

# Maxillary nerve block via the greater palatine canal: An old technique revisited

Georges Aoun<sup>1,2</sup>, Ibrahim Zaarour<sup>1</sup>, Sayde Sokhn<sup>3</sup>, Ibrahim Nasseh<sup>3</sup>

<sup>1</sup>Department of Oral Pathology and Diagnosis, <sup>2</sup>Department of Fundamental Sciences and <sup>3</sup>Department of Dentomaxillofacial Radiology and Imaging, School of Dentistry, Lebanese University, Beirut, Lebanon

**Corresponding author** (email: <aoungeorges@yahoo.com>)

Dr. Georges Aoun, Departments of Oral Pathology and Diagnosis and Fundamental Sciences, School of Dentistry, Lebanese University, Beirut, Lebanon.

## Abstract

**Background:** Maxillary nerve block through the greater palatine canal is rarely adopted by dental practitioners due to lack of experience in the technique at hand which may lead into several complications. Nevertheless, it is an excellent method to achieve profound anesthesia in the maxilla. This review focuses on the anatomy as well as the indications, contraindications, and complications associated with this technique. **Materials and Methods:** A literature search was performed using the scientific databases (PubMed and Google Scholar) for articles published up to December 2014 in English, using the key words “maxillary nerve block via the greater palatine canal.” A total of 34 references met the inclusion criteria for this review and were selected. **Conclusion:** Block of the maxillary nerve through the greater palatine canal is a useful technique providing profound anesthesia in the hemi-maxilla, if practiced properly.

**Key words:** Anesthesia, cone beam computed tomography, greater palatine canal, greater palatine foramen, maxillary nerve block, pterygopalatine fossa

## INTRODUCTION

The greater palatine canal (GPC) transmits the greater palatine nerve [branch of the pterygopalatine ganglion that carries both general sensory fibers from the maxillary nerve (V2) and parasympathetic fibers from the nerve of the pterygoid canal] and the descending palatine artery (branch of the maxillary artery) from the pterygopalatine fossa (PPF) to the oral cavity through its lower orifice, the greater palatine foramen (GPF). Blocking of the V2 through the GPC is an old technique, which was described for the first time in 1917 by Nevin.<sup>[1]</sup> It is one of two intraoral approaches, the other being the high tuberosity technique, to administer local anesthesia

to the PPF in order to anesthetize the maxillary division of the trigeminal nerve. With time, it lost its interest due to the numerous complications (diplopia, ptosis, infraorbital nerve injury, etc.) resulting from improper operation, mostly due to the poor knowledge of the region's anatomy such as GPF location and GPC length.<sup>[2-4]</sup> However, this technique consists of a single injection resulting in an anesthetic effect to the entire hemi-maxilla, including teeth, palatal and gingival mucosa, skin of the midface, maxillary sinus, and nasal cavity.<sup>[2]</sup> Silverman,<sup>[3]</sup> Wong and Sved,<sup>[4]</sup> and many other authors have tried to revise this technique and even modify it in order to minimize the complications that can occur during and/or post procedure.

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Among these modifications are the use of new palatal landmarks to enable consistent canal location, an increase in the needle/maxillary occlusal angle from 45° to 60°, and utilization of standard dental syringe.

The aim of this article is to review the technique of the V2 block through the GPC from an anatomic point of view, its indications, contraindications, and complications, and to highlight the advantages presented by the cone beam computed tomography (CBCT) technique in observing the exact pathway of the GPC in order to increase the success of the technique and decrease any potential complications. Literature was retrieved through databases including PubMed and Google Scholar.

### Anatomy

V2 is the second of the three branches of the trigeminal nerve, the fifth (V) cranial nerve. Purely sensory, it leaves the skull via the foramen rotundum opening directly into the posterior wall of the PPF.<sup>[5]</sup>

The PPF, located between the maxilla, sphenoid, and palatine bones, is a bilateral, inverted, pyramidal-shaped structure extending from the infratemporal fossa to the nasal cavity via the sphenopalatine foramen.<sup>[6]</sup>

Its small size combined with the numerous structures that traffic through makes the PPF a complex region.

Beside its communication with the middle cranial fossa through the foramen rotundum (and the pterygoid canal also known as vidian canal), the PPF communicates with the following:<sup>[6,7]</sup>

- The infratemporal fossa (via the pterygomaxillary fissure)
- The nasopharynx (via the pharyngeal canal)
- The nasal cavity (via the sphenopalatine foramen)
- The orbit (via the infraorbital fissure)
- The oral cavity (via the GPC).

These communications transmit blood vessels and nerves between these regions.

The openings between the PPF and other regions, and the nerve and vessels passing through are summarized in Table 1.

After leaving the skull through the foramen rotundum, the V2 crosses the PPF giving off a number of branches (infraorbital nerve, zygomatic nerve, nasopalatine nerve, superior alveolar nerves, pharyngeal nerve, and palatine nerves), inclines laterally on the back of the maxilla, traverses the infraorbital groove and canal, and opens through the infraorbital foramen. There, it becomes the infraorbital nerve, a terminal branch, and gives lower eyelid, nasal and labial branches.<sup>[8]</sup>

In the PPF, the greater palatine nerve leaves V2, crosses the GPC located in the thickness of the lateral wall of the nasal cavities, emerges through the GPF, and runs forward in a groove almost up to the incisor teeth where it communicates with the nasopalatine nerve. The latter, which is also a branch of the V2, enters the palate through the incisive foramen and innervates the anterior part of the hard palate behind the incisor teeth.<sup>[9]</sup>

### MATERIALS AND METHODS

Knowing that the success of the technique of the V2 block through the GPC is based on knowledge of the anatomy of the palatal region, our goal in this review was to describe, based on previous studies found in the literature, the location of the GPF according to intraoral landmarks that enable the clinician to locate it in a consistently reliable manner and the average length of the GPC.

Matsuda was the first to describe the location of the GPF.<sup>[10]</sup> Most textbooks locate the foramen in a general way:

- Close to the lateral palatal border<sup>[11]</sup>
- In the posterolateral border<sup>[12]</sup>
- Medial to the 3<sup>rd</sup> maxillary molar<sup>[13]</sup>
- Opposite to the 3<sup>rd</sup> maxillary molar.<sup>[14]</sup>

**Table 1: The openings between the PPF and other regions and the nerve and vessels passing through**

Opening	Communication with	Passing nerves	Passing vessels
Pterygomaxillary fissure	Infratemporal fossa	Posterior superior alveolar nerve	The terminal portion of the maxillary artery
Foramen rotundum	Middle cranial fossa	Maxillary nerve	-
Pterygoid canal (vidian)	Middle cranial fossa	Nerve of the pterygoid canal (vidian)	Artery and vein of the pterygoid canal (vidian)
Pharyngeal canal	Nasopharynx	Pharyngeal branch of the maxillary nerve	Pharyngeal branch of the maxillary artery
Infra 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
Sphenopalatine foramen	Nasal cavity	Nasopalatine nerve	Sphenopalatine vein and artery

PPF=Pterygopalatine fossa

For other more specialized studies, the location of the GPF was observed using many palatal landmarks such as:

- Its relation to the maxillary molar teeth
- Its distance from the midline maxillary suture (MMS)
- Its distance from the posterior border of the hard palate (PBHP)....

The study of Slavkin *et al.*<sup>[15]</sup> found the GPF 1–3 mm distal to the 3<sup>rd</sup> maxillary molar in adult skulls. In 1982, Westmoreland and Blanton<sup>[16]</sup> observed only 6% of the foramen distal to the 3<sup>rd</sup> molar and 9.7% medial to the maxillary 2<sup>nd</sup> molar. According to Ajmani,<sup>[17]</sup> 48% of the GPF in Nigerian and 64% in Indian skulls were located medial or opposite to the maxillary 3<sup>rd</sup> molar. Saralaya and Nayak<sup>[18]</sup> and Chrcanovic and Custódio<sup>[19]</sup> concluded in their studies that 74.6% and 54.87% of the GPF, respectively, were opposite to the 3<sup>rd</sup> molar.

Some data retrieved from the literature regarding the positional variance of the GPF with respect to the maxillary molars are compared and summarized in Table 2.

As for the distance between the GPF and the MMS, it was found to be around 15 mm according to the study of Westmoreland and Blanton.<sup>[16]</sup> Ajmani reported a distance of 15.4 mm in Nigerian skulls and a mean of 14.7 mm in Indian skulls.<sup>[17]</sup> The same distance (14.7 mm) was reported by the study of Saralaya and Nayak<sup>[18]</sup> and an average of 14.56 mm was reported by Chrcanovic and Custódio.<sup>[19]</sup>

Concerning the mean distance of the GPF from the PBHP, it varies between 1.9 mm and 4.2 mm.<sup>[16-19]</sup>

Some data retrieved from the literature regarding the mean distance of the GPF from the MMS and the PBHP are compared and summarized in Table 3.

Regarding the length of the GPC, Swirzinski *et al.*<sup>[20]</sup> and Sheikhi *et al.*,<sup>[21]</sup> in their studies based on CBCT observations, concluded that the average length of the GPC in adult population was 29 ± 3 mm (ranging from 22 to 40 mm) and 31.82 ± 1.37 mm, respectively. Tomaszewska *et al.*<sup>[22]</sup> observed 1500 adult Caucasian head CT scans and found that the average length of the GPC was 31.1 ± 2.9 mm (range 15–44) mm. According to Das *et al.*,<sup>[23]</sup> the range of the GPC length is located between 27 and 44 mm with a mean of 32 mm.

Some data retrieved from the literature regarding the length of the GPC are compared and summarized in Table 4.

**Clinical applications**

Clinically, the GPF is located by applying pressure on a cotton swab at the junction of the hard palate and the maxillary alveolar process until it falls into the depression of the GPF.

As mentioned above, the GPF is most often located distal to the 2<sup>nd</sup> maxillary molar and its average length is 32 mm.<sup>[2,23]</sup> Knowing that long canals could lead to lack of anesthesia and, conversely, short ones could have a higher occurrence of complications if the standard

**Table 2: Comparison of some data from the literature on the positional variance of the GPF with respect to the maxillary molars**

Study	Year	Relation to maxillary molars %			Distal 3M
		2M	2M-3M	3M	
		Westmoreland and Blanton	1982	9.70	
Ajmani (Nigerian skulls)	1994	13.07	38,46	48,46	0,00
Ajmani (Indian skulls)	1994	0,00	32,35	64,69	2,94
Saralaya and Nayak	2007	0.40	24,20	74,60	0,80
Chrcanovic B and Custódio A	2010	0,00	6,19	54,87	38,94

*2M=2<sup>nd</sup> maxillary molar; 3M=3<sup>rd</sup> maxillary molar; Chrcanovic BR and Custódio ALN, J Oral Sc 2010;52 (1):111. GPF=Greater palatine foramen*

**Table 3: Comparison of some data from the literature on the mean distance of the GPF from the MMS and the PBHP**

Study	Year	GPF-MMS	GPF-PBHP
		(mean*: mm)	(mm)
Westmoreland and Blanton	1982	14,90	1,90
Ajmani (Nigerian skulls)	1994	15,40	3,50
Ajmani (Indian skulls)	1994	14,65	3,70
Saralaya and Nayak	2007	14,70	4,20
Chrcanovic B and Custódio A	2010	14,56	3,39

*\*Mean distance between the right and left sides, Chrcanovic BR and Custódio ALN, J Oral Sc 2010;52 (1):111. GPF=Greater palatine foramen, MMS=Midline maxillary suture, PBHP=Posterior border of the hard palate*

**Table 4: Comparison of some data from the literature on the length of GPC**

Study	Year	Mean length of the GPC
Das <i>et al.</i>	2006	32 mm
Swirzinski <i>et al.</i>	2010	29±3 mm
Sheikhi <i>et al.</i>	2013	31.82±1.37 mm
Tomaszewska <i>et al.</i>	2014	31.1±2.9 mm

*GPC=Greater palatine canal*

needle is used,<sup>[20]</sup> a CBCT is indicated prior to the procedure to analyze the GPC anatomy, mainly its localization and length [Figures 1 and 2].

Once the GPF is identified, at the most a 27 G needle on a dental syringe is inserted perpendicularly until bone contact and 0.5 ml of local anesthetic is deposited to provide local anesthesia in the area to be injected. After waiting for 3–5 min, the needle is introduced slowly at an angle of 45° to the long axis of the hard palate in the canal to nearly a depth of 32 mm for adults.<sup>[2]</sup>

Exactly 1.8 ml of local anesthetic is injected without any compression, in order to avoid the risk of tissue necrosis.<sup>[24,25]</sup> Maximum anesthesia effect is obtained in 5–15 min.<sup>[26]</sup>

Aspiration is necessary before injection; if blood (needle is in a vessel) or bubbles (needle is in the nasopharynx) are aspirated, the needle is removed, redirected, and reinserted at a different angle.

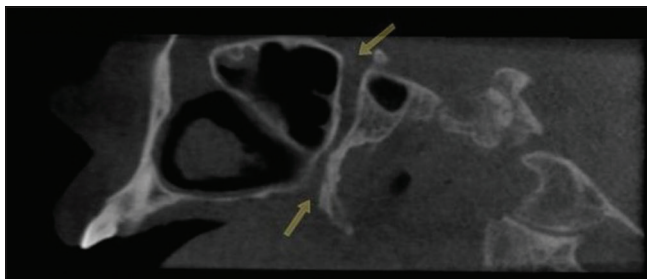
### Indications and contraindications

Maxillary nerve block via the GPC achieves anesthesia of the following:

- The hemi-maxilla including teeth, bone, and soft tissue (this effect could be useful for surgical procedures in this region)<sup>[2,20,27]</sup>
- The skin of the midface (for patients with maxillary trauma)<sup>[28]</sup>
- The nasal cavity and sinus (during endoscopic sinus surgery and septorhinoplasty).<sup>[22,29,30]</sup>

Furthermore, this technique is used for the diagnosis and treatment of chronic oral and maxillofacial pain syndromes.<sup>[28]</sup>

Jonas *et al.*<sup>[31]</sup> successfully treated posterior epistaxis (nosebleeds) with endoscopic sphenopalatine artery ligation technique by infiltration of local anesthesia



**Figure 1:** Sagittal view showing the GPC; the arrows show the superior and inferior openings of the canal

with vasoconstrictors via the GPC in the PPF. This process can cause vasospasm of the terminal (third) part of the maxillary artery, decreasing the blood flow in its terminal branch and thus facilitating the ligation procedure.

As for the contraindications, the following can be mentioned:

- The presence of infection in the foramen region, which can lead to the infection spreading in the PPF<sup>[32]</sup>
- The presence of systemic coagulation defect inducing bleeding in case of vascular injury<sup>[27]</sup>
- Difficulties to locate the GPF or negotiate the GPC.<sup>[25,32]</sup>

### Complications

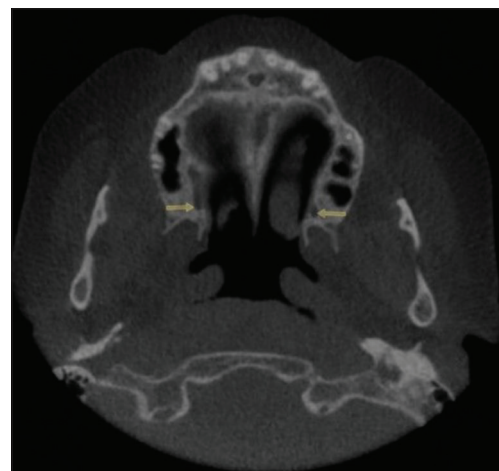
Complications can be as follows:

#### I. Related to the local anesthetic:

- Toxicity caused by a large quantity of the anesthetic or an intravascular injection. The toxicity may develop minimal to moderate symptoms such as anxiety, numbness, dizziness, weakness, and tremors. Sometimes, more severe symptoms like central nervous system or cardiovascular collapse may occur
- Allergic reaction caused generally by an ester group local anesthetic and/or the preservatives added to it (methylparaben, sodium metabisulfite, etc.)<sup>[33]</sup>

#### II. Related to the technique itself:

- Persistent paresthesia and numbness due to V2 trauma or local hematoma formation
- Diplopia (double vision), the most common (35.6%) complication, resulting from



**Figure 2:** Axial view showing the GPF



the accidental block of the abducens nerve (the 6<sup>th</sup> cranial nerve) innervating the lateral rectus muscle, one of the extraocular muscles, by dissemination of the anesthetic through the superior orbital fissure<sup>[24,27,34]</sup>

- Transient ophthalmoplegia by anesthetizing the extraocular muscles of the eye<sup>[25]</sup>
- Ptosis (upper eyelid paralysis) due to anesthesia of the superior division of the oculomotor nerve (the 3<sup>rd</sup> cranial nerve) responsible of the innervation of the upper eyelid levator muscle.<sup>[27]</sup>

More serious complications can occur such as:<sup>[33]</sup>

- Infraorbital nerve injury and/or injection (accidental penetration of the orbit)
- Neural tissue damage
- Temporary blindness from vasoconstriction of the ophthalmic artery or block of the optic nerve
- Unconsciousness from intracranial injection (diffusion of the anesthetic via the foramen rotundum).

## CONCLUSION

The maxillary nerve block via the GPC was revisited regarding its implementation by a dental practitioner. The technique is deemed advantageous in terms of achieving profound anesthesia of the hemi-maxilla, especially for oral surgeons; however, due to the possibility of rare but potentially serious complications, the said technique should only be performed by proficient and qualified personnel with all necessary equipments at hand. This being said, it is to be noted that a CBCT is imperative to analyze the GPC anatomy, mainly its localization and length.

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## Conflicts of interest

There are no conflicts of interest.

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