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Position of the Mental Foramen in Panoramic Radiography and Its Relationship to Age in a Selected Iranian Population

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Abstract

Background: The position of the mental foramen is critical for surgery and local anesthesia.
Objectives: This study was conducted to assess the position of the mental foramen and its relationship to age in a selected Iranian population.
Materials and Methods: This was a cross-sectional descriptive study. Three hundred panoramic radiographs were assessed. Three variables were assessed for each radiograph: anterior-posterior position, superior-inferior position, and radiographic appearance. The position and appearance of the mental foramen were recorded according to gender and age. The results were analyzed using Chi-square and Fisher's exact tests.
Results: Considering the anterior-posterior position, the mental foramina were located in the following positions: between premolars (41.5%), at the apex of the second premolars (31.7%), in the posterior area of the second premolars (19.2%), in the anterior area of the first premolars (4.3%), and at the apex of the first premolars (3.3%).The superior-inferior position of the mental foramina were below, above, and at the level of the apices of the premolars in 78.8%, 2.5%, and 18.7% of cases, respectively. The appearance of the mental foramen was continuous in relation to the mandibular canal in 55.9% of cases, while it was separated, diffuse, and unidentified in 29.5%, 9.7%, and 5% of cases, respectively. Age was found to affect the position and appearance of mental foramen.
Conclusions: The mental foramina were most commonly located between the first and second premolars and below the apex. A continuous appearance was the most common appearance for the mental foramen, which was similar in males and females.

Keywords: Mental Foramen, Radiography, Panoramic, Mandible

1. Background

Preservation of the form and function of an organ without injury to its anatomic structures is an important objective in surgical procedures. One of the important anatomic structures in maxillofacial surgery is the mental foramen (MF). The MF is often involved in certain steps of maxillofacial surgeries, and it is especially important to identify its boundaries and to preserve it in periapical and implant surgeries, maxillofacial trauma, and orthognathic procedures (1).

The mental nerve passes through the MF and innervates the lower lip, the buccal vestibule, and the gingiva to the mesial surface of the first mandibular molars. The exact position of the MF should be identified for nerve blocks (2, 3). Mental nerve injury may lead to temporary or permanent changes in thermal and tactile sensation, and localizing the MF during surgical procedures helps prevent such injuries (4).

It may be difficult to localize the MF due to the lack of fixed anatomic landmarks as reference points to make it identifiable during clinical examination (4). It is necessary to be aware of the normal range of possible MF positions (5). Incorrect detection of the MF as a radiolucent lesion in the apical area of the mandibular premolars may lead to iatrogenic injuries (6).

Panoramic radiography is a curved-plane topographic technique that provides extensive coverage of the oral structures with low radiation exposure. In spite of the introduction of newer methods, such as computed tomography, panoramic radiography is still more commonly used (6), as the newer radiographic techniques are more expensive, less available, and expose the patient to a higher radiation dose (7).

The position of the MF has been assessed in different populations (5). Most studies have found it to be located below the apex of the second premolars or between the apices of the first and second premolars (7).

2. Objectives

This study was conducted to assess the position and appearance of the MF in relation to the premolars in different genders and age groups, using panoramic radiography.

3. Materials and Methods

This was a cross-sectional descriptive study. Three hundred panoramic radiographs (600 sides) were selected from the Department of Oral and Maxillofacial Radiology of the Dental School at Shahid Sadoughi University of Medical Sciences. Images with minimal technical errors, acceptable density and contrast, minimal structural superimpositions, and the presence of at least 22 teeth (which must include mandibular canines, premolars, and first molars) were included in the study. The exclusion criteria were pathologic lesions in the mandible or maxilla, unerupted or missing mandibular teeth (except for the third molar), the presence of supernumerary teeth or gross crowding in the mandibular premolar area, or the presence of periodontal lesions in the mandibular premolar area. The patients consisted of 184 females and 116 males, aged 11 – 64 years.

Panoramic radiography was performed with an EC Planmeca device (Proline XC, Helsinki, Finland). The exposure settings were 80 KVP and 12 MA. Panoramic images were analyzed by Planmeca Romexis 2.9.2.R software.

Three variables were assessed for each panoramic radiograph: anterior-posterior position, superior-inferior position, and radiographic appearance. The anterior-posterior position of the MF was categorized according to al Jasser and Nwoku (8) into the following five positions: position 1, anterior to the long axis of the first mandibular premolars; position 2, in line with the long axis of the first mandibular premolars; position 3, between the long axes of the first and second mandibular premolars; position 4, in line with the long axis of the second mandibular premolars; and position 5, posterior to the long axis of the second mandibular premolars.

The superior-inferior position of the MF was categorized by Al-Khateeb et al. (1) into the following three positions: position 1, above the level of the apices of the first and second mandibular premolars; position 2, below the level of the apices of the first and second mandibular premolars; and position 3, at the level of the apices of the first and second mandibular premolars.

The radiographic appearance of the MF was categorized by Yosue and Brook into the following four types: continuous (radiographic continuity of the mandibular and mental canals), separated (foramen separated from mandibular canal), diffuse (mental foramen with indistinct borders), and unidentified (foramen cannot be identified on panoramic radiography under ordinary exposure and viewing conditions).

In order to locate the anterior-posterior position of the MF, lines were drawn parallel to the long axis of each mandibular premolar, and the MF's position was recorded in relation to these two lines (Figure 1). The foraminal border was drawn to find the superior-inferior position and to characterize the MF's appearance. According to Yosue and Brook (9), if there are multiple mental foramina, the most superior and distal foramina in relation to the mandibular canal should be considered the real MF, as it is possible to misdiagnose a part of the mandibular canal as the second or third MF (9). The position and appearance of the MF was recorded for the different ages and genders. To check the reproducibility of the observations, a second observer examined 20 radiographs daily for five days, in random order. No difference was found between the observers.

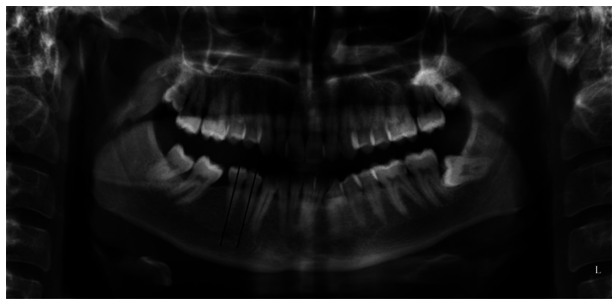

Figure 1. Lines were drawn parallel to the long axis of each mandibular premolar, and the mf's position was recorded in relation to these two lines.

This study was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences (code: 77745), and was in accordance with the Helsinki Declaration of 1975. Data were analyzed with SPSS version (ver. 17), and Chi-square test and Fisher's exact test were applied to determine the associations. P value < 0.05 indicated statistical significance.

4. Results

In this study, 300 panoramic radiographs (600 sides) were assessed. For each radiograph, three variables were assessed: anterior-posterior position, superior-inferior position, and radiographic appearance.

Table 1 shows the anterior-posterior position of the MF according to gender. The most frequent anterior-posterior position in both genders was the area between the first and

second premolars (41.5%), followed by the level of the second premolar apex. There was a relationship between age and anterior-posterior position of the MF (P = 0.001) (Table 2). In the age groups of 11 - 20, 21 - 30, and 31 - 40 years, the most common anterior-posterior position was position 3, while position 5 was the most common anterior-posterior position in the age groups of 41 - 50 and > 50.

Table 3 shows the superior-inferior position of the MF according to gender (P = 0.43). The MF was located most commonly below the premolar apices for this method (78.8%), followed by the position at the level of the premolar apices, which was similar in both genders. There was a relationship between the superior-inferior position of the MF and age (P = 0.001) (Table 4). In all age groups, the most common superior-inferior position was position 2.

Table 5 shows the appearance of the MF according to gender (P = 0.41). A continuous appearance was most commonly observed (55.9%), followed by a separated appearance, which was similar in both genders. We found a relationship between MF appearance and age (P = 0.001) (Table 6). The most common appearance in the age groups of 11 - 20 and > 50 years was separated, and in the other groups, it was continuous.

5. Discussion

The MF is often involved in certain steps of maxillofacial surgeries. It is especially important to identify its boundaries and to preserve it during surgery, trauma, and local anesthesia (1-3). In this study, three variables were assessed to determine the location and appearance of the MF with panoramic radiography. Although it is recommended to cautiously use panoramic radiography for exact measurements and comparisons, previous studies have shown that there is a close relationship between the radiographic position of the MF and the skull (9-11).

The position of the MF in relation to the mandibular body is probably more precise, and is not affected by factors such as malocclusion, mesiodistal width of the tooth, race, nutrition, and age (1). However, in most studies, the position of this foramen is assessed in relation to the teeth, as this is simpler to use in clinical applications (12).

In the current study, for the anterior-posterior method, the MF was most commonly situated between the premolars, while the apex of the second premolar was its second most common position. Several studies have used the anterior-posterior method for MF localization (4-7, 13). Al-Khateeb et al. in Jordan (1), Rupesh et al. (4), Gada et al. (6), Jamdade et al. in India (7), and Haghanifar et al. in Iran (14) found that the MF is most commonly located between the first and second premolars, consistent with the present study. They also found that the apex of the second premolar is the second most common position of the MF.

Chkoura et al. (5) and Al Talabani et al. (13) found that the MF is most commonly situated at the level of the second premolar, followed by between the first and second premolars, which was inconsistent with the results of the current study. Studies on Mongolian and African populations showed that a posterior position for the MF is more common. In Chinese populations, the MF is located most commonly at the level of the second premolar, but the most common position in Europeans and Indians is between the first and second premolars (8, 11, 15-23).

Al-Khateeb et al. (1) found that the most common anterior-posterior position of the MF among females was at the apex of the premolars, followed by the area between the first and second premolars, which was inconsistent with the results of the present study. However, the observed difference was small, and the sample size was different between the two studies.

Rupesh et al. (4), Chkoura et al. (5), and Gada et al. (6), consistent with the results of the current study, found a similar anterior-posterior position for the MF in males and females. Al-Khateeb et al. (1) found that increased age caused the MF to be located more posteriorly in relation to the second premolars, which was consistent with the results of the current study; however, the sample size was different in the two studies. Also in that study, the superior-inferior method for the MF was assessed as well, and the MF was found to be most commonly situated below the apex of the premolars, both in males and females (1). This result was in agreement with the results of the current study. The previous study found that increased age caused the MF to move to a more inferior position, whereas in the current study, position 2 was constant as the most prevalent position. This difference can be caused by the different sample sizes and age groups in the two studies.

Yosue et al. (9) expressed the superior-inferior position of the MF in millimeters, and their measurements were taken from the crest to the border of the mandible. This method is more precise, but on a practical level, it is more time-consuming and is therefore used less commonly. In the present study, age affected the position of the MF, which was consistent with many previous studies (1, 8-10, 19, 22, 24-26).

In the study of Yosue et al. (27), the MF's appearance was affected by factors related to the exposure settings; however, our study was retrospective, so we could not assess these factors. Al-Khateeb et al. (1), consistent with the current study, found that a continuous appearance was most common for the MF, but in Yosue et al.'s study (9), a separated appearance was the most common. In this study, an MF with clear cortical subdivision was considered to have

Table 1. Anterior-Posterior Position of MF by Gender[a]

Position	Female	Male	Total
1	10 (1.7)	16 (2.7)	26 (4.3)
2	10 (1.7)	10 (1.7)	20 (3.3)
3	172 (28.7)	77 (12.8)	249 (41.5)
4	115 (19.2)	75 (12.5)	190 (31.7)
5	60 (10)	55 (9.2)	115 (19.2)
Total	367 (61.7)	233 (38.3)	600 (100)

[a]Values are expressed as No. (%).

Table 2. Anterior-Posterior Position of MF by Age[a]

Position	11 – 20 years	21 – 30 years	31 – 40 years	41 – 50 years	50 years
1	5 (0.8)	3 (0.5)	9 (1.5)	9 (1.5)	NA
2	3 (0.5)	6 (1)	6 (1)	NA	5 (0.8)
3	50 (8.3)	116 (19.3)	50 (8.3)	21 (3.5)	15 (2.5)
4	39 (6.5)	85 (14.2)	30 (5)	24 (4)	12 (2)
5	21 (3.5)	27 (4.5)	19 (3.2)	30 (5)	18 (3)
Total	118 (19.7)	238 (39.7)	114 (19)	80 (13.3)	50 (8.3)

Abbreviation: NA, not available.
[a]Values are expressed as No. (%).

Table 3. Superior-Inferior Position of MF by Gender[a]

Position	Female	Male	Total
1	10 (1.7)	5 (0.8)	15 (2.5)
2	283 (47.2)	190 (31.2)	473 (78.8)
3	74 (12.3)	38 (6.3)	112 (18.7)
Total	367 (61.7)	233 (38.3)	600 (100)

[a]Values are expressed as No. (%).

Table 4. Superior-Inferior Position of MF by Age[a]

Position	11 – 20 years	21 – 30 years	31 – 40 years	41 – 50 years	50 years
1	2 (0.3)	8 (1.3)	5 (0.8)	NA	NA
2	74 (12.3)	186 (31)	103 (17.2)	64 (10.7)	46 (7.7)
3	42 (7)	44 (7.3)	6 (1)	16 (2.7)	4 (0.7)
Total	118 (19.7)	238 (39.7)	114 (19)	80 (13.3)	50 (8.3)

Abbreviation: NA, not available.
[a]Values are expressed as No. (%).

a separated appearance. Race and environmental factors that affect growth and development may explain the different MF positions in different populations (6) (Table 7).

5.1. Conclusions

The MF was most commonly situated between the first and second premolars and below the apex of the premo-

Table 5. Appearance of MF by Gender[a]

Appearance	Female	Male	Total
Continuous	195 (32.5)	140 (23.4)	335 (55.9)
Separated	114 (19)	63 (10.5)	177 (29.5)
Diffuse	38 (6.3)	20 (3.3)	58 (9.7)
Unidentified	20 (3.3)	10 (1.7)	30 (5)
Total	367 (61.7)	233 (38.3)	600 (100)

[a]Values are expressed as No. (%).

Table 6. Appearance of MF by Age[a]

Appearance	11 – 20 years	21 – 30 years	31 – 40 years	41 – 50 years	50
Continuous	46 (7.6)	138 (23)	68 (11.3)	64 (10.6)	19 (3.8)
Separated	50 (8.3)	66 (11)	33 (5.5)	7 (1.3)	21 (3.5)
Diffuse	13 (2.2)	20 (3.3)	9 (1.6)	9 (1.6)	7 (1.3)
Unidentified	9 (1.6)	14 (2.3)	4 (0.7)	NA	3 (0.5)
Total	118 (19.7)	238 (39.7)	114 (19)	80 (13.3)	50 (8.3)

Abbreviation: NA, not available.
[a]Values are expressed as No. (%).

Table 7. Comparison of MF Positions in Different Populations and Ethnic Group

Sample Size	Year	Distribution					Population	Reference	Technique	Journal
		1	2	3	4	5				
169	2003	0	3.4	19.6	69.2	7.7	Malay	Ngeow et al. (21)	Pan.	J Oral Sci
70	2005	0	2.8	10	62.9	24.3	Malawian	Igbigbi et al. (18)	DM	West Afr J Med
361	2006	1.2	3.2	71.5	22.4	1.33	Turkish	Gungor et al. (28)	Pan.	Coll Antropol
72	2006	-	-	26.8	64.3	-	Korean	Kim et al. (29)	Pan.	Implant Dent
100	2007	-	-	-	45	35	Tanzanian	Fabian et al. (30)	DM	Ital J Anat Embryol
860	2007	1	3	47	40	10	Jordanian	Al-Khateeb et al. (1)	Pan.	Surg Radiol Ant
70	2008	-	-	30		-	Turkish	Yesilyurt et al. (31)		Folia Morphol
160	2008	1.8	35.9	55	7.27	0	Iraqi	Talabani et al. (13)	Pan.	Oral Radial 2008
400	2009	0	1.6	47.3	46	5.1	Iranian	Haghanifar et al. (14)	Pan.	Indian J Dent Res
500	2011		40	55		33.2	-	Pria et al. (32)	Pan.	J Contemp Dent Pract
723	2011	3.5	1	46.7	33.5	11.4	Indian	Rupesh et al. (4)	Pan.	J Med Science 2011
500	2013	-	4.4	44.4	43.2	8	Kosovarian	Kqiku et al. (33)	Pan.	Coll Antro
377	2013	0.4	1.32	30	62.8	5.3	Moroccan	Chkoura et al. (5)	Pan.	Imaging Sci Dent
500	2013	0	1.9	46.1	45.5	6.5	Indian	Jamdade et al. (7)	Pan.	Innovative Journal

Abbreviations: DM, dry mandible; Pan, panoramic radiograph.

lars, and was similar in males and females. The most common appearance of the MF was continuous, which was similar in males and females. There was a relationship between age and the position and appearance of the MF.

Footnote

Authors' Contribution: Study concept and design: Mahdieh Dehghani, acquisition of data: Mahdieh Dehghani; analysis and interpretation of data: Sahar Ghanea; drafting of the manuscript: Sahar Ghanea; critical revision of the manuscript for important intellectual content: Sahar Ghanea; statistical analysis: Mahdieh Dehghani, administrative, technical, and material support: Mahdieh Dehghani; study supervision: Mahdieh Dehghani

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