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Radiographic assessment of variation in horizontal position of mental foramen in Indian population on panoramic radiographs: A retrospective study

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Running title: Radiographic assessment of variation in horizontal position of mental foramen

Clinical Significance: The mental foramen (MF) is an important landmark located on the anteroinferior aspect of the body of the mandible.

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ABSTRACT

The mental foramen (MF) is an important landmark commonly encountered in various craniofacial, maxillofacial, plastic surgery procedures, in anesthetics, during placement of implants and even in forensics. There may be differences concerning the shape and position of the foramen. The foramen either may be completely absent or may show the presence of accessory foramina.

The mental nerve that emerges through this foramen may be damaged and cause temporary or permanent thermal, sensitive, or even tactile changes.

Objectives: To determine the most common horizontal position of the mental foramina in a selected population, and to compare the results with those reported for other populations.

Materials and Methods: Two hundred digital panoramic radiographs (DPR) were selected, and the position of mental foramen was recorded about the longitudinal axis of the nearest mandibular tooth.

Results: The most common position of the mental foramen was located in line with the longitudinal axis of the second premolar (54%); followed by the site between the first and second premolars (33.5%). Mental foramen was bilaterally symmetrical in 74% of the radiographs.

Conclusion: Studies and textbooks mention the location of the mental foramen in the Indian population as being predominantly located below the apex of the second premolar or between the apices of the first and second premolars; thereby showing agreement with our findings.

Keywords: Horizontal position; mental foramen; panoramic radiograph, Bangalore population

INTRODUCTION

The mental foramen (MF) is a funnel- shaped opening, usually located closer to the anterior and inferior border of the mandible. It marks the end of the mandibular canal. The mental nerve passing through it is one of the end branches of inferior alveolar nerve. [1] It innervates and supplies the facial structures, such as the soft tissues of the chin, lower lip, and gingiva on the ipsilateral side of the mandible. [2] The foramen is invariably manipulated during various surgical procedures that are performed in the anterior region of the jaws; causing the mental nerve to be easily damaged during the administration of local anaesthetics, surgical procedures and implant placements. It is, therefore, imperative to have a method, which aids in accurate prediction of its location. Variations in the position of mental foramen are common, which may lead to perio-operative complications. [3,4]According to Moiseiwitsch, individual variations could place the mental foramen anywhere below the canine, to a point between the roots of the first molar.[5]

The location of mental foramen has been studied in various populations. Yosue and Brooks,[6,7]classified the panoramic appearance of the mental foramen as:

- continuous,
- separated,
- diffuse, or
- unidentified type.[7]

Panoramic radiographs are the commonly used diagnostic radiographic aids, for imaging the mandible. Mental foramen is best identified in this type of radiograph. Advanced imaging techniques are expensive and have high radiation exposure.[5]

Literature findings, to determine the location of mental foramen on panoramic radiograph in the Indian population,are very limited. Hence, this study was conducted to document the location, symmetry, and variations in the position of the mental foramen on panoramic radiographs.

MATERIALS AND METHODS

Digital panoramic radiographs (DPR) of randomly selected 200 patients of Indian origin; among whom 97 were males and 103 were females; were retrospectively analyzed. All patients were over 18 years of age.

Criteria for radiograph selection included:

- All radiographs must be of dentate mandible
- Free from radiolucent or radiopaque lesions.
- Radiographs that showed drifting crowding, spaced lower teeth, or previous orthodontic treatment was excluded from the study.
- High- quality images with proper angulations, contrast and reduced artefacts in the mental foramen region.
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- Cases, where the upper premolars were missing were excluded because of the chance of an over eruption of lower premolars which can alter the location of the mental foramen.
- MF unidentified on radiograph was also excluded.

All DPRs were taken by maintaining standard criteria (tube potential: 60-90 KV, tube current: 2-15 mA, and time: 14 s). Three observers, including the principle observer, read the DPRs. The principle observer calibrated the readings. Any difference in the observations was settled with forced consensus.

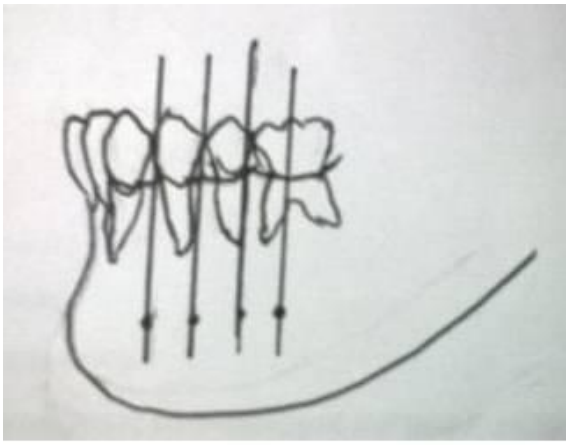
The position of the MF was recorded according to a modified Haghanifar and Rokoue scale as follows (**Figure. 1**)

- Position 1: Situated anterior to the first premolar
- Position 2: In line with the first premolar
- Position 3: Between the first and second premolars
- Position 4: In line with the second premolar
- Position 5: Between the second premolar and mesial root of the first molar
- Position 6: In line with the mesial root of the first molar

A calibrated scale was used to identify the longitudinal axis of the nearest tooth, and its location about the MF was recorded. The position of the mental foramen on the right and left side was recorded. (**Figure 1**)

Figure 1: Figure showing the variations in the position of the mental foramen on the mandible

FIGURE 1



RESULTS

The most common location of the mental foramen in this series was found in line with second premolar (position4 =54%); followed by the location between first and second premolars (position 3= 33.50%); between second premolar and mesial root of first molar (position 5= 10.25%); in line with the mesial root of first molar (position 6=1.25%), in line with first premolar (position 2= 1.9%). [**Table1]**

Table 1: Percentage distribution of Mental Foramen according to position

TABLE 1

Position	No. of MF	%age
1	-	-
2	4	1.00
3	134	33.50
4	216	54.00
5	41	10.25
6	5	1.25
Total	400	100.00

In both males and females, position 4 (54.1% and 53.9%) was found to be the most common position of MF followed by position 3 (34% and 33%) respectively.[**Table 2]**

Table 2: Percentage distribution of Mental foramen between the genders

TABLE 2

Position	Male		Female	
	Frequency	%	Frequency	%
1	-	-	-	-
2	1	0.5	3	1.5
3	66	34.0	68	33.0
4	105	54.1	111	53.9
5	22	11.3	19	9.2
6	-	-	5	2.4
Total	194	100.0	206	100.0

The location of MF was bilaterally symmetrical in 74% of cases [**Table 3]**.

Table 3: Symmetry of location of the Mental foramen

TABLE 3

Position	Symmetry		
	Male	Female	Male &Female%
1	-	-	
2	-	-	-
3	27	24	34.4%
4	42	41	56%
5	6	6	8.1%
6	-	2	1.5%
Total	75	73	100%
Total	148		74%

For the symmetrically placed MF, the most common location was position 4 (56%), followed by position 3 (34.4%).

DISCUSSION

The mental foramen has been identified either by studying radiographs of patients or by directly measuring it on dry mandibles.

Panoramic radiographs depict the mandible as a single dimension image; thus allowing for an accurate positioning of both mental foramina. Periapical radiographs do not reveal its location if it lies outside the border of the film**.** Comparative analysis between right and left foramina was difficult to detect on other radiographs. [4, 5, 6, 7]

Predominant observations in various studies have shown that the position of the mental foramen was located along the long axis of the second premolar; [8, 9, 10]others have reported it to lie between the first and second premolars, with individual variations occurring occasionally. [11,12,13]However, in many studies it was found to lie between the canine and the mesial root of the first molar; and its location below the canine or first molar was either absent or very rarely present. [11]

In our analysis of 200 panoramic radiographs, the most common location of the foramen was in line with apex of second premolar (position 4=54%); between first and second premolar (position 3=33.51%); between second premolar and mesial root of first molar (position 5= 10.25%); in line with the mesial root of first molar (position 6=1.25%); and in line with first premolar (position 2= 1%). No mental foramen was found at position 1.

Position 4 and position 3 contributed to an overall prevalence of 87%. These locations of the MF comprised of the maximum number of cases, in our review of the literature.

There is no consensus regarding the normal position of the mental foramen in different populations. A study on Indian population, showed that these two positions (position 4 and position 3) are the most common, and was seen in 81.1% of population; [4]and in the Iranian population, position 3 and 4 were found in 93.2% cases, according to the study conducted by Sina Haghanifer et al. [8]

Studies conducted by authors such as Moiseiwtsch; [5] Rupesh et al.[14] Taseir Al-Khateeb et al[.15] and Olasoji et al.[16]in different ethnic populations, reported that the foramina was located precisely between the two premolar

However, studies conducted on populations, such as the Asian Indians, by Shankland, [10]Central regional Indians, by S Gangotri, [17]Malays, by Ngeow and Yuzawati, [18]black Zimbabweans, by Mbajiorgu,[19]Kenyan Africans, by Mwaniki and Hassanali,[20]Iraqis, by Muhsen, [21]Saudis, by Al-Jasser and Nwoku, [22]and Koreans, by Kim, [23]have indicated that MF, is most commonly positioned in line with the second premolar (position 4).

Mental foramen was symmetrically located in the majority (74%) of our cases, but the percentage is somewhat lower as compared to other populations. It was 90.4% in Turkish, 77% in North Jordanian, 82.7% in Kurdish and Iranians with 85.7% of symmetry. [17]Study on the Asian Indians reported a decreased incidence of symmetry. (57%). [17]

There is nostudy, that showed 100% symmetry, in the mental foramen positioning; therefore clearly indicating that MF is not always symmetrical in every individual.

The reason for the variance in the location and symmetry of the MF in various populations can be attributed to genetic factors, diet and local factors in the growth and development of the mandible.

CONCLUSION

Mental foramen exhibits variance in position, symmetry and size being located in various positions about the mandibular teeth. It is usually located below the mandibular second premolars or near the site between the first and second premolars with a high percentage of symmetry. Hence, it is advisable to assess this important landmark before initiating any surgical procedures in the area.

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