

Intraoral Maxillary Nerve Block: an anatomical and clinical study.

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INTRODUCTION

The second division (maxillary or V2) nerve block is a technique for achieving anesthesia of a hemimaxilla. Indications for its use include extensive dental therapy or surgery; as an alternative to other regional nerve blocks or injection techniques when infection is present; and as an aid in diagnosis.

Two intraoral approaches to the maxillary nerve are described. The first, the "high tuberosity approach"⁽¹⁾ involves insertion of the needle in the region of the mucobuccal fold at the maxillary 2nd molar and advancing the needle in a posterior, superior, and medial direction, into the region of the pterygopalatine fossa. While technically a simple approach to the maxillary nerve block, the high tuberosity approach presents with several negatives, primary amongst which is a greater incidence of peri- and post-operative complications, such as hematoma. It also requires a heavier than 25 gauge, long needle (32mm.) to prevent deflection. Such needles are not a common part of the local anesthetic armamentarium in dental practice.

The second intraoral approach to the maxillary nerve is through the greater palatine canal (GPC).^(2,3) There are several compelling reasons to consider the use of this approach, including a high rate of success and a low incidence of complications. The major contraindication to this approach has been occasional difficulty in locating the greater palatine foramen (GPF), and in negotiating the greater palatine canal.

METHOD

It was our goal in this study to describe those intraoral landmarks which enable the clinician to locate the GPF in a consistently reliable manner; to determine the probability of successfully advancing a 25 gauge needle through the GPC to the pterygopalatine fossa; and to determine the depth of

needle insertion from the point of entry of the needle to the pterygopalatine fossa.

A total of two hundred and four (n=204) human skulls were examined. Geographical origin of the skulls included the western United States, Scandinavia, Europe, and North Africa (table one).

Measurements recorded included:

- location of the GPF in the sagittal plane.
- patency of the GPF.
- optimal angle of needle insertion into the GPC.
- distance from the infraorbital foramen to the crest of alveolar bone between the maxillary bicuspids.
- distance of the GPF from the end of the hard palate.
- relationship of the GPF and the pterygoid hamulus.

TABLE 1
Geographical distribution of skulls*

<u>Location</u>	<u>number (n=204)</u>
United States	57
Germany	29
Lithuania	28
Austria	24
Egypt	21
Poland	12
Greece	12
Italy	9
Turkey	7
Denmark	2
France	2
Hungary	1

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RESULTS

Location of the Greater Palatine Foramen:

The location of the greater palatine foramen was determined in both its medial-lateral and sagittal relationships.

Medially-laterally the GPF was located (n=204) at the junction of the horizontally placed hard palate and the vertical maxillary alveolar process of bone.

Its sagittal placement did demonstrate some variation (table two).

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TABLE 2

Location of Greater Palatine Foramen

<u>Location</u>	<u>No.</u>	<u>Percent</u>
Anterior half of 2nd molar	0	0
Posterior half of 2nd molar	63	39.87
Anterior half of 3rd molar	80	50.63
Posterior half of 3rd molar	15	9.49

Note: Measurements from 158 skulls with maxillary second and third molars present.

Only those skulls with maxillary posterior teeth present were evaluated (n = 158). Almost 40% of the GPF examined were located between the middle of the maxillary second molar and the interproximal space between the second and third molars. Fifty-one percent were located between the later site and the mid-portion of the third molar. In no case was the GPF located anterior to the middle of the 2nd molar (figure 1).

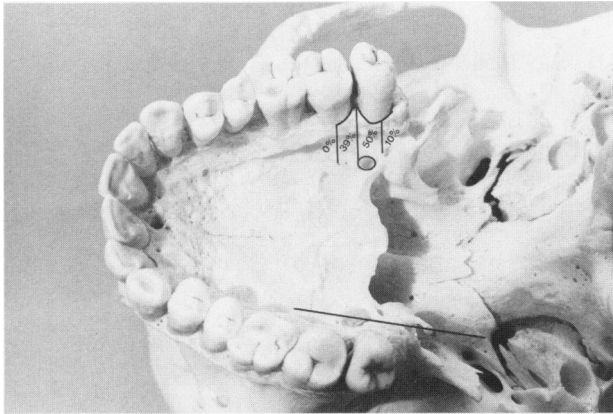


Figure 1

Location of the greater palatine foramen, and its relationship to the hamular process.

Patency of the Greater Palatine Foramen

In 199 of the 204 skulls evaluated, a 3" probe (25 gauge spinal needle) was passed through the GPF without difficulty into the pterygopalatine fossa, for a patency rate of 97.55%

Angle of Greater Palatine Canal

The optimal angle of insertion of the needle was determined in those foramina which were patent (n = 199). The angle recorded was that formed by the long axis of the needle and the horizontal plane of the hard palate (figure 2). In all instances the needle was angled towards the anterior portion of the mouth.

The optimal angle varied considerably (table three), ranging from 20 to 70 degrees. The average of 199 was 45.88 degrees. In over 75% the optimal angle for penetration of the GPC was between 37 and 57.5 degrees.

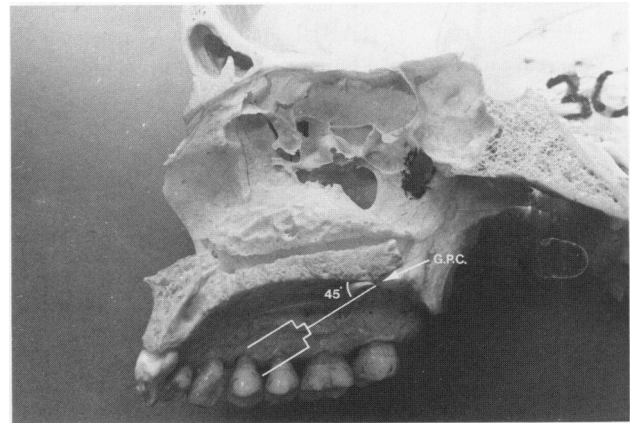


Figure 2

Optimal angle of entry into GPC.

TABLE 3

Angle of Greater Palatine Foramen to Hard Palate

<u>Angle</u>	<u>n = 199</u>	<u>Percent</u>
20-22.5	2	1.005
25-27.5	4	2.01
30-32.5	18	9.045
35-37.5	28	14.07
40-42.5	25	12.56
45-47.5	34	17.08
50-52.5	34	17.08
55-57.5	29	14.57
60-62.5	17	8.54
65-67.5	7	3.51
70	1	0.50

Distance from Infraorbital Foramen (IOF) to Crest of Alveolar Bone Between Maxillary Bicuspid

The distance in millimeters between the lower border of the IOF and the alveolar crest between the maxillary bicuspid was measured, as this height correlates quite well with the position of the maxillary nerve in the pterygopalatine fossa. By recording this distance the depth of penetration of the needle into the GPC might rather closely be estimated.⁽²⁾

The height varied from 24 to 41 millimeters (table 4), with an average distance of 32.157 mm. in the 200 skulls examined. In 65% of the skulls the height was between 30 and 35 mm.; in 18% the height was less than 30 mm.; while in 17% this distance was greater than 35 mm (figure 3).

Relationship of the GPF to Posterior Aspect of Hard Palate

The distance from the end of the hard palate to the distal aspect of the GPF was measured in 185 skulls (table five). Considerable variation in this distance existed, the range being from 3.0 to 12.0 mm., with an average distance of 6.97 mm. The GPF was located between 6.5 and 8.0 mm. from the end of the hard palate in more than 48% of the skulls ex-

TABLE 4

Distance from Infraorbital Foramen (lower border) to Alveolar Crest between Maxillary Bicuspids

distance (mm)	n = 200	Percent
24	1	0.5
25	1	0.5
26	3	1.5
27	10	5.0
28	7	3.5
29	14	7.5
30	20	10.0
31	19	9.5
32	23	11.5
33	25	12.5
34	22	11.0
35	21	10.5
36	10	5.0
37	10	5.0
38	3	1.5
39	8	4.0
40	0	0.0
41	3	1.5

TABLE 5

Distance from Posterior Aspect of Hard Palate to Middle of Greater Palatine Foramen

distance (mm)	number (n = 185)	Percent
3.0	8	4.32
3.5	0	0.00
4.0	5	2.70
4.5	3	1.62
5.0	26	14.05
5.5	8	4.32
6.0	9	4.86
6.5	17	9.18
7.0	21	11.35
7.5	20	10.81
8.0	31	16.75
8.5	8	4.32
9.0	15	8.10
9.5	4	2.16
10.0	4	2.16
10.5	0	0.00
11.0	3	1.62
11.5	2	1.08
12.0	1	0.54

TABLE 6

Distance from Tip of Hamular Process of Pterygoid to Middle of Greater Palatine Foramen

distance (mm)	n = 164	Percent
5.0 - 5.5	1	0.60
6.0 - 6.5	2	1.21
7.0 - 7.5	4	2.43
8.0 - 8.5	9	5.48
9.0 - 9.5	21	12.80
10.0 - 10.5	14	8.53
11.0 - 11.5	31	18.90
12.0 - 12.5	20	12.19
13.0 - 13.5	15	9.14
14.0 - 14.5	17	10.36
15.0 - 15.5	8	4.87
16.0 - 16.5	9	5.48
17.0 - 17.5	9	5.48
18.0 - 18.5	1	0.60
19.0 - 19.5	2	1.21
20.0 - 20.5	1	0.60

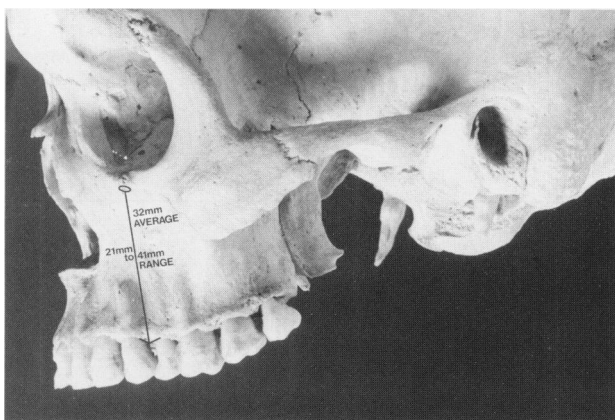


Figure 3

Measurement of IOF to maxillary bicuspid alveolar crest.

amed. Twenty-seven percent were less than 6.5 mm. from the end of the hard palate, while 24% were greater than 8.0 mm.

Relationship of the GPF to Hamular Process of Pterygoid

The hamular process bears a constant relationship in the sagittal plane to the GPF. Palpation of the hamular process of the pterygoid aids in locating the GPF.⁽⁴⁾ The distance from the tip of the hamular process to the middle of the GPF was measured (table six). The recorded distance (n=164) ranged from 3.0 to 20 mm. In 72% of the skulls the measurements were between 9.0 and 14.5 mm. The average distance from the tip of the hamular process to the middle of the GPF was exactly 12.0 mm.

CLINICAL APPLICATION

Discussion

Employing the figures obtained above, the following is a description of the greater palatine canal approach to the maxillary nerve block.

The patient is placed in the dental chair in a supine or semisupine position, with the mouth opened widely. It has been our experience that a mouth prop greatly facilitates access and visibility, and assists the patient in maintaining an adequately opened mouth throughout the procedure.

The greater palatine foramen is located using a cotton applicator stick applying pressure to the palatal mucosa at the junction of the hard palate and the alveolar process, or palpating with a fingertip, on the hamular process to orient the proper sagittal

plane. The foramen, when located, will cause the cotton swab to "fall" into the soft tissue of the palate. The GPF will most often be located between the middle of the 2nd molar and the middle of the third molar. This site will be approximately 7 mm. from the end of the hard palate or 12 mm. directly anterior to the tip of the hamular process of the pterygoid.

Topical anesthesia is applied to the soft tissues directly over the GPF for at least one full minute, and then pressure anesthesia is applied, using the cotton swab. Used correctly, these two procedures can eliminate most of the discomfort involved in the initial phase of this technique.⁽¹⁾

Using a 25 gauge long needle (32 mm. in length), the palatal mucosa is entered at an angle of approximately 45 degrees to the long axis of the hard palate (figure 2). Small amounts of local anesthetic solution are deposited during needle advancement through the soft tissues covering the hard palate to minimize discomfort and to anesthetize the periosteum. If the needle does not immediately enter the GPF, "step" the needle around in the region until the foramen is located.

Once the GPF is located, advance the needle slowly until it has been inserted 32 mm. In the typical adult patient the needle tip will lie within 2-3 mm. of the pterygopalatine fossa. The measurement of 32 mm. from the IOF to the alveolar crest of bone in the "average" patient does not take into consideration the 3-4 mm. of palatal soft tissues overlying this bone, nor the 1-2 mm. of soft tissues overlying the alveolar crest between the bicuspid.

In patients who anatomically are smaller than average size, it is recommended that the distance from the infraorbital foramen to the alveolar crest between the bicuspid be recorded and this number be employed as the depth of penetration through the GPC. A piece of rubber dam may be placed on the needle at the correct measurement to prevent overinsertion, however unless sterile dam is used, needle contamination may occur, leading to an increased risk of post-injection infection.

In 17% of the skulls studied, the length of the GPC was in excess of 35 mm. In such patients needles longer than 32 mm. might be employed, although little difficulty has been encountered in these patients using the 25 gauge, 32 mm. long dental needle.

There is surprisingly little discomfort experienced by the patient during needle advancement. There is little need for deposition of small volumes of anesthetic solution. The needle should be advanced slowly, in the sagittal plane without veering laterally or medially, until the correct depth has been reached. Never force the needle. When resistance is encountered the needle should be withdrawn 1 mm., the angle change slightly, and the needle advanced again. In this manner the correct depth of penetration can almost always be achieved.

Aspiration is performed prior to injection, and if negative, 1.8 ml. of local anesthetic solution is de-

posited slowly. The patient usually feels little or nothing during the deposition of the solution but may experience a sensation of pressure behind the maxilla on the side of injection.⁽²⁾

Onset of palatal anesthesia is almost immediate, with profound anesthesia developing within 5 to 7 minutes. The only area where occasional difficulty in achieving profound anesthesia has been encountered is the labial surface of the incisor teeth, and their pulpal innervation. Should this occur, either infraorbital nerve block, or supraperiosteal (infiltration) injection will provide the necessary anesthesia. Most often the one GPF injection will achieve a maxillary nerve block with anesthesia of the hemimaxilla for 3 to 3.5 hours, when 2% lidocaine with 1:100,000 epinephrine is used.

The most common error occurring during the administration of the maxillary nerve block through the GPC is stepping the needle off the posterior aspect of the hard palate. The administration of the anesthetic solution results in the patient gurgling and swallowing some of the solution, at which point it is obvious that the needle has been improperly placed. A clue to this error prior to injection of the solution is the ease with which the needle "traverses" the GPF. There is absolutely no resistance to needle penetration when the needle enters the nasopharynx. Depositing anesthetic solution off the sagittal plane will result in solution entering the posterior nasal cavity (medially) or the antrum (laterally). This may occur because the bone lining the GPC is often paper thin in these areas.

Complications

Complications of the greater palatine canal approach to the maxillary nerve block are few. They include: inability to obtain anesthesia; the lack of profound anesthesia; and intravascular injection. Anesthesia of the extraocular muscles of the eye may occasionally produce a transient ophthalmoplegia. In a clinical study of 150 maxillary nerve blocks, at Montefiore Hospital & Medical Center, two patients experienced transient ophthalmoplegia which resolved after 60 and 90 minutes, without sequelae.

There were no instances of hematoma formation or persistent paresthesia.

Mercuri⁽²⁾ summarizes the complications of maxillary nerve block and their management.

CONCLUSION:

The greater palatine canal approach to the maxillary nerve is a highly effective method of achieving profound analgesia of the hard and soft tissues of the hemimaxilla with one injection. It is a technique which presents with a low incidence of complications. Unfortunately however, anatomical variation occasionally makes locating and traversing the GPC a difficult endeavor. This study of 204 human skulls seeks to present parameters which will make the

greater palatine approach more readily accessible to the dental and medical professions.

In our clinical studies of the maxillary nerve block via the greater palatine canal, success approximated 90% — defined as adequate anesthesia, not requiring supplemental injections. Procedures performed included multiple restorations, multiple extractions, incision and drainage of abscessed anterior teeth, apical surgery, maxillary antrostomy, diagnostic blocks, and segmental osteotomy.

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Jorgensen Memorial Library

As the official archival repository for the American Dental Society of Anesthesiology, the Jorgensen Memorial Library of the School of Dentistry at Loma Linda University is responsible for collecting and maintaining historical material significant to the development of the ADSA and the field of dental anesthesiology and pain control.

To develop a useful as well as comprehensive archival resource, the Archives Committee must depend on the ADSA membership to assist the Library in its efforts to locate items suitable to the collection. Needed information may be divided into four major areas: First, *archival material by and about the ADSA*, including records and minutes of committees; interim and annual meetings; presidential correspondence; official publications; and minutes and records of special conferences, conventions, or seminars. Second, *oral and written history of the ADSA*. Third, *selected materials relating to dental anesthesiology, pain control, and the psychotherapeutic management of dental patients*. And finally, fourth, *archival material relevant to the ADSA's early antecedent, the New York Dental Society of Anesthesiology*.

In addition to acquiring the more formalized types of archival materials, the Jorgensen Library also col-

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