



SMU
Sikkim Manipal University



SMU Medical Journal



ISSN : 2349 – 1604 (Volume – 3, No. 2, July 2016) Research article

Indexed in SIS (USA), ASI (Germany), I2OR & i-Scholar (India) and SJIF (Morocco) databases. Impact Factor: 3.835 (SJIF)

Location of greater palatine foramen in the Indian population

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Manuscript received : 04.03.16

Manuscript accepted: 21.04.16

Abstract

Accurate knowledge of the location of Greater palatine foramen (GPF) holds importance not only for anesthesia and analgesia with regard to the Greater palatine nerve, but also for carrying out surgical intervention in the posterior palatal region. The morphometric study was carried out on 100 adult dry, unsexed Indian skulls. These skulls had fully erupted third molar teeth and were free of any pathological changes. The measurements

were taken with divider, Castroviejo callipers, metal scale, flexible scale and digital vernier calliper. The statistical analysis indicated that there was no significant differences in measurements between the right and left sides with regards to distances of the GPF to the midpalatal suture and GPF to posterior border of hard palate. The most common position of greater palatine foramen was found to be opposite the third maxillary molar (77.14%). The bilateral symmetry between the sides of the skull was remarkable. The most common shape of GPF as per our study was oval (95.5%). GPF is a surgical landmarks which is important during resection of palatal tumor or incision and drainage of palatal abscess has to be done or when posterior palatine anesthesia is desired and as an alternative to posterior nasal packing and arterial ligation in epistaxis and is also important for prosthetic dentistry and comparative racial studies.

Key Words: Skull, maxilla, hard palate, soft palate, greater palatine foramen

Introduction

Knowledge of accurate location of Greater palatine foramen (GPF) is crucial for dental surgeons for administering local anesthetic and dental implants placement and for maxillofacial and ENT surgeons for performing palatal osteotomies, sinonasal surgery and operating on palatal tumors [1]. The Greater palatine foramen (GPF) transmits the greater palatine nerve one of the branches of the maxillary division of the trigeminal nerve which is responsible for innervation of posterior part of hard palate. Evaluation of relative position of GPF is required for posterior palatal anesthesia and for blocking the maxillary division of trigeminal nerve. The ability to better and easily anesthetize the maxillary nerve and its branches with a single injection could make it possible to perform surgical procedures such as maxillary sinus elevation for dental implants in the posterior maxilla as routine procedures in private clinics [2].

Grays anatomy states that GPF lies near the lateral border of the transverse palatal [3]. The most common location of the foramen is reported at posterolateral side of hard

palate [4] . Relationship of the GPF as superior to the apices of the third maxillary molar roots is also reported [5] . The most common location of the foramen between the maxillary second and third molars has been also found [6] and most common position of foramen is located distal to mid palatal aspect of upper third molar tooth⁷. In view of these discrepancies among the various investigators it is no surprise that there are repeated failures to locate the GPF for injections and other operative procedures. The present study was conducted with the aim of finding out the exact location and distances of Greater palatine foramen from the important anatomical and surgical landmarks and to find related variations if any.

Material and Methods

The study was conducted on 100 adult human Indian skulls of unknown gender. The collections of crania were unrelated. Measurements were made using divider and then transferred to digital vernier caliper (YAMAYO digital vernier caliper) (**Fig.1: Armamentarium**).



Fig.1 Armamentarium

Bilateral measurements were made on the skulls .The presence and location of accessory foramina (if any) in relation to the key foramina under study were recorded . The shape

of GPF was broadly categorized into round, oval and others (i.e. those foramen which were neither round or oval in shape) .The presence and location of accessory foramina (if any) in relation to key foramina under study was recorded. All measurements were made from the centre of each foramen. The distance of Greater palatine foramen was measured from mid palatal suture, alveolar crest and posterior margin of hard palate. In each case two measurements were taken from diametrically opposite points and mean of these values were taken as the reading.

The following measurements were recorded for the Greater palatine foramen (**Fig.2:**

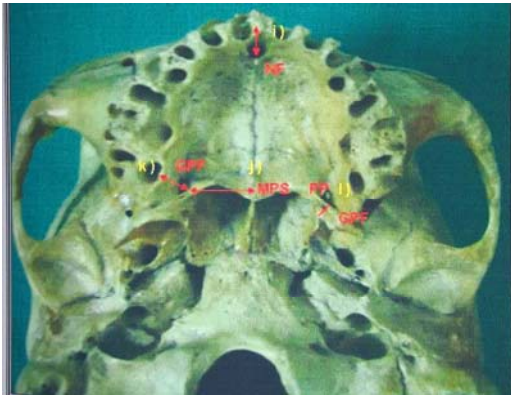


Fig.2 Distances of the key foramina from the surgical landmarks

GPF - Greater Palatine Foramen
MPS - Mid palatal suture

Distances of the key foramina from the surgical landmarks):

- The horizontal distance from centre of the foramen to the mid palatal suture.
- The horizontal distance between the Alveolar crest and centre of Greater palatine foramina.
- The distance from centre of greater palatine foramen to posterior margin of hard palate.
- The position of greater palatine foramen was evaluated in relation to maxillary molar/socket.

The position of greater palatine foramen was recorded as position 1 to 5 in the following manner:-

Position 1- Proximal to second molar

Position 2- Lingual to second molar

Position 3- Interproximal to second and third molar

Position 4- Lingual to third molar

Position 5- Distal to third molar (retromolar)

Results

As evident in **Table-1** distance from centre of Greater palatine foramen to the mid palatal suture was 15.08±1.33 mm on left side and 15.08±1.27 mm on the right side (average distance of GPF to MPS 15.08±1.29 mm). While, the distance of GPF to Alveolar crest on left side was found to be 13.00±2.36 mm on left side and 12.81±2.79 mm on the right side (Average distance of GPF to Alveolar crest 12.91±2.58 mm). Whereas, distance of GPF to posterior palate on left side measured 5.06±1.15mm the same distance on right side measured 5.05±1.08 mm (Average distance of GPF to posterior palate 5.06±1.16 mm).

Table 1: Distance (mm) of greater palatine foramen (GPF) from the surgical landmarks.

S.No.	Parameter	LEFT (Mean±SD)	RANGE	RIGHT (Mean±SD)	Range	PAIRED t-value	Correlation coefficient	Combined	Combined Range
I	GPF – MPS	15.08±1.33	12-18.38	15.08±1.27	11.9- 17.45	-0.1844 ^{NS} (p=0.8541)	0.6931 ^{**} (P0)	15.08±1.29	11.99-18.38
II	GPF to Alveolar Crest	13.00± 2.36	7.2-19.65	12.81±2.79	4.4-21.03	1.007 ^{NS} (P=0.3164)	0.7517 ^{**} (P0)	12.91±2.58	4.4-21.03
III	GPF to Posterior Palate	5.06 ±1.15	1.00-7.77	5.05±1.08	0.5 8.11	0.082 ^{NS} (P=0.9345)	0.7776 ^{**} (P0)	5.06±1.16	0.5-8.11

GPF : Greater Palatine Foramen
SD : Standard deviation

MPS : Mid palatal suture
NS : Non-significant

The data was subjected to paired t-test and the analysis revealed that there was no significant difference (p> 0.05) in the measurement between the right and left side with

regard to distance of the GPF to the midline, to the alveolar crest and to the posterior border of the hard palate .The analysis of the readings showed that correlation coefficient in respect to the three parameters of the greater palatine foramen to be highly significant (Table 2) .

Table 2 Position of Greater Palatine Foramen

Position	Position of greater palatine foramen	LEFT N (%)	RIGHT N (%)	TOTAL (%)
I	Proximal to second molar	1(1.08%)	1(1.08%)	1.08%
II	Opposite Second molar	12(13.04%)	8(8.6%)	10.82%
III	Between Second and third molar	8(8.6%)	10(10.8%)	9.7%
IV	Opposite third molar	70(76.08%)	72(78.2%)	77.14%
V	Distal to Third molar	1(1.08%)	1(1.08%)	1.08%

As regards to position with respect to position with respect to maxillary molar teeth the most common location of greater palatine foramen was found to be position 4 i.e. opposite the third molar (77.14%).The second most common position recorded for GPF was position 2 i.e. Opposite second molar (10.82%).In eight skulls (8.6%) on the left side the foramen was positioned between second and third molars whereas it was seen in this position in 10 skulls (10.8%) on the right side, making the combined percentage of this position to be 9.7% which is close to second most common position observed (opposite second molar) for greater palatine foramen.

In majority of the skulls studied, the greater palatine foramen was oval in shape (Table 3). The other shapes observed in 4.08% cases included lancet and crescent.

Table 3: Shape of greater palatine foramen.

Sr. No.	Shape of Greater Palatine Foramen	LEFT N (%)	RIGHT N (%)	TOTAL
I	Oval	96 (97.95%)	94(95.91%)	95.5%
II	Round	0(0%)	0(0%)	0%
III	Lancet/ Crescent	2(2.15%)	4(4.08%)	4.08

Accessory greater palatine foramen (**Table 4**) was recorded only in 3 out of 100 skulls studied, two of which were found on the right side while one accessory foramen was found on left side.

Table 4 Accessory greater palatine foramina.

Sr. No.	Accessory Greater Palatine Foramen	LEFT N	RIGHT N
I	Absent	98	98
II	Accessory Greater Palatine Foramen	1	2
III	Position	Lateral	Anterior

The accessory exits on the right were placed anterior to the main exit while that on the left was positioned lateral (towards the alveolar crest) to the main exit (**Fig.3**).



Fig.3: Showing accessory greater palatine foramen in skull

Discussion

The landmarks used in the present study for identification of the position of the GPF are simple and can be easily located in living subjects. Even if one of the molar teeth is missing, the teeth immediately mesial or distal to it can help in accurately locating the foramen. The mean distance of the greater foramen from the mid palatal suture recorded in our study was found to be 15.08 ± 1.29 mm with a range of 11.99-18.38 mm. This was

comparable to the results reported by **Westmoreland and Blanton** (1.48 mm on right side and 1.5 cm on left) who carried out study on East Indian skulls [8] , **Langenegger** recorded this distance to be 14.9 mm [7] , **Ajmani** reported this distance to be 1.47 cm on right and 1.46 cms on left in Indian skulls and 1.54 cms both on the left and right in Nigerian skulls [9] , **Jaffar and Hamadah** reported this distance to be 1.57 ± 0.136 cm with a range of 1.22-1.86 cm [10] while **Saralya and Nayak** reported a distance of 14.7 mm which is comparable to the result of our study **Wang et al** reported a slightly higher distance of 16.00 ± 0.14 mm of the greater palatine foramen from the saggital plane [6,11].

The distance of greater palatine foramen from the posterior margin of the hard palate was found to be 5.06 mm on an average in our study and in a range of 0.5-8.11 mm which is in agreement with the results of Jaffar and Hamdah (mean distance 0.486 ± 0.115 cm range 0.24-0.8 cm) [10] and with Wang et al 4.11 ± 0.14 mm [6] , Saralaya and Nayak reported this distance to be 4.2 mm [11] .Our results were not consistent with the results of Ajmani who reported this distance to be 0.35 cm in Nigerian and 0.37 cm in Indian skulls [9] whereas Westmoreland and Blanton found the mean distance of 0.19 cm of the greater palatine foramen from the posterior border of hard palate [8] .This variability in location of the greater palatine foramen has been explained by Ajmani due to sutural growth occurring between the maxilla and palatine bone [9] .

The greater palatine foramen was found to be most commonly found in Position 4 i.e. opposite the third molar in majority of the skulls (77.14%) this was in agreement with study of Saralaya and Nayak (74.6%) [11] , Westmoreland and Blanton [8] , Langenegger [7] and Ajmani [9].

Ajmani reported the greater palatine foramen to be opposite the third molar in 64.7% of the Indian skulls studied, on the contrary [9] , Wang et al reported the most common location of greater palatine foramen as between second and third maxillary

molars[6] and Jaffar and Hamadh reported the most common location to be medial to the third maxillary molar [10].

In the 100 skulls studied by us, greater palatine foramen in 95.5% of the cases was found to be oval in shape. This is in agreement with the findings of Langenegger et al who reported oval in 99% of the foramen studied [7]. Jaffar and Hamadh found the greater palatine foramen to be elongated anteroposteriorly in 97% of the cases [10].

Conclusion

The results of this study would be of great significance when a trigeminal nerve second division block is needed. Knowledge of the surgical landmarks with respect to the GPF will be important when resection of palatal tumor is required or incision and drainage of palatal abscess has to be done or when posterior palatine anesthesia is desired and as an alternative to posterior nasal packing and arterial ligation in epistaxis. It is also important for prosthetic dentistry and comparative racial studies.

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