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Case report

The location of the mental foramen in a selected Malay population

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Abstract: Knowledge of the position of the mental foramen is important both when administering regional anesthesia and performing periapical surgery in the mental region of the mandible. This study determines the position of the mental foramen in a selected Malay population. One hundred and sixty nine panoramic radiographs of Malay patients retrieved from a minor oral surgery waiting list were selected to identify the normal range for the position of the mental foramen. The foramen was not included in the study if there was any mandibular tooth missing between the lower left and right first molars (36-46). The findings indicated the most common position for the mental foramen was in line with the longitudinal axis of the second premolar (69.2%) followed by a location between the first and second premolar (19.6%). The right and left foramina were bilaterally symmetrical in three of six recorded positions in 67.7% patients. The mental foramen was most often in line with the second premolar. (J. Oral Sci. 45, 171-175, 2003)

Key words: mental foramen; location; Malay; radiograph.

Introduction

The mental foramen is defined as the entire funnel-like opening in the lateral surface of the mandible at the terminus of the mental canal (1). This foramen is contained entirely within the buccal cortical plate of bone. The average size of the foramen is 4.6 mm horizontally and 3.4 mm vertically on the lateral surface of the mandible. The foramen is usually larger on the left side of the mandible. Based on its radiographic appearance, the mental foramen has been classified by Yosue and Brooks (2) into four types:

- Type I: mental canal is continuous with the mandibular canal
- Type II: the foramen is distinctly separated from the mandibular canal
- Type III: diffuse with a distinct border of the foramen
- Type IV: "unidentified group"

The mental foramen marks the termination of the mandibular canal in the mandible, through which the inferior alveolar nerve and vessels pass. At this point, the mandibular canal bifurcates and forms the mental and incisive canals (3). The mental bundle passes through the mental foramen and supplies sensory innervation and blood supply to the soft tissues of the chin, lower lip and gingiva on the ipsilateral side of the mandible (4).

The accurate identification of the mental foramen is important for both diagnostic and clinical procedures. The radiographic appearance of the mental foramen may result in a misdiagnosis of a radiolucent lesion in the apical area of mandibular premolar teeth. Clinically, the mental bundle could be injured during surgical procedures, resulting in paraesthesia or anesthesia. Generally the mental foramen is difficult to locate (4). There are no absolute anatomical landmarks for reference and the foramen cannot be clinically visualized or palpated. As a result, the reported anatomical position of the mental foramen has been variable. Most studies and textbooks however, describe the location of the mental foramen as being below the apex of the second premolar or between the apices of the first and second premolars (1,3,5-8).

As the location of the mental foramen in Malay

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population has not been described previously, this study was undertaken to determine the most common (modal) position of the mental foramen in a selected population using orthopantomograms. Factors influencing its identification also were examined.

Materials and Methods

The method employed is similar to that described by Al Jasser and Nwoku (7). One hundred and sixty nine panoramic radiographs of Malay patients taken from 1992 and 2000, were obtained from the minor oral surgery waiting list kept in our Department of Oral and Maxillofacial Surgery. The panoramic radiographs belonged to the patients who attended because of third molar impaction and fully erupted permanent dentition. Patients with mixed dentitions were eliminated because of the possibility that a permanent tooth bud might obscure the mental foramen.

All panoramic radiographs were taken by Siemen Orthophos® and Planmeca®. The magnification factors reported by the manufacturers were 1.2 and 1.25, respectively. The radiographs were chosen according to the following criteria:

1 High quality with respect to angulation and contrast.
2 All mandibular teeth from the right first molar to the left first molar were present.
3 Radiographs in which the lower teeth (between 36 and 46) were missing, had deep caries, root canal treatment or various restorations were eliminated because of a possible associated periapical radiolucency.
4 The films must be free from any radiolucent or radiopaque lesion in the lower arch and showed no radiographic exposure or processing artifacts.
5 Radiographs that showed the lower canine was missing were excluded because of the possibility of mesial premolar drift.
6 Panoramic radiographs in which the mental foramen could not be identified were excluded.

The position of the image of the mental foramen was recorded as follows:

Position 1: Situated anterior to the first premolar.
Position 2: In line with the first premolar.
Position 3: Between the first and second premolar.
Position 4: In line with second premolar.
Position 5: Between the second premolar and first molar.
Position 6: In line with the first molar.

The position of the mental foramen was recorded in line with the longitudinal axis of a tooth using the edge of a metal ruler. If the mental foramen was too large or was between two teeth, the position of the foramen was indicated by drawing an imaginary line parallel to the long axis of the teeth. In addition, the side that showed more radiolucency was designated the side for mental foramen analysis.

In agreement with Yosue and Brooks (2), when there

Table 1 Frequency of location of mental foramen in 161 Malay patients (n = 322)

Position	Male		Female		Total	
	Freq.	(%)	Freq.	(%)	Freq.	(%)
1	0	0	0	0	0	0
2	7	3.5	4	0.03	11	3.4
3	40	19.8	23	19.2	63	19.6
4	139	68.8	84	70	223	69.2
5	14	6.9	8	6.7	22	6.8
6	2	0.9	1	0.8	3	0.9
Total	202	100	120	100	322	100

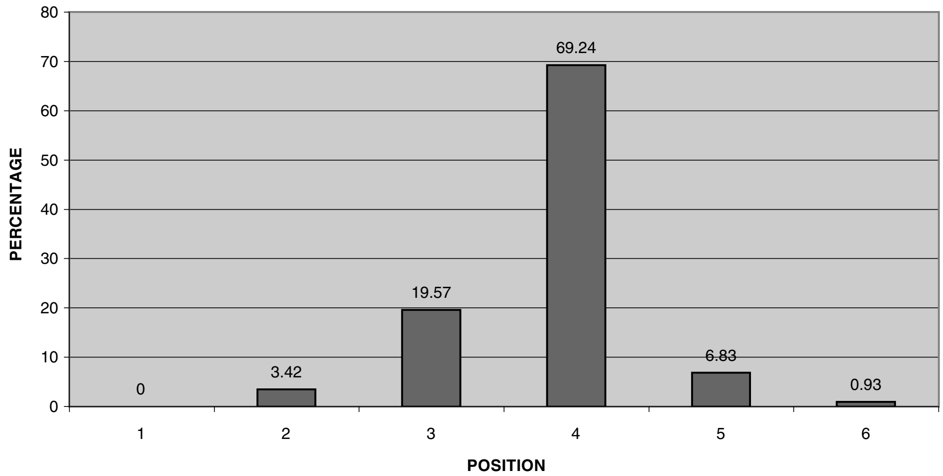

Fig. 1 Distribution of mental foramen on panoramic radiographs of selected Malay patients.

appeared to be multiple foramina, the true radiographic mental foramen was considered to be the uppermost one, closest to the mandibular canal (2,9).

Results

Of the 169 panoramic radiographs analyzed, 161 showed a mental foramen on both sides. In the remaining eight, the mental foramen was unilateral. These radiographs were excluded from the study.

The mean age of the patients was 24.8 years. The youngest patient was 14 years old and the oldest was 43 years old. Sex analysis showed a higher male percentage (62.7%). The male to female ratio was about 10:6.

The most common (modal) position for the mental foramen relative to the teeth in this sample was in line with the second premolar for both the right and left side (n = 223, 69.24%). The second most common location was between the first and the second premolar (position 3) (n = 63, 19.57%) (Fig. 1). No case was noted in position 1.

Position 4 was also the most common position among the males (n = 139, 68.8%) and females (n = 84, 69.2%). No case was noted in position 1 (Table 1).

The mental foramen was symmetrical in 109 (67.7%) radiographs with the remaining 52 (34.2%) being asymmetrical. For the symmetrically placed mental foramina, the most common position was position 4 (n = 88, 80.7%), followed by position 3 (n = 15, 13.9%). No case was noted in position 1 and 6 (Fig. 2).

The asymmetrical mental foramina were found most commonly on the right side, with the highest frequency at position 4 (n = 24, 51.1%), followed by position 3 (n = 13, 27.7%). This is followed by position 5 (10.6%), position 2 (n = 4, 8.5%) and position 6 (n = 1, 2.1%) respectively (Table 2). The findings were the same on the left side, only the percentage was slightly lower for position 4 (n = 23, 44.2%) (Table 2). No case was noted in position 1 for both sides.

Discussion

The present study provides new data on the position of the mental foramen in the Malay population. This group is of interest because it represents an estimated population of 250 million Malays in Malaysia, Indonesia and the Malay Archipelago.

Anatomically, the mental foramen is the opening of the short mental canal, a branch of the mandibular canal. Although on most standardized panoramic radiographs, the radiographic landmarks of the mental foramen can be seen, the appearance of these landmarks varies without any change of radiographic quality.

Of twelve current, readily available editions of books on dental analgesia, nine indicate that the mental foramen is most commonly found between the apices of the first and second premolar. Although this teaching is in accord with the results of early studies of some European populations, it ignores completely a mass of more recent

Table 2 Distribution of asymmetrical mental foramina in 52 Malay patients

Location	Right	(%)	Left	(%)	Total	(%)
1	0	0	0	0	0	0
2	4	8.5	5	9.6	9	9.1
3	13	27.7	15	28.8	28	28.3
4	24	51.1	23	44.2	47	47.5
5	5	10.6	7	13.5	12	12.1
6	1	2.1	2	3.8	3	3
Total	47	100	52	100	99	100

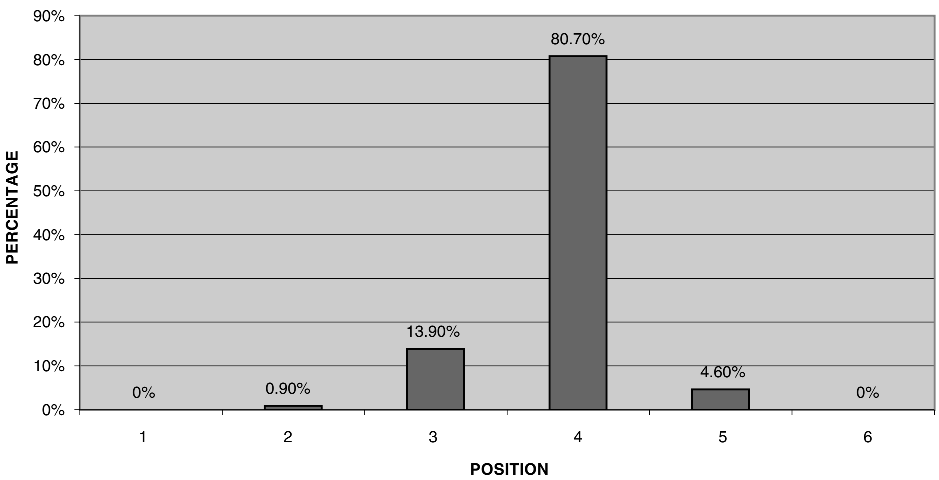

Fig. 2 Distribution of symmetrical mental foramina in 109 Malay patients.

data and is therefore misleading (1,3,4,7,10).

In the analysis of 161 panoramic radiographs in this study, it was found that the mental foramen was positioned anywhere between the long axis of the canine to that of the mesiobuccal root of the first molar. This agrees with the findings of other researchers (3,7,11,12). However, the most common position was in line with the longitudinal axis and apex of the second premolar (n = 223, 69.2%) followed by the position between the first and second premolar (n = 63, 19.6%); with these two positions making an overall prevalence of 88.8%. This is in agreement with previous Western and Asia studies (3,10,11).

In eight samples, the mental foramen was only noted on one side. Yosue and Brooks suggested that the reason for the absence of the mental foramen included the inability to distinguish it from the trabecular pattern in complete dentition radiographs and over-exposed radiographs (9). The reason for the difference in position could be due to the shape of the foramen itself. The mental foramen is a funnel-shaped opening in the buccal cortical bone of the mandible (1). The direction of exit through the bone is usually in a posterior and superior direction (4,13). The smallest diameter of the foramen would usually be inferior and mesial to the buccal surface of the mandible. It appears that the radiographic foramen corresponds to the smallest diameter of the foramen on the internal surface of the buccal plate. This also would be the area where the mental canal joins the cortical bone (1).

Kjaer has found that the prenatal location of the mental foramen is in the alveolar bone between the primary canine and first molar (14). It is possible that positions other than the two most common ones we described could be due to a lag in prenatal development (14). Also, the position of the mental foramen changes with age, the alveolar bone, and loss of teeth (5). Green reported a clear racial trend in the anterior posterior position of the mental foramen, it being more anterior in the Caucasoid groups (10).

Panoramic radiographs were utilized because they have certain advantages over intra-oral radiography. These include a greater area of hard and soft tissue and also the ability to visualize adjacent areas, thus allowing for a more accurate localization of the mental foramen in both the horizontal and vertical dimensions. Periapical radiographs do not reveal the position of the mental foramen if it falls below the edge of the film (1,15). Our study was limited to adult patients, because in a mixed dentition, permanent tooth buds might obscure the mental foramen (12).

This study demonstrates that the mental foramen can easily be identified on panoramic radiographs. However, as the bone density increases, the foramen becomes more difficult to identify and it may not be seen clearly even with optimal illumination. Yosue and Brook classified these examples as the 'unidentified type' (9).

When panoramic radiographs were taken with proper patient position, there usually will be limited horizontal overlap of teeth. However, variations in facial characteristics of patients, associated with growth and development as well as errors in patient positioning, can lead to mesial or distal angulation of the X-ray beam (2). Besides, the greatest image distortion was found when the patient's head was positioned too far anteriorly and posteriorly (8) and the appearance of the mental foramen changes with the position of the mandible (8). The distortion and magnification factors inherent in the orthopantomogram techniques cannot be eliminated if the image is too sharp. Since interpatient variation with respect to position in the focal plane will always be present, the distortion and magnification will consequently vary from one patient to another. Therefore, this technique is unsuitable for studies requiring quantitative measurement without the incorporation of a correction factor for each patient (16). The radiation beam of the panoramic machine comes from the lingual side of the mandible. Therefore, there would be a greater separation between the apex and the mental foramen because of the buccal object rule (15).

Dental anthropologic studies of the origin and the variation of the human dentitions, is a useful tool because the physical anthropologist relies upon the mental foramen in the identification of species, races and determining age. Structures useful for identification purposes include size, number and location of cusps, occlusal pattern, root configurations, number and arrangement of teeth, and individual tooth measurements (17).

Dental texts do not deal with the influences that known racial variation in tooth form may have upon the tooth morphology and root canal anatomy. The detailed morphologic structure that reflects the results of isolation, inbreeding, hybridization, drift and other phenomena responsible for the genetic composition of populations, makes dental analysis of human groups of great significance in the identification and classification of races. These populations, over varying periods of time and to varying degrees, have maintained endogamous breeding. The teeth manifest certain states of physiologic disequilibrium that, either in the past or at the moment, odontogenetically speaking, have occurred or are occurring. It is often stated that the gross morphology of the entire dentition is governed strictly by the action of genes (18).

For example, the lower first premolar, which shows an extremely wide range of morphologic variability, is less inclined towards occlusal wear because of the inclination of its masticatory surface and apparently has not been subjected to much scrutiny. Kraus and Furr found the addition of genes governing dental features to a small pool of human genes for common phenotypic traits would be of great significance for furthering our understanding of the dynamics of human evolution, race and population genetics (18). We believe that the location of the mental foramen in relation to the lower first and second premolar is influenced by genes.

Lastly, the Malays are Mongoloid. From the study of anthropology, there are two patterns of Mongoloid dental variation (19). One is the Sundadonts pattern typical of South-East Asia, occurring in the Malays, Southern Chinese, Thai, Nepalese, Burmese, Indonesians and Pacific Islanders. The other, the Sinodont pattern typically of North-East Asia occurs in Northern Chinese, Eskimo and North and South American Indian. Also, there are variations in the modern Southeast Asian mainland, as the typical Sundadonts possesses some Sinodonts characteristics, though the population of early Southeast Asian mainland has the typical Sundadont pattern (19). It is not surprising that our findings are similar to those reported by Green on the Southern (Hong Kong) Chinese, as both the Southern Chinese and Malays are genetically related (Mongoloid with Sundadonts) (10).

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