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RADIOGRAPHIC LOCALIZATION OF MENTAL FORAMEN IN A SELECTED INDIAN POPULATION

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ABSTRACT

Objective: The purpose of this study was to determine the most common location of the mental foramen (MF), its gender differences and bilateral symmetry in a selected Indian population and to compare the results with those reported for other populations.

Materials and Methods: 500 digital panoramic radiographs (DPR) of a randomly selected Indian population were retrospectively studied.

Results: The commonest position of the mental foramen was located between the first and second premolars (46.1%) followed closely by in line with the longitudinal axis of the second premolar (45.5%). MF was symmetrical in 64.8% of patients.

Conclusions: Mental foramina are usually symmetrically located either mesial to or in line with second premolar, consistent with previous findings in other ethnic and racial groups.

INTRODUCTION

Knowledge of location of mental foramen is very important for correct administration of local anesthesia, diagnostic and treatment purposes in order to avoid damage to the mental nerve. Generally, the mental foramen is difficult to locate due to lack of consistent anatomical landmarks for reference and the foramen cannot be clinically visualized or palpated.[1] Most studies and textbooks describe its common location as either below the apex of the second premolar [1-7] or in between the apices of the first and second premolar.[8-11] Others reported that both locations are common. [12-14] According to Moiseiwitsch, individual variation could place the MF anywhere from below the canine to between the roots of the first molar. [8] However, no investigator stated its common position below the canine or first molar or even first premolar. Despite the advanced imaging, the panoramic radiographs are commonly used especially to study the mandible, since advanced imaging cannot be used routinely because of high radiation exposure, cost and availability.

According to Yosue and Brooks, [15, 16] the panoramic appearance of the mental foramen has been be classified into four types: in the first mental canal is continuous with the mandibular canal; the second is the separated type, where the foramen is distinctly separated from the mandibular canal; a third is said to be diffuse with a distinct border of the foramen, while the fourth group is so called 'unidentified type. The location of mental foramen has been studied in different populations. As data on the Indian population is limited [17, 18], this study focuses on the usual radiographic position of the mental foramen in a randomly selected larger series of Indians using DPR.

MATERIAL AND METHOD:

2200 digital panoramic radiographs of randomly selected Indian patients who were referred to our Maxillofacial Diagnostics, (Jaipur, Rajasthan, India) over a period of two years prior to October 2012 were retrospectively analyzed.

All DPR were taken by Kodak Dicom 8000 system (tube potential: 60-90 KV, tube current: 2-15 mA, and time: 14 s). The magnification factor reported by the manufacturers was 1.2. Total 500 radiographs (354 males and 146 females) were selected after certain exclusion criteria. All radiographs were of dentate subjects, especially with erupted premolars and first molars. In addition, the radiographs were of high quality with respect to angulation and contrast, free from radiolucent or radiopaque lesions in the lower arch and showed no exposure or processing artifacts. DPR where the MF could not be identified were excluded. These were considered to be those classified as 'unidentified type' of MF [15, 16]. In agreement with Yosue and Brooks, [15, 16] when there appeared to be multiple foramina, the true radiographic MF was considered to be the uppermost one, nearest the mandibular canal. According to Kjaer, [19] the location of the mental foramen could change during the development of the jaws, therefore the subjects over 18 years of the age were chosen for the study. Other exclusion criteria were radiographs of patients with drifted, crowded or spaced lower teeth and previous orthodontic treatment as these conditions could cause teeth migration leading to false interpretation of the

location of the MF in relation to the teeth. The youngest patient was of 18 years old and the oldest of 64 years with a mean of 30.6 years.

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 premolars
Position 4: In line with second premolar
Position 5: Between the second premolar and mesio-buccal root of first molar
Position 6: In line with the mesio-buccal root of first molar

The position of the MF was recorded according to Haghanifar and Rokouei [20]. We used the edge of a ruler to identify the longitudinal axis of the nearest tooth and the position of the mental foramen was recorded in relation to this. If the mental foramen was too large or was situated between two teeth, the position of the foramen was established after drawing an imaginary line parallel to the long axis of the teeth [21]. All DPRs were analyzed by two of our authors, both oral radiologists (VK) and (AJ) who were blind to each other. When disagreement existed, a final diagnosis was reached by forced consensus. The location and symmetry or asymmetry of the mental foramen was reported on the basis of the gender.

Results

Of the 500 panoramic radiographs analyzed, 354 were males and 146 females. The most common location of the mental foramen in this series was found in between the first and the second premolars (position 3= 46.1%), followed by in line with second premolars (position 4= 45.5%), position 5 (distal to second premolar= 6.5%) and position 2 (in line with first premolar= 1.9%) **[Table1]**. No case found in position 1(mesial to first premolar) and 6 (in line with the mesio-buccal root of first molar).

Table 1 Distribution of mental foramina in horizontal relation to the apices of teeth on the panoramic radiographs of 500 Indian subjects (n=1000).

Location	No. of MF	Percentage
1	00	0.0
2	19	1.9
3	461	46.1
4	455	45.5
5	65	6.5
6	00	0.0
Total	1000	100.0

In both males and females, again position 3 (46.4% and 46.1%) was found to be most common position of MF followed by position 4 (45.3% and 45.5%) respectively **[Table 2]**.

Table 2 Frequency of location of mental foramen by gender.

Location	Male		Female		Total	
	Frequency	%	Frequency	%	Frequency	%
1	00	0.0	00	0.0	00	0.0
2	12	1.6	7	2.3	19	1.9
3	329	46.4	132	45.2	461	46.1
4	321	45.3	134	45.8	455	45.5
5	46	6.4	19	6.5	65	6.5
6	00	0.0	00	0.0	00	0.0
Total	708	100.0	292	100.0	1000	100.0

The location of MF was bilaterally symmetrical in 62.8% of cases **[Table 3]**. For the symmetrically placed MF, the most common location was position 3 (29.4%), followed by position 4 (27%). The symmetry of MF in males and females were 57.06% and 76.71% respectively. On the right side, the commonest position of the MF was position 4 (24.1%) and on the left side it was position 3 (23.9%) **[Table 4]**. No statistically significant differences were seen between males and females in symmetry and asymmetry of location of MF in both sides. $P < 0.05$ was taken to indicate statistical significance.

Table 3 Frequency of symmetrical and asymmetrical positioning of mental foramen by gender

Location	Symmetry Frequency (%)		Asymmetry Frequency (%)		P* (Two tailed P value)
	Male	Female	Male	Female	
1	0 (0)	0 (0)	0 (0)	0 (0)	
2	5 (0.5)	5 (0.5)	7(0.7)	2 (0.2)	0.6976
3	187 (18.7)	107(10.7)	142 (14.2)	25 (2.5)	0.1221
4	171 (17.1)	99 (9.9)	150(15.0)	35 (3.5)	0.1963
5	41 (4.1)	13 (1.3)	5 (0.5)	6 (0.6)	0.5287
6	0 (0)	0 (0)	0 (0)	0 (0)	
Total	404 (40.4)	224(22.4)	304 (30.4)	68 (6.8)	
Total	628 (62.8)		372 (37.2)		

* Analysis between male and female based on symmetry and asymmetry parameters

Table 4 Distribution of location of mental foramen on right and left sides by gender

Location	Male Frequency (%)		Female Frequency (%)	
	Right	Left	Right	Left
1	0 (0)	0 (0)	0 (0)	0 (0)
2	5 (0.5)	7 (0.7)	3 (0.3)	4 (0.4)
3	163 (16.3)	166 (16.6)	59 (5.9)	73 (7.3)
4	171 (17.1)	150 (15.0)	70 (7.0)	64 (6.4)
5	24 (2.4)	22 (2.2)	11 (1.1)	8 (0.8)
6	0 (0)	0 (0)	0 (0)	0 (0)
Total	363 (36.3)	345 (34.5)	143 (14.3)	149 (14.9)
Total	708 (70.8)		292 (29.2)	

DISCUSSION

Panoramic radiography (PR) shows greater part of maxilla-facial skeleton as a continuous image, thus allowing for a more accurate localization of both mental foramina in both vertical and horizontal dimensions. On other hand, periapical radiograph may not reveal the position of the mental foramen if it is below the edge of the film [22]. Comparative analysis between right and left foramen is also difficult on other conventional radiographs. PR with proper patient positioning, there will be insignificant horizontal minification or magnification. Plus, comparartive studies on dry skulls have shown a close correlation with the radiographic location of the mental foramen [1-4, 16]. Therefore, we selected panoramic radiographs free from positioning artefacts to study the positioning of the MF.

According to the most authors the mental foramen is frequently situated along the long axis of the second premolars in the fully developed mandible [1, 2, 5, 18, 21-36]. While some reported it is in between first and second premolars [8, 17, 20, 37-42] but individual variations can occur occasionally.

In our analysis of 500 panoramic radiographs we found the mental foramen anywhere between the long axis

of the first premolar to that of mesial to first molar. However, in many other studies it was found in between canine to that of mesio-buccal root of the first molar but the location below the canine or first molar was either absent or very rarely present. In our case, no mental foramen was found at position 1 and 6. The most common position we found was in between first and second premolar (46.1%) followed by in line with apex of second premolar (45.5%), followed by position 5 (distal to second premolar) (6.5%) and position 2 (in line with first premolar) (1.9%). The first two positions were making an overall prevalence of 91.6%. Both these location of MF are also found most common in almost all of our reviewed literature. Another study on Indian population also showed that these two positions are most common and seen in 81.1% of population [17]. According to study by Sina Haghanifer et al [20] on Iranian population, position 3 and 4 are found in 93.2%.

There is considerable debate regarding the normal position of the mental foramen in different populations. Studies done by Moiseiwtsch [8] in a North American white population, by Rupesh et al [17] in a Asian Indians, by S. Haghanifar et al [20] in an Iranian population, by Taseir AL-khateeb et al [38] in a northern regional Jordanian population and Olasoji et al. [39] in Northern Nigerian adults showed that the most common location of the mental foramen was between first and second premolars. These findings are consistent with our results. However some studies done on similar or different populations such as Asian Indians by Shankland [2], Central regional Indians by S Gangotri [18], Malays by Ngeow and Yuzawati [21], black Zimbabweans by Mbajiorgu [25], Kenyan Africans by Mwaniki and Hassanali [26], Iraqis by Muhsen [27], Saudis by Al-Jasser and Nwoku [5, 29] and Koreans by Kim [36] have indicated that MF is most commonly positioned in line with the second premolar.

Mental foramen was symmetrically located in majority (62.8%) of our cases **[Figure 1 and 2]** but the percentage is somewhat lower as compared to other populations; for example 90.4% in Turkish, 77% in North Jordanian, 82.7% in Kurdish and Iranians with 85.7% of symmetry. However, lower percentage of symmetry was also found in other studies on Asian Indians. [17, 18] No single study showed 100% of symmetry of mental foramen positioning on both sides that clearly indicate MF is not always symmetrical in same individual.

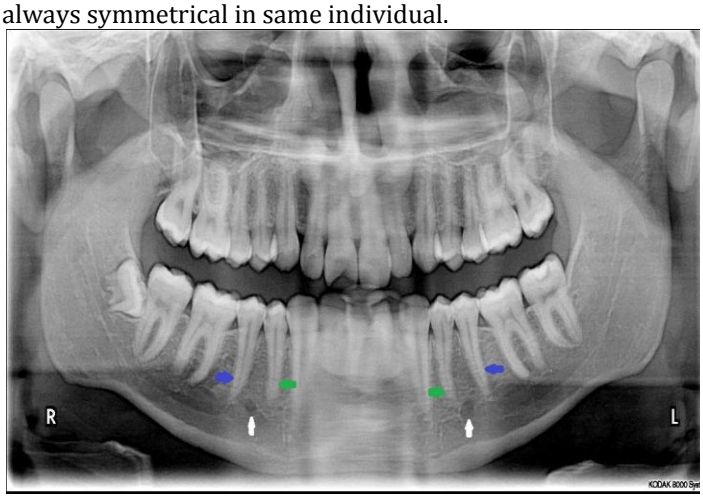

Figure 1 Panoramic radiograph shows the location of mental foramen (white arrow) is present in between first (green arrow) and second (blue arrow) premolar on both right and left side indicating bilateral symmetry.

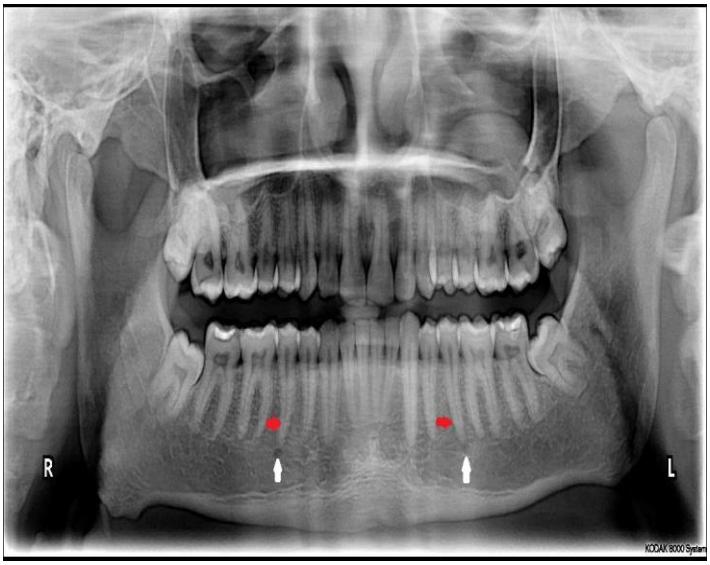

Figure 2 Panoramic radiograph shows horizontal positioning of the mental foramen (white arrow) is in line with second premolar (red arrow) on both right and left side indicating bilateral symmetry.

No significant differences were seen between males and females either in positioning or symmetry of the mental foramen in our as well as reviewed studies. It would therefore appear that, the location of the MF is not gender-dependent. Ngeow and Yuzawati [21] stated that this location of the mental foramen in relation to the first and second premolars is influenced by genes and that other positions could be due to a lag in the prenatal development. Most studies indicated that MFs are usually symmetrically located at either position 3 or 4 but in some (small percentage) cases it can be found asymmetrical **[Figure 3]** and at other positions. Therefore, our reasoning for the difference in the positioning and symmetry of the MF in different populations might be influenced majorly by the genes then followed by environmental and local factors of growth and development of the mandible.

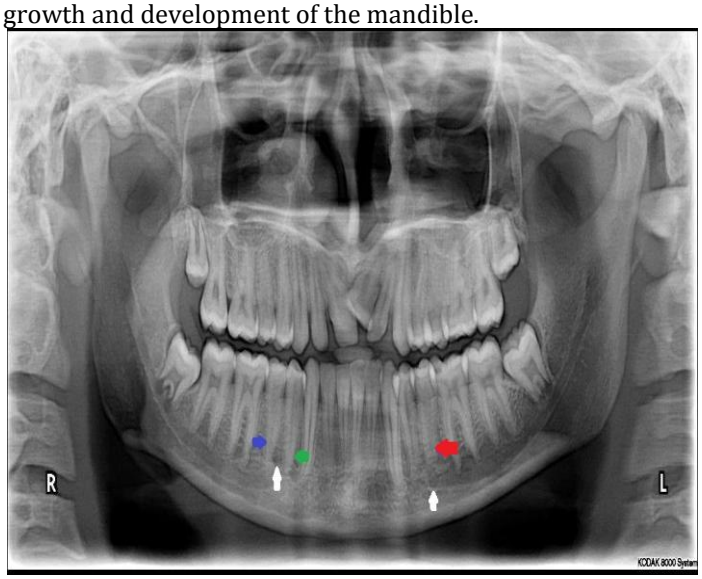

Figure 3 Panoramic radiograph shows asymmetrical positioning of mental foramina (white arrows), on right side it is in between first (green arrow) and second (blue arrow) while on left side, it is in line with second premolar (red arrow).

Further studies are required utilizing a larger sample size to evaluate both horizontal and vertical positioning with quantitative measurement for precise localization of the mental foramen.

CONCLUSION

Mental foramina are usually symmetrically located either in between first and second premolars or below the second premolars and this might be greatly influenced by the genes rather than environmental factors for growth of the mandible.

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