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MORPHOMETRIC STUDY OF THE HARD PALATE AND LOCALIZATION OF GREATER PALATINE FORAMEN

Anatomy

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ABSTRACT

Greater palatine nerve blocks are administered to anesthetise palatal soft tissues distal to maxillary canines. So, the knowledge of the normal morphology of the hard palate and position of the greater palatine foramen (GPF) is of utmost importance to dentists and oral maxillofacial surgeons. The aim of this study was to analyse the variations in the dimensions of the hard palate and to localise the greater palatine foramen with reference to certain standard landmarks. 60 adult Indian skulls of unknown sex were studied for shape, mastoid-to-mastoid length, palatal length, palatal width, the relative position of the greater palatine foramen to the maxillary molars on either side and the distance of the right and left greater palatine foramen from the incisive fossa and the median palatal suture. Skulls were classified based on palatal index.

KEYWORDS

Greater Palatine Foramen, Palatal length, Palatal width, Palatal Index.

INTRODUCTION

The hard palate is an integral part of the skull that forms the floor of the nasal cavity and the roof of the oral cavity. The anterior two-third of the palate is formed by the palatal process of the maxillary bones while the posterior one-third is formed by the horizontal process of the palatine bones. The mid palatine suture (MPS) divides the palate in the midline into two halves. The palate is thicker anteriorly than posteriorly and has passages for numerous nerves and vessels. Along the posterolateral border of the hard palate, near its junction with the alveolar process of the maxilla, is the greater palatine foramen (GPF) on either side through which the greater palatine nerves and vessels emerge. The greater palatine nerve, branch of the maxillary division of the trigeminal nerve originates as the maxillary nerve, courses through the pterygopalatine fossa and via the greater palatine canal emerge on the inferior surface of the hard palate through the GPF. The soft tissues of the hard palate are innervated by the greater palatine nerves up to the level of the canines anteriorly and medially till the midline of the palate on the corresponding side. [1]

The nerves are accompanied by the greater palatine vessels originating in the pterygopalatine fossa as branches of the third part of maxillary artery and coursing through the greater palatine canal reach the GPF to emerge and supply the palate. [1]

Any surgical or dental procedure that involves the palatal soft tissues or the teeth up to the canines requires a palatal block. This includes simple dental procedures like endodontic procedures and extractions to complex procedures like cleft repair and hemi maxillectomy. Hence, blocking this nerve becomes an essential part of all procedures involving the maxillary teeth and the palatal soft tissues.[1]

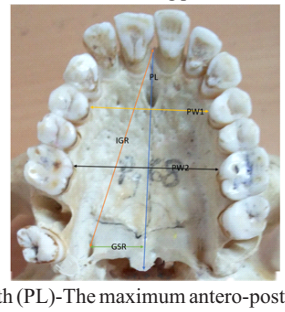
To anesthetise the mucosa and teeth of the hard palate, two approaches are commonly followed. One is a direct greater palatine nerve block at the GPF while the other is the maxillary nerve block given directly in the pterygopalatine fossa. This in turn can be attained through the high tuberosity approach or through the greater palatine canals. The major disadvantages with the high tuberosity approach are the risk of a developing a hematoma and the risk of over insertion as there are no bony landmarks available to follow. A maxillary nerve block is a single nerve block that blocks all innervation to one half of the maxilla. The greater palatine canal is the most easily accessible and reliable route of approach to the maxillary nerve situated in the pterygopalatine fossa. The location of the GPF is hence imperative to administer the block accurately be it to anesthetise the greater palatine nerve alone or the maxillary nerve as a whole. [2]

The present method followed is to locate the GPF by applying pressure on the palate (using a cotton swab) and feeling for a depression on the palate. This method is not very reliable as it is not based on any reference landmarks and is purely based on the tactile sensation of the practitioner. This has led to a decline in the usage of this technique even though it provides reliable anaesthesia and is relatively atraumatic. [2, 3]

This study aims to localise the position of the GPF with reference to reliable bony landmarks on the adult hard palate to aid in proper nerve block techniques with minimum trauma and maximum patient compliance even in the absence of teeth. [2]

MATERIALS AND METHODS

60 unsexed adult Indian skulls were obtained from the bone bank in the Department of Anatomy, AIMS, Kochi, India. The mastoid-to-mastoid length from the lateral border of the base of one mastoid to the other was measured with digital Vernier callipers. Standard procedures were followed for fixing the skull, camera height and the focal length to obtain pictures of the base of the skulls. Using the photo measure software and keeping the mastoid-to-mastoid length as the required reference measurement, the following parameters were measured:



1. Palatal length (PL)-The maximum antero-posterior distance of the hard palate from the anterior margin of the incisive fossa to the posterior nasal spine.
2. Palatal width (1) (Pw1)– The transverse distance between the inner alveolar margin of the hard palate measured at the level of the 1st maxillary premolar
3. Palatal width (2) (PW2) – The transverse distance between the inner alveolar margin of the hard palate measured at the level of the 1st maxillary molar.
4. Palatal index (PI)= Palatal width at the level of the 1st maxillary molar / Palatal length x 100
5. The distance from the anterior margin of the incisive fossa to the anterior margin of the GPF on the right (IGR) and on the left (IGL).
6. The perpendicular distance from the median palatal suture to the GPF on right and left sides (SGR and SGL).
7. The relation of the greater palatine foramen to the maxillary

molars on either side.
8. The shape of the foramen.

The data was analysed statistically for mean and standard deviation of the variables. PL of each skull was correlated with IGR and IGL using Pearson correlation. Similarly, PW of each skull was correlated with SGR and SGL. The results were compared with contemporary studies. Based on PI the palates were classified as follows
(a)Leptostaphyline: Narrow palate with PI <80%.
(b)Mesostaphyline: Intermediate palate with PI 80-85%.
(c)Brachystaphyline: Wide palate with PI >85%.

RESULTS

The mean PL, PW, PI of the present study were found to be 45.67 ± 5.723 mm, 35.14 ± 4.025 mm and 77.52 ± 9.265 respectively. Most skulls analysed in the present study showed Leptostaphyline characteristics, followed by Mesostaphyline and Brachystaphyline. The mean distance of the GPF form the MPS was found to be 13.34 ± 1.642 mm on the right and 13.88 ± 1.656 mm on the left side.The mean distance between the GPF and the incisive fossa was found to be 40.99 ± 4.719 mm and 40.86 ± 4.634 mm on the right and left sides respectively.The most common location of the GPF was found to be opposite the third molars (40%) followed by between second and third molars (35%), distal to the third molars (20%) and opposite the second molars (5%).Ellipse (55.09%) was found to be the most common shape of the GPF followed by slit like (22.14%), circular (13.12%) and triangular (10.65%) shapes.

There is strong positive correlation between the values of PL with IGR and IGL with a significance of p<0.001(for both). There was also a strong positive correlation of the values of PW2 with distances of the GPF from the MPS with statistical significance of p<0.001 (for both).

DISCUSSION

The PL, PW, PI of the present study were found to be 45.67 ± 5.723 mm, 35.14 ± 4.025 mm and 77.52 ± 9.265 respectively. The results were very similar to the results obtained by Anil Kumar *et al*, Hassanali and Mwaniki obtained similar results on Kenyan skulls, with PL of 49.2 ± 3.6 mm, PW of 40.2 ± 3 mm and PI of 82.01 ± 7.84. Dave *et al* obtained PL of 43.54 ± 0.28 mm, PW of 33.83 ± 0.2 mm and a PI of 77.97 ± 7.02 on Indian skulls. Erli Sarlita *et al* obtained a PL of 52.2 ± 3.2 mm, PW of 37.97 ± 3.32 mm and a PI of 73 ± 7.72 on Indian skulls. Tomaszewska *et al* obtained a PL of47 ± 4.5 mm, PW of 46.9 ±3.3 mm and a PI of 99.8 ± 5.4 on Polish skulls.Values of the present study have been compared to other studies in Table (1). [4,5,6,7,8,9,10,11]

Most skulls analysed in the present study showed Leptostaphyline (63.3%) characteristics, followed by Mesostaphyline (20%) and Brachystaphyline (16.7%). Narrow palates were found to be the most frequent type of palate in almost all the referred studies except D'Souza *et al*(South Indian skulls) who obtained Brachystaphyline as the most frequent type. This discrepancy could be attributed to the smaller sample number of the referred study. Values of the present study have been compared to other studies in Table (1). [4,6,7,8,9,10,11]

The distance of the GPF form the MPS was found to be 13.34 ± 1.642 mm on the right and 13.88 ± 1.656 mm on the left side. Jotania *et al* obtained a value of 14.8 mm on the right side and 14.83 mm on the left side. Lopes *et al* obtained 15.62 ± 1.33mm on the right side and 15.40 ± 1.41 mm on the left side. Erli Sarlita *et al* obtained 14.02 ± 14 mm and 13.57 ± 1.5 mm on the right and left sides respectively. Distance between the GPF and the MPS on the right and left sides was found to be lesser than the results of other studies. Discrepancies could be attributed to the slight changes in the reference points taken from the MPS.[4,8,9,10,12,13,14,15]

The most common location of the GPF was found to be opposite the third molars (40%). 35% were located between the second and third molars, 20% distal to the third molars and 5% opposite the second molars. Similar results were obtained by Hassanali and Mwaniki (76%), Saralaya and Nayak (74.6%), D'Souza *et al* (73.75%), Jotania *et al* (78.33%) and Erli Sarlita *et al* (58.7%). The least frequent position was opposite the second molar in all the above-mentioned studies. [4,6,9,10,13]

The most common shape of GPF was found to be oval (55.09%) followed by slit-like shape (22.14%), circular (13.12%) and triangular (10.65%). Methathrathip *et al* obtained 82.4% of oval shaped GPF followed by lancet shaped (7.1%), slit-like (5.7%) and circular (4.8%) shapes. Klosek and Rungruang obtained 90% of oval shaped GPF and 10% of circular GPF. Lopes *et al* obtained 56.9% oval shaped, 26.1% slit shaped and 17% circular. Erli Sarlita *et al* obtained 57.1% oval shaped, 30.2% slit shaped and 12.7% oval shaped. Values of the present study have been compared to other studies in Table (2). [4,7,8,10,12,14,15]

Table 1 PL, PW, PI and types of palate – Comparing our study with other studies [4,6,7,8,9,10,11]

Study	PL (mm)	PW (mm)	PI	L (%)	M (%)	B (%)
Hassanali and Mwaniki	49.2±3.6	40.2±3	82.01±7.84	43.2	23.7	33.1
Jaffar and Hamadah	50.82±0.53	39.29±3.41	77.6±5.97			
D'Souza (2012)				37.5	22.5	40
Dave *et al* (2013)	43.54±0.28	33.83±0.2	77.97±7.02	63	24	13
Jotania *et al* (2013)	49.74	37.75		70	15	15
Tomaszewska *et al* (2014)	47±4.5	46.9±3.3	99.8±5.4			
Erli Sarlita *et al* (2015)	52.2±3.2	37.97±3.32	73±7.72	84.1	7.9	7.9
Present study	45.67±5.723	35.14±4.025	77.52±9.265	63.3	20	16.7

Table2Comparison of shapes and position of the GFP [4,7,8,10,12,17,18]

Study	Opp2M	2-3M	Opp3M	Distal3M	O	L/S	R	T
Methathrathip *et al* (2005)	5.6	23.1	64.4	6.9	82.4	L-7.1 S-5.7	4.8	
Klosek and Rungruang (2009)	F-35.7 M-65	F-35.7 M-10	F-14.3 M-25		90		10	
Lopes *et al* (2012)					56.9	26.1	17	
Dave *et al* (2013)	1	3	87.5	8				
Jotania *et al* (2013)	4.17	17.5	78.33					
Tomaszewska *et al* (2014)	16.3	6.8	74.7	2.2				
Erli Sarlita *et al* (2015)	4	37.3	58.7		57.1	30.2	12.7	
Present Study	5	35	40	20	55.09	22.14	13.12	10.65

CONCLUSION

The given set of standard values is of utmost importance to oral and maxillofacial surgeons and dental practitioners. The PI is essential for fabricating complete maxillary dentures and in the reconstruction of the hard palate as a part of cleft reconstruction procedures. Due to its easy approachability and accessibility, the greater palatine foramen is the best path to perform the maxillary nerve block to anesthetise the palatal bones, lingual gingival, mucosa and associated soft tissues which is an essential part of routine dental procedures such as extractions, endodontic procedure, etc.The values obtained in this study can be used to localise the GPF on the palate independent of the presence or absence of teeth. This may be followed by tactile confirmation. The newly introduced technique of computer controlled local anaesthetic. Digitally measuring the dimensions of bones enhances the accuracy and reduces subjective bias.The results of this study can be used preoperatively and intraoperatively as a standard for radiographs, moulds and endoscopic techniques. Hence, this study has potential significance to radiologists and surgeons.

REFERENCES

1. Simon Holmes, section editor. Face and Scalp, In: SusanStandring, editor. Gray's Anatomy the Anatomical Basis of Clinical Practice, 41st ed, Britain, Elsevier Limited; 2016. p.484-486.
2. Georges Aoun,Ibrahim Zaarour, SaydeSokhn, Ibrahim Nasseh. (2015). Maxillary nerve block via the greater palatine canal: An old technique revisited; J Int Soc Prev Community Dent., Sep-Oct; 5(5): 359–364.
3. Stanley F. Malamed, Norman Trieger. (1983). Intraoral Maxillary Nerve Block: an anatomical and clinical study. Anesth Prog., Mar-Apr; 30(2): 44–48.
4. ErliSarlita, Roger Soames. (2015). Morphology of The Hard Palate: A Study of Dry Skulls and Review of The Literature. Rev Arg de Anat Clin., 7 (1): 34-43.
5. Anil Kumar, Madan Lal Ajmani, Thomas Heming (2016). Morphological and morphometric study of hard palate in Indian population.Int J Biomedical Research., 7(11): 778-784.
6. Hassanali J, Mwaniki D. (1984). Palatal analysis and osteology of the hard palate of the Kenyan African skulls. Anat Rec., 209: 273-80.
7. Dave MR, Gupta S, Vyas KK, Joshi HG. (2013). A study of palatal indices and bony prominences and grooves in the hard palate ofadult human skulls. NJIRM., 4: 7-11.
8. Tomaszewska IM, Tomaszewski KA, Kmiotek EK, Pena IZ, Urbanik A, Nowakowski M, Walocha JA. (2014). Anatomical landmarks for the localization of the greater palatine foramen– a study of 1200 head CTs, 150 dry skulls, systematic review of literature and meta–analysis. J Anat., 225: 419-35.
9. D'Souza AS, Mamatha H, Jyothi N. (2013). Morphometric analysis of hard palate in south Indian skulls. Biomed Res., 23: 173-75.
10. Jotania B, Patel S, Patel S, Patel P, Patel S, Patel K. (2013). Morphometric analysis of hard palate. Int J Res Med., 2: 72-75.
11. Jaffar A, Hamadah H. (2003). An analysis of the position of the greater palatine foramen. J Basic Med Sci., 3: 24-32.
12. Lopes, P. T. C.; Santos, A. M. P. V.; Pereira, G. A. M. & Oliveira, V. C. B. D. (2011). Morphometric analysis of the greater palatine foramen in dry Southern Brazilian adult skulls.Int. J. Morphol., 29(2):420-423.
13. Ajmani M. (1994). Anatomical variation in position of the greater palatine foramen in the adulthuman skull. J Anat., 184: 635.
14. Bruno R. Chrcanovic and Antônio L. N. Cusótdio, (2010). Anatomic variations in the position of the greater palatine foramen. J Oral Sci.
15. Urbano E, Melo K, Costa S. (2010). Morphologic study of the greater palatine canal. J Morphol., 27: 102-04.
16. Saralaya V, Nayak SR. (2007). The relative position of the greater palatine foramen in dry Indian skulls.Singapore Med J., Dec;48(12):1143-6.
17. Methathrathip D, Apinhasmit W, Chompoopong S, Lertsirithong A, Ariyawatkul T, Sangvichien S. (2005). Anatomy of greater palatine foramen and canal and pterygopalatine fossa in Thais: considerations for maxillary nerve block. SurgRadiolAnat., 27: 511-16.
18. Klosek SK, Rungruang T. (2009). Anatomical study of the greater palatine artery and related structures of the palatal vault: considerations for palate as the subepithelial connective tissue graft donor site. SurgRadiolAnat., 31: 245-50.