A Morphologic and Morphometric Study of the greater palatine foramen:
An osteological study in Upper Egypt

By

Mohammed, A.Desouky (a), Salwa, M. Ouies (b) and Abeer,F. Abd EL Naeem (c).

(a) Professor of anatomy & Embryology. Faculty of Medicine. Al-Minia University.
(b) Lecturer of anatomy& Embryology. Faculty of Medicine .Sohag University.
(c) Assistant lecturer.Anatomy & Embryology department. Sohag University.

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Abstract:

Background: Evidence supports a clear racial variation in the position of the greater palatine foramen. Therefore detailed knowledge of the population specific data on biometric features of the greater palatine foramen will facilitate therapeutic, local anesthetic and surgical manipulations in the maxillo-facial region.
Aims & Objective: The goal of this study was to elucidate the morphological features and precise anatomical position of the greater palatine foramen in relation to the molar tooth .
Materials and Methods: A total of one hundred adult dry skulls were assessed to determine the position, shape, and straight distance from it to incisive foramen. The position of the greater palatine foramen was determined in relation to the maxillary molars.
Result: The results indicated that 47% opposite 3rd molar.27%opposite 2nd molar.26% between 2nd and 3rd molars. Distance from incisive foramen: on the right side it varied between 30.01to 40.94mm. On the left side it varied between 32.1to 41.4 mm.
Conclusion: The GPF is most frequently palatal to the third maxillary molar. For an edentulous patient the distance from incisive foramen was about 30mm.
Keywords: greater palatine foramen, 3rd molar, incisive foramen.

Introduction:

The hard palate is formed by the union of palatine processes of the maxilla anteriorly and the horizontal plates of the palatine bone posteriorly **(Chrcanovic and Custódio, 2010; Ilayperuma et al., 2014).**The foramen located postero-laterally, on either side of the bony palate marks the greater palatine foramen (GPF). It represents the lower end of the greater palatine canal which transmits the greater palatine vessels and nerve from the pterygopalatine fossa (**Williams et al., 2000 and Teixeira et al., 2010).**
The anterior (greater) palatine nerve supplies the main sensory innervation to the palate. It is a branche of the maxillary nerve and passes through the greater palatine canal (GPC) to surface on the hard palate from the greater palatine foramen (GPF), and continues anteriorly, ending just short of the front incisors (**Sharma & Garud, 2013).**
It supplies mucosa of hard palate, medial wall of maxillary sinus and posterior aspect of lateral wall of nose. Identification of GPF is of prime value for dentists and the oral and maxillofacial surgeons **(Viveka and Kumar, 2016).**

A large body of evidence shows a clear racial variation in the morphometry and relative position of the greater palatine foramen in relation to the maxillary molars among different populations **(Jaffar and Hamadah, 2003; Methathrathip et al., 2005; Saralaya and Nayak,2007 ; Chrcanovic and Custódio, 2010).** It is also interesting to note that traits such as localization of the foramina not only differ between populations of different geographic zones but also within the inhabitants of the same geographic environment **(Saralaya and Nayak, 2007; Ilayperuma et al., 2009;).**

Numerous methods have been employed to produce profound regional anesthesia of the maxillary arch (**Ilayperuma et al., 2014),** the most commonly described route of administration is inserting a needle into the greater palatine canal through the greater palatine foramen and depositing the local anesthetic solution into the superior aspect of the pterygopalatine fossa, where the trunk of the maxillary nerve lies **(Baddour, 1979 & Piagkou et al., 2012**).

The maxillary nerve block is an effective method of achieving profound anesthesia of the hemimaxilla in maxillofacial surgery **(Ashwini and Jaishree, 2014**). It is useful in procedures involving quadrant dentistry or in extensive maxillary surgical procedures **(Chopra et al., 2016)** to allow exodontia, palatal surgery, quadrant restorative dentistry, Caldwell-Luc procedure or periodontal therapy **(Lepere, 1993).**

What is more, accurate GPF localization is needed when aiming to mobilize the greater palatine artery during oroantral fistulae closure using mucoperiosteal pedicled palatal flaps **(Bell, 2011 and Piagkou et al.,2012)** or during palatal mucosa graft or during palatal mucosa graft harvesting for periodontal proposes**(Klosek and Rungruang, 2009).**

Materials and Methods:

The present study was conducted on 100 adult dry skulls obtained from the Department of Human Anatomy on 100 dry, adult human skulls irrespective of sex, randomly selected obtained from Anatomy department of medical College of Qena ,Sohag, Assiut and El-Menya university. The observations were measured on both Right & Left sides in each skull measured. Unequivocal and well defined points were selected for evaluation. The following measurements and observations were made: (a) location of the foramen in relation to maxillary molar teeth**(Chopra et al., 2016)**., (b) distance from the anterior wall of the GPF to the posterior border of the incisive foramen**(Chrcanovic and Custódio, 2010)**(Figure.1) and(c)measurement of antero-posterior and transverse diameter of the foramen **(Kumar et al., 2015)**. The average, largest, and smallest sizes of the different foramina were listed. All these data were measured using a digital vernier calliper with an accurate resolution up to 0.01mm **(Sethi et al., 2014).**

Morphometric and Statistical analysis:

The metric data was analysed statistically with SPSS version 16 **(Sethi et al., 2014)**.Statistical evaluations were performed for each measurement:

- The mean, ± standard deviation of mean.
- The student comparisons t-test, and value were performed to determine if there was a significant difference between the right and left sides **(Sangari et al., 2015).**

Finally the significance was considered according to the level of significance p value as follows:P ≥ 0.05 non significance.

P* ≤ 0.05 significant.

P **≤ 0.01 highly significant.

P***≤0.0001 very high significant**.**

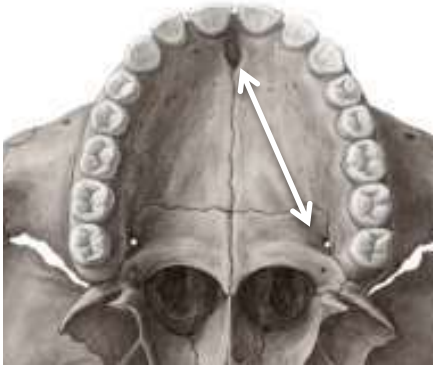

Fig 1. base of skull. arrow between greater palatine foramen and incisive foramen

RESULTS

A) Site: 47% opposite 3rd molar.27%opposite 2nd molar.26% between 2nd and 3rd molars (figure2).

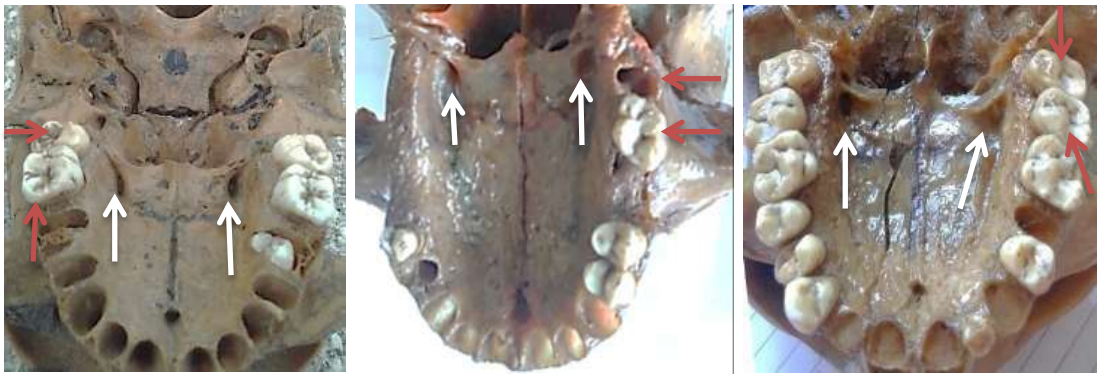

Figure (2): Site of greater palatine foramen (white arrow) (A): Opposite 2nd molar (B)opposite 3rd molar (C)between 2nd and 3rd molars(red arrows).

B) Distance from incisive foramen: on the right side it varied between 30.01to 40.94mm. On the left side it varied between 32.1to 41.4 mm (Table1).

	Mean distance from incisive foramen
Right foramen	36.59±2.87mm
Left foramen	36.737±2.90mm

Table (1): Mean distance of greater palatine foramen from incisive foramen.

C) Size: On the right side: AP. Diameter varied between 2.3 -6.42mm. Transverse diameter varied from1.76-5.27 mm.
On the left side: AP. Diameter varied from 2.11-7.26mm.Transverse diameter varied from 1.85- 4.29(table 2) and (Figure 3).

	AP. diameter	Transverse. diameter
Right side	4.45 ±1.01mm	3.35± 0.79mm
Left side	4.50 ±1.12mm	3.26± 0.61mm

Table(2):Mean AP and T diameter of greater palatine foramen in 100 adult skulls.

There was no significant change from right to left side p=0.38(p≥0.05).

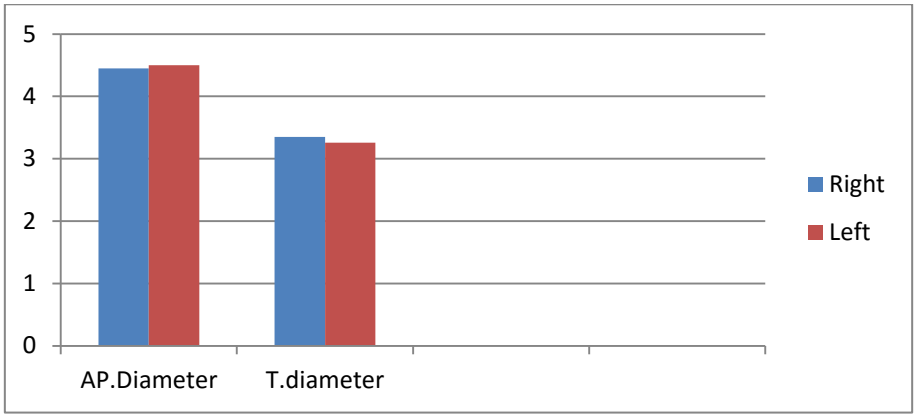

Figure (3): Mean AP and T diameter of greater palatine foramen in 100 adult skulls.

Discussion:

Greater palatine canal approach to maxillary nerve block, demands a perfect three-dimensional orientation of its position. The preliminary step is identification of GPF. Utilizing multiple anatomical landmarks to identify the GPF increases the accuracy and minimizes the complications of injecting anaesthetic drug **(Viveka and Kumar, 2016).**
The present study provides valuable new data pertaining to the greater palatine foramen in relation to the surrounding anatomical landmarks in upper Egypt Population specific linear measurements have a clinical implication as it will enable clinicians to locate the greater palatine foramen in a consistently reliable manner thus avoiding injury to the neurovascular bundle that exit through it.
The modal position of the greater palatine foramen in the presnt study was 47% opposite 3rd molar. 27% opposite 2nd molar.26% between 2nd and 3rd molars. **Ilayperuma et al., 2014** on study on136 dry skulls found that in Sri Lankans it was in line with the long axis of the third upper molar (55.56%).While it was in majority of the skulls (77.14%) in study of **Chopra et al.,2016** who studied on 100 dry skulls. Also in study of **Saralaya and Nayak, 2007** (74.6%) , but different from Chinese where it was found predominantly between the second and third molars **(Wang et al., 1988).**

The results of the current study further highlight the racial differences in the modal position of the greater palatine foramen in relation to the upper molars observed among different populations. Such diversity in the location of greater palatine foramen may be attributed to ethnic factors **(Cutright et al., 2003).**
The anatomy of the GPF is bound to gain even more attention, as through the GPF it is possible to stimulate the pterygopalatine ganglion **(Piagkou et al., 2012).** This can be used in stroke patients to reduce the stroke's effect, but also to intervene in patients with cluster and migraine headaches, as well as cerebral vasospasm conditions **(Oluigbo et al.,2011).**
In the present study,the distance from the GPF to the incisive fosse was 36.59mm on right and 36.73 mm on left. The distance from the GPF to the incisive fosse was 37.3 mm on the left side and 37.2 mm on the right side in the study of **Saralaya and Nayak, 2007** which was close to those of the present study. The mean distance on the right side was 36.21 ± 3.16 mm (and 36.52 ± 3.34 mm on the left side in the study of **Chrcanovic and Custódio, 2010**. While by **Viveka and Kumar, 2016** it was 39.67mm right and 37mm on left.

Conclusion: Since a significant difference in the different parameters were found in studies when compared with other authors from different region of world, this clearly indicates that anthropologically, the positions of the GPF differ among ethnic groups. The present data will be helpful in comparing the skulls with those from various other regions as well as skulls of different races. The data of the present study will also be helpful for clinicians anaesthetists and as well as for maxillofacial surgeons.

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