

Short Report

Anatomical variation in position of the greater palatine foramen in the adult human skull

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ABSTRACT

Sixty-five Nigerian and 34 Indian adult human skulls with full eruption of the 3rd molar teeth were examined to ascertain the location of the greater palatine foramen. The location of the foramen from the posterior border of the hard palate was quite consistent, being 0.35 cm in Nigerian and 0.37 cm in Indian skulls. The usually accepted description as opposite the upper 2nd molar was observed for only 13.1% of foramina in Nigerian skulls. The most common position of the foramen was found to be medial or opposite the 3rd maxillary molar, the next most common being between the 2nd and 3rd maxillary molars. The direction of opening of the foramen into the oral cavity was inferiorly in an anteromedial direction in 58.5% Nigerian and 91.1% Indian skulls. In 38.5% Nigerian skulls the opening was in an anterolateral direction. A bilaterally symmetric bony projection extending from the posterior margin of the foramen was observed in 24.6% of the Nigerian and 35.3% of Indian skulls. The palatal vault of was U-shaped in all instances, its height varying from flat to 0.3–0.8 cm.

Key words: Hard palate; molar teeth.

INTRODUCTION

Blocking of the maxillary division of the trigeminal nerve or its branches for local anaesthesia is a common practice in maxillofacial surgery. The route utilised in the oral cavity is through the greater palatine foramen to enter the palatine canal which contains the palatine nerves and vessels. The published descriptions of the position of this foramen in the adult human skull have not been consistent. Most current English language textbooks locate the foramen only in a general way, e.g. near the lateral palatal border (Williams et al. 1989), in the posterolateral border (Gardner et al. 1975), medial to the last molar (Moore, 1980) or opposite the last molar (Romanes, 1981). Textbooks on anaesthesia are somewhat more specific in relating the position of greater palatine foramen to the molar teeth. Accordingly, this is stated to be opposite the 2nd molar (Selden, 1948), opposite the 3rd molar, or anywhere between the 2nd and 3rd molars (Shane, 1975).

In view of the limited anthropometric studies and discrepancies between standard anatomy texts, this study was undertaken to define the position of the greater palatine foramen relative to the maxillary molars in Nigerian and Indian skulls. The study also examined the variability in the direction of opening foramen into the oral cavity and the presence of a bony projection extending from the posterior margin of the foramen.

MATERIAL AND METHODS

The study was conducted on 65 Nigerian and 34 Indian dry, unsexed, adult human skulls available in the Department of Anatomy, Faculty of Medicine, Uni-Jos, Nigeria and the All India Institute of Medical Sciences, New Delhi, over a period of 6 years. Skulls taken for this study were normal and had a full complement of teeth with fully erupted 3rd molars.

Unequivocal and well defined points were selected for evaluation. The following measurements and

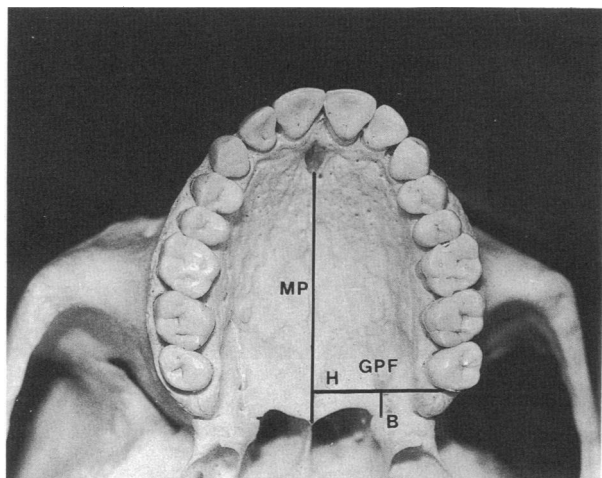


Fig. Illustration indicating the measurement points. MP, sagittal plane; GPF, greater palatine foramen; H, horizontal line; B, distance from posterior border of the hard palate.

observations were made (see Fig.). (1) Location of the foramen in relation to maxillary molar teeth. (2) Distance from the middle of the greater palatine foramen to the sagittal plane. (3) Distance from the middle of the greater palatine foramen to the posterior border of the hard palate. (4) Direction of opening of the foramen onto the palate. (5) Presence of a bony projection. (6) Shape of the palatal vault.

Table 1. Incidence of variation in the location of the greater palatine foramen in relation to maxillary molars in Nigerian skulls

Group	Opposite 2nd molar	Between 2nd & 3rd molars	Medial to 3rd molar	Opposite 3rd molar	Distal to 3rd molar
Right	7	24	28	6	—
Left	10	26	24	5	—
Total	17	50	52	11	—
Percentage	13.07	38.46	40.0	8.46	—

Table 2. Incidence of variation in the location of the greater palatine foramen in relation to the maxillary molars in Indian skulls

Group	Opposite 2nd molar	Between 2nd & 3rd molars	Medial to 3rd molar	Opposite 3rd molar	Distal to 3rd molar
Right	—	10	9	14	1
Left	—	12	6	15	1
Total	—	22	15	29	2
Percentage	—	32.35	22.05	42.64	2.94

RESULTS

Observations concerning the relative position of the greater palatine foramen to the maxillary teeth are presented in Tables 1 and 2. In majority of the Nigerian (48.5% foramina) and Indian (64.7% foramina) skulls, the greater palatine foramina were medial or opposite to the 3rd maxillary molar; 13% of foramina were opposite the 2nd molar in Nigerian skulls. The statistical significance of variations in the frequencies of the locations of the foramen in relation to the maxillary molar teeth was assessed by χ^2 analysis. No significant relationships were detected ($P > 0.05$ for both the Nigerian and the Indian subjects).

The mean distance from the sagittal plane to the greater palatine foramen on the right side was 1.54 ± 0.021 (s.d.) cm in Nigerian skulls. Of the 65 foramina, 30 (46.1%) were exactly 1.52 cm from the sagittal plane. On the left the foramen had a mean distance of 1.54 ± 0.021 cm. Of the 65 foramina on the left, 30 (46.2%) were 1.56 cm from the sagittal plane. In Indian skulls the mean distance measured from the sagittal plane to the foramen was almost the same on both sides, being 1.47 ± 0.096 cm on the right and 1.46 ± 0.108 cm on the left. Of the 68 foramina, 6 (17.6%) on each side measured 1.6 cm from the sagittal plane.

The distance from the posterior border of the hard palate to the greater palatine foramen was fairly consistent. The mean on the right was 0.35 ± 0.021 cm in Nigerian and 0.37 ± 0.115 cm in Indian skulls; the mean distance on the left was 0.35 ± 0.021 cm in Nigerian and 0.37 ± 0.138 cm in Indian skulls. Of the 65 Nigerian skulls, 26 (40%) foramina on the left were 0.36 cm and 29 (44.6%) foramina on the right 0.37 cm from the posterior border of the hard palate.

DISCUSSION

In this study the location of the foramen was more variable than is implied by authors of anatomy texts. According to Slavkin et al. (1966) the greater palatine foramen is located 1–3 mm distal to the 3rd maxillary molar in adult skulls. Westmoreland & Blanton (1982) observed only 6% foramina distal to the 3rd molar. In the present study, 2.9% foramina were distal to 3rd maxillary molar in Indian skulls, and 48% in Nigerian and 64% in Indian skulls were located medial or opposite to the 3rd maxillary molar. These observations support the findings of Westmoreland & Blanton (1982). In Nigerian skulls, 13.1% of foramina were opposite the second molar. Westmoreland & Blanton (1982) found 9.7% of foramina to be medial

to the 2nd molar. In the present study, which was conducted on adult crania, the molar-foramen positional relationship was the same bilaterally. In infants and children the relative location of the greater palatine foramen moves posteriorly as the next posterior tooth erupts (Slavkin et al. 1966).

Based on the mean measurements, the foramen was located 1.54 cm from the sagittal plane in Nigerian skulls and 1.47 cm on right and 1.46 cm on the left in Indian skulls. According to Westmoreland & Blanton (1982) the distance from the sagittal plane to the greater palatine foramen on the right had a mean of 1.48 cm and 1.5 cm on the left. The distance from the posterior border of the hard palate to the foramen was fairly consistent. In the present material it was 0.35 and 0.37 cm in Nigerian and Indian skulls respectively. Westmoreland & Blanton (1982) found a mean distance of 0.19 cm from the posterior border of the hard palate. Variability in location of the foramen may be due to sutural growth occurring between the maxilla and the palatine bone. The anteroposterior dimension of the palate increases with the eruption of the posterior teeth (Slavkin et al. 1966).

The opening of the foramen was directed inferiorly in an anteromedial direction in 38 (58.7%) Nigerian and 31 (91.4%) Indian skulls. In a relatively large number of Nigerian skulls (38.7%) the opening of the foramen was directed anterolaterally, pointing towards the maxillary molars. This observation may explain the occasional difficulty encountered while attempting to insert the point of needle into the greater palatine foramen and pterygopalatine canal. According to Slavkin et al. (1966) the frequency of anatomical obstruction of the needle increases with

age. Westmoreland & Blanton (1982) reported that the opening of the foramen was directed inferiorly (vertically) from the hard palate in 82% skulls.

A bony projection along the posterior margin of the foramen was observed in 16 (24.6%) of Nigerian and 12 (35.3%) of Indian skulls. It is formed by the raised posterior margin of the foramen. Although it has no apparent clinical significance, it may be helpful at times in providing an anatomical obstruction to the needle and preventing clinical hazards associated with the injection. The bony projection was observed in 16% of skulls by Westmoreland & Blanton (1982).

All the skulls in the present study were characterised by a U-shaped palatal vault. The height of the U varied from flat to 0.3–0.8 cm. A similar finding was obtained by Westmoreland & Blanton (1982).

REFERENCES

- GARDNER E, GRAY DJ, O'RAHILLY R (1975) *Anatomy*, 4th edn, p. 997. Philadelphia: W. B. Saunders.
- MOORE KL (1980) *Clinically Oriented Anatomy*, 1st edn, p. 1004. Baltimore: Williams and Wilkins.
- ROMANES GJ (1981) *Cunningham's Textbook of Anatomy*, 12th edn, p. 116. New York: Oxford University Press.
- SELDEN HM (1948) *Practical Anesthesia for Dental and Oral Surgery*, 3rd edn, p. 206. Philadelphia: Lea and Febiger.
- SHANE SME (1975) *Principles of Sedation, Local and General Anesthesia in Dentistry*, 1st edn, p. 173. Illinois: Charles C. Thomas.
- SICHER H (1960) *Oral Anatomy*, p. 438, St Louis: C. V. Mosby.
- SLAVKIN HC, CANTER MR, CANTER SR (1966) An anatomic study of the pterygomaxillary region in the craniums of infants and children. *Oral Surgery* **21**, 225–235.
- WESTMORELAND EE, BLANTON PL (1982) An analysis of the variations in position of the greater palatine foramen in the adult human skull. *Anatomical Record* **204**, 383–388.
- WILLIAMS PL, WARWICK R, DYSON M, BANNISTER H (1989) *Gray's Anatomy*, 37th edn, p. 354. London: Longmans.