg Neurol Int. 2013;4(Suppl 6):S422-428.
DOI: 10.4103/2152-7806.121628

8. Piagkou M, Demesticha T, Troupis T, Vlasis K, Skandalakis P, Makri A, et al. The pterygopalatine ganglion and its role in various pain syndromes: from anatomy to clinical practice. Pain Pract. 2012;12(5):399-412.
DOI: 10.1111/j.1533-2500.2011.00507.x
9. Pai UT, Nayak R, Molloy R. Head and neck blocks. In Elsevier B.V. (ed): essentials of pain medicine and regional anesthesia, ed 2. Churchill Livingstone. 2005:598-606.
DOI: 10.1016/B978-0-443-06651-1.50076-9
10. Nturibi E, Bordoni B. Anatomy, head and neck, greater petrosal nerve. [Updated 2021 Nov 5]. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2022.
Available:https://www.ncbi.nlm.nih.gov/books/NBK553121/
11. Prasad S, Lee TC, Chiocca EA, Klein JP. Superficial greater petrosal neuropathy. Neurol Clin Pract. 2014;4(6): 505-507
DOI: 10.1212/CPJ.0000000000000066.
12. Tubbs RS, Menendez J, Loukas M, Shoja MM, Shokouhi G, Salter EG, Cohen-Gadol A. The petrosal nerves: anatomy, pathology, and surgical considerations. Clin Anat. 2009;22(5):537-544.
DOI: 10.1002/ca.20814
13. Kiyosue H, Tanoue S, Hongo N, Sagara Y, Mori H. Artery of the superior orbital fissure: an undescribed branch from the pterygopalatine segment of the maxillary artery to the orbital apex connecting with the anteromedial branch of the inferolateral trunk. AJNR Am J Neuroradiol. 2015; 36(9): 1741-1747.
DOI: 10.3174/ajnr.A4331
14. Alfieri A, Jho HD, Schettino R, Tschabitscher M. Endoscopic endonasal approach to the pterygopalatine fossa: anatomic study. Neurosurgery. 2003; 52(2):374-378; Discussion 378-380.
DOI:10.1227/01.neu.0000044562.73763.00

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/92081