



## Assessment of Vertical and Horizontal Position of Mental Foramen in a Subpopulation of Kermanshah City by Panoramic Radiographs

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DOI: 10.5455/jrmds.20186270

### ABSTRACT

Adequate knowledge about the position of mental foramen in different populations is imperative for successful anesthetic and surgical interventions. This study sought to assess the vertical and horizontal position of the mental foramen in a subpopulation of Kermanshah city using panoramic radiographs. This cross-sectional study was performed on 500 panoramic radiographs (250 males, 250 females) retrieved from the archives of the oral and maxillofacial radiology clinics in Kermanshah city. The horizontal position of mental foramen was classified according to the classification by Chkoura and El-Wady (6 types). To determine its vertical position, a line was drawn from the center of the mental foramen perpendicular to the inferior border of the mandible and continued to reach the alveolar crest. This distance was divided into four equal segments and the position of mental foramen in each segment was recorded. Data were analyzed using chi-squared, Fisher's exact and Monte Carlo chi-square tests ( $P < 0.05$ ). Mental foramen in most cases was in the lower mid one-fourth segment ( $>99\%$ ). Type 4 (in alignment with the apex of the second premolar) was the most common horizontal position of mental foramen on both sides ( $>50\%$ ). Mental foramen positioned between the apices of the first and second premolars ranked second in terms of frequency (seen in about one-third of the cases). The position of mental foramen was almost the same in males and females, and symmetrical in the right and left sides (73%). Our findings highlighted the variability in the position of mental foramen in a subpopulation of Kermanshah city, which should be taken into account in dental practice.

**Key words:** Mental Foramen, Panoramic Radiography, Mandible

**HOW TO CITE THIS ARTICLE:** Farzad Rezaei, Ehsan Bahrampour, Saeid Alizadeh, Mohammad Moslem Imani, Assessment of Vertical and Horizontal Position of Mental Foramen in a Subpopulation of Kermanshah City by Panoramic Radiographs, J Res Med Dent Sci, 2018, 6 (2):459-465, DOI: 10.5455/jrmds.20186270

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**Received:** 05/02/2018

**Accepted:** 25/02/2018

artery, mental vein, and mental nerve pass through the mental foramen [2].

### INTRODUCTION

Mental foramen is a small foramen located on the anterolateral surface of the body of mandible. Normally, mental foramen is located between the mandibular first and second premolars. It is often located 13 to 15 mm above the inferior border of the mandible. The opening of mental foramen often faces superiorly and posteriorly [1]. Mental

The shape and position of mental foramen are widely variable in different individuals. The mental foramen may be non-existent in some, while some others may have an additional, accessory foramen in addition to the main mental foramen [3]. On radiographs, mental foramina may be mistaken for radiolucent lesions around the apices of mandibular premolars and lead to iatrogenic trauma [4]. The position of mental foramen has numerous anatomical variations. In the anterior-posterior plane, the position of

mental foramen may vary from close to the apex of the first premolar to distal to the apex of the first molar tooth [5]. Significant differences have been reported in the position of mental foramen among different populations such as different ethnic groups residing in India [6], Indian, Chinese and European races [7] and also among the Chinese, Caucasians and Negroid people [8]. Gawlikowska-Sroka *et al.* [9] demonstrated that in Europeans, mental foramen is often located between the first and second premolars and its position has not changed in the past 10 centuries. However, Green [8] found that in Chinese people, similar to other Mongoloid populations, mental foramen is often located in alignment with the longitudinal axis of the second premolar tooth. Kurds in western Iran have significantly different soft tissue cephalometric norms compared to Caucasians and have more convex faces [10]. The available information about the position of mental foramen in males and females is controversial. Some studies did not find a significant difference in position of mental foramen between males and females [11,12] while some others reported that mental foramina had a significantly different location in males and females [13]. Ajmal [14] evaluated the location of mental foramen on digital panoramic radiographs according to age and gender and showed that the distance from the mental foramen to alveolar ridge crest was greater in males than in females. They also stated that this distance significantly decreased with aging.

Determination of the exact position of mental foramen prior to dental procedures such as regional anesthesia, periapical surgery, dental implant treatment and endodontic treatment of the mandibular teeth is imperative to prevent iatrogenic injuries [15]. Considering the anatomical variations in the position of mental foramen among different populations, the most common anatomical variants should be identified in different populations. This study aimed to assess the frequency of different vertical and horizontal positions of the mental foramen on panoramic radiographs of an Iranian subpopulation residing in Kermanshah city.

#### MATERIALS AND METHODS

This descriptive analytical study evaluated 500 panoramic radiographs of patients (250 males and 250 females) retrieved from the archives of the oral and maxillofacial radiology clinics of Kermanshah city. The sample size was calculated

to be 500 radiographs according to previous studies by Kumar *et al.*, [6] and Chkoura and El-Wady [11]. Radiographs that met the following criteria were included using convenience sampling.

The inclusion criteria were the presence of a minimum of 22 teeth including canines, premolars and first molars, clear visualization of borders of the mandible on radiographs with adequate density and contrast, accurate positioning of the head during radiography and no superimposition of structures.

The exclusion criteria were the absence of information regarding the gender of patient, the presence of congenital anomalies, positive history of maxillofacial trauma, the presence of deciduous or impacted teeth, the presence of pathological radiolucent or radiopaque lesions in the body of mandible and absence or difficult visualization of mental foramen.

One oral and maxillofacial surgeon and one oral and maxillofacial radiologist independently observed the radiographs on a LED monitor (Samsung, Korea) under similar lighting conditions using Scanora version 4.3.1.1 software (Soredex; Tuusula, Finland). The observers were allowed to change the zoom, brightness, and contrast of the images, and no time limitation was set for evaluation of images. The observers were calibrated prior to evaluation of images. To ensure calibration, three panoramic radiographs not included in the study were chosen and evaluated by the observers, and the results were compared. The inter-observer agreement was found to be excellent ( $\kappa$  coefficient=1).

The horizontal position of mental foramen was classified using the digital ruler tool according to the classification by Chkoura and El-Wady [11] as follows (Figure 1):

Type 1: Mesial to the apex of the first premolar

Type 2: In alignment with the apex of the first premolar

Type 3: Between the apices of the first and second premolars

Type 4: In alignment with the apex of the second premolar

Type 5: Between the apices of the second premolar and first molar

Type 6: In alignment with the mesial half of the first molar

To determine the vertical position of mental foramen (Figure 2), the distance from the bone crest to the inferior border of the mandible was first determined. For this purpose, a line was drawn from the center of the mental foramen perpendicular to the inferior border of the mandible and continued to reach the alveolar crest. This distance was divided into four equal segments, and the position of mental foramen in each segment was recorded as upper one-fourth, upper mid one-fourth, lower mid one-fourth or lower one-fourth.

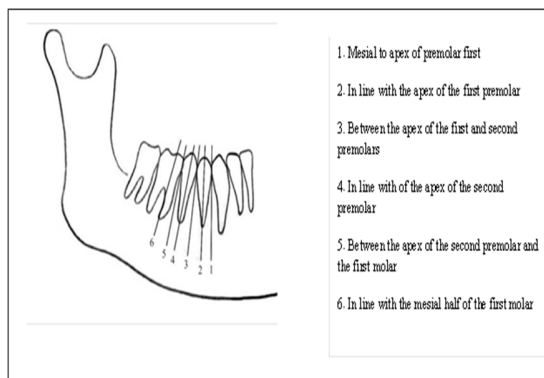


Figure 1: Horizontal position of the mental foramen

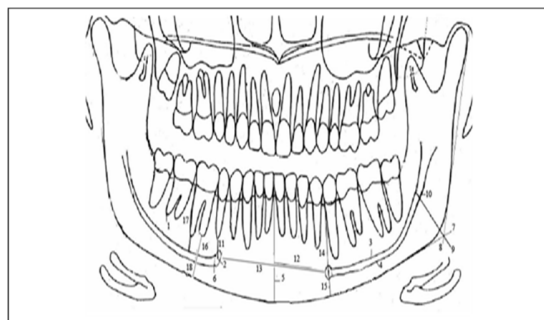


Figure 2: Vertical position of the mental foramen

Data were analyzed using descriptive and analytical statistics. The frequency and percentage values were reported for descriptive data and chi squared test, Fisher’s exact test and Monte Carlo chi square test were used to analyze the analytical data. All statistical analyses were carried out using SPSS version 18 (SPSS Inc., IL, USA) at 0.05 level of significance.

**RESULTS**

Table 1 shows the frequency of different vertical positions of the mental foramen. The most common vertical position of mental foramen in

both the right and left sides was in the lower mid one-fourth (99.4% in the right side and 99% in the left side). The coefficient of agreement for the vertical position of mental foramen in the right and left sides was 0.645 (P<0.001), which indicated its symmetrical position in the right and left sides in most cases.

Table 1: Frequency of different vertical positions of the mental foramen

Segment, n (%)	Right side (n=500)	Left side (n=500)
Upper one-fourth	0	0
Upper mid one-fourth	0	1 (0.2)
Lower mid one-fourth	497 (99.4)	495 (99)
Lower one-fourth	3 (0.6)	4 (0.8)

Table 2 presents the frequency of different vertical positions of the mental foramen in males and females. As shown, the right mental foramen was in the lower mid one-fourth in 99.2% of females and 99.6% of males. The left mental foramen was in the lower mid one-fourth in 98.8% of females and 99.2% of males. No significant association was found between the vertical position of the right (P=1, Fisher’s exact test) or left (P=1, Monte Carlo chi-square test) mental foramen and gender.

Table 2: Frequency of different vertical positions of the mental foramen in males and females\*

Segment, n (%)	Right side (n=500)		Left side (n=500)	
	Male (n=250)	Female (n=250)	Male (n=250)	Female (n=250)
Upper one-fourth	0	0	0	0
Upper mid one-fourth	0	0	0	1 (0.4)
Lower mid one-fourth	249 (99.6)	248 (99.2)	248 (99.2)	247 (98.8)
Lower one-fourth	1 (0.4)	2 (0.8)	2 (0.8)	2 (0.8)

\* P>0.05

Table 3 shows the frequency of different horizontal positions of the mental foramen. Type 4 (in alignment with the apex of the second premolar) was the most common horizontal position of mental foramen on both sides such that its frequency was 54.6% in the right and 52.2% in the left side. Also, the coefficient of agreement for the horizontal position of mental foramen in the right and left sides was 0.75 (P<0.001), which indicated its symmetrical position in the right and left sides in most cases.

**Table 3: Frequency of different vertical positions of the mental foramen\***

Type, n (%)	Right side (n=500)	Left side (n=500)
Type 1	1 (0.2)	0
Type 2	5 (1)	5 (1)
Type 3	178 (35.6)	169 (33.8)
Type 4	273 (54.6)	261 (52.2)
Type 5	43 (8.6)	65 (13)
Type 6	0	0

\* P<0.05

Table 4 shows the frequency of different horizontal positions of the mental foramen in males and females. As shown, the horizontal position of mental foramen in the right side was type 4 (in alignment with the apex of the second premolar) in 54.8% of females and 54.4% of males. The horizontal position of mental foramen in the left side was type 4 in 51.2% of females and 53.2% of males. No significant correlation was noted between the horizontal position of mental foramen in the right (P=0.308) or left (P=1) side and gender using Monte Carlo chi- square test.

**Table 4: Frequency of different horizontal positions of the mental foramen in males and females\***

Type, n (%)	Right side (n=500)		Left side (n=500)	
	Male (n=250)	Female (n=250)	Male (n=250)	Female (n=250)
Type 1	1 (0.4)	0	0	0
Type 2	4 (1.6)	1 (0.4)	4 (1.6)	1 (0.4)
Type 3	84 (33.6)	94 (37.6)	80 (32)	89 (35.6)
Type 4	136 (54.4)	137 (54.8)	133 (53.2)	128 (51.2)
Type 5	25 (10)	18 (7.2)	33 (13.2)	32 (12.8)
Type 6	0	0	0	0

\* P>0.05

The position of mental foramen was symmetrical in the right and left sides in 73.6% of females and 80.4% of males (Table 5). The chi-square test failed to show a significant correlation between the symmetrical position of mental foramen in the right and left sides and gender (P=0.071 and P=0.264, respectively).

**Table 5: Frequency of the degree of symmetry according to gender\***

Variable, n (%)	Male (n=250)	Female (n=250)
Symmetrical	201 (80.4)	184 (73.6)
Asymmetrical	49 (19.6)	66 (26.4)

\* P>0.05

### DISCUSSION

Variability in the anatomical position of mental foramen is one reason for failure of regional anesthesia in the mental foramen region [16].

Race has been confirmed as an important factor affecting the anatomical variations in the location of mental foramen [6, 7]. This study assessed the vertical and horizontal position of mental foramen on panoramic radiographs of a subpopulation of Kermanshah city and showed that mental foramen in most cases was in the lower mid one-fourth segment (>99%). Type 4 (in alignment with the apex of the second premolar) was the most common horizontal position of mental foramen on both sides (>50%). Mental foramen positioned between the apices of the first and second premolars ranked second in terms of frequency (seen in about one-third of the cases). The position of mental foramen was almost the same in males and females (P>0.05), and symmetrical in the right and left sides in 73% of the cases.

Some previous studies evaluated the location of mental foramen by studying dry human mandibles [12, 17] or panoramic radiographs [11, 18]. Panoramic radiographs provide a comprehensive view of the maxillofacial region for assessment of the position of mental foramen [13]. Thus, we used panoramic radiographs for evaluating the location of mental foramen in our study population.

Our study showed that the most common vertical location of the mental foramen was in the lower mid one-fourth segment in both the right and left sides. Similarly, Afkhani *et al.*, [17] in their study on a subpopulation residing in Mashhad indicated that mental foramen was commonly close to the inferior border of the mandible. In a study by Dehghani and Ghanea [19] on a Yazdi subpopulation, the most common vertical location of the mental foramen was below the apices of premolars (78.8%). Mental foramen positioned at the level of the apices of premolars ranked second in terms of frequency (18.7%). In only 2.5% of the cases, mental foramina were located at a level above the apices of premolars. Voljevica *et al.*, [2] in their study in Sarajevo showed that mental foramen was mainly located at the mid-point between the inferior border of the mandible and the alveolar border of the mandible. Oguz and Bozkir [17] in Turkey evaluated the vertical position of mental foramen and reported that mental foramina in the right and left sides had 14.16 mm and 14.29 mm distance from the inferior border of the mandible and 13.62 and 14.62 mm distance from the superior border, respectively. Sankar *et al.*, [20] measured the distance from the mental foramen of the right and

left sides to the inferior border of the mandible to be 16.5 mm and 14.3 mm, respectively. The distance from the right and left mental foramina to the superior border was 13.7 mm and 16.4 mm, respectively.

Our findings indicated that the vertical position of the mental foramen in the right and left sides was symmetrical in most cases. Gungor *et al.*, [21] evaluated the Turkish population and reported that the distance from the mental foramen to the inferior border of the mandible was not significantly different in the right and left sides. However, Sankar *et al.*, [20] in India showed that the vertical position of the mental foramen had 2 to 3 mm difference in the right and left sides.

The results of present study revealed no significant difference in vertical position of the mental foramen in males and females, which was in agreement with the results of Gungor *et al.*, [21] in Turkey. In contrast, Apinhasmit *et al.*, [22] in their study on a Thai population reported that the distance from the mental foramen to the inferior border of the mandible in males was significantly greater than that in females.

In our study, type 4 (in alignment with the apex of the second premolar tooth) was the most frequent horizontal position of mental foramen followed by type 3 (between apices of the first and second premolars). This finding was in line with the results of Chkoura and El-Wady [11] on a Moroccan population. They observed that mental foramen was in alignment with the apex of the second premolar tooth in two-thirds and between the apices of the first and second premolars in one-third of the cases. Afkhami *et al.*, [18] in their study on a Mashhadi subpopulation reported that mental foramen was in alignment with the apex of the second premolar in most cases. Its position between the apices of the first and second premolars ranked second in terms of frequency. Voljevica *et al.*, [2] in Sarajevo anatomically examined the human mandible and found that the mental foramen was over the root of the second premolar in 60.3% and between the first and second premolars in 20.3% of the cases. In contrast, Haghanifar and Rokouei [13] evaluated the people of Babol and reported that the most common horizontal position of mental foramen was between the first and second premolars (47.2%). Moreover, Gungor *et al.*, [15] in Turkey reported that the horizontal location of mental foramen between the first and second premolars

had the highest frequency (71.5%). Olasoji *et al.*, [12] evaluated Nigerians and showed that mental foramen was most commonly located between the first and second premolars (34%); it was located apical to the second premolar tooth in 25.5% of the cases. Currie *et al.*, [23] in Britain reported that mental foramen was most commonly located between the first and second premolars. These findings highlight the difference in horizontal position of mental foramen in citizens of different countries and people of different racial and ethnic groups. In this regard, Kumar *et al.*, [6] reported that the most frequent location of mental foramen was between the first and second premolars (59.2%) in people residing in North-East India while it was mainly in alignment with the longitudinal axis of the second premolar (62.8%) in the South Indian population.

In our study, the horizontal position of mental foramen was symmetrical in the right and left sides. This symmetry was also confirmed in studies by Haghanifar and Rokouei [13] in Babol (85.7%) and Afkhami *et al.*, [18] in Mashhad (80%). Symmetry in the horizontal position of mental foramina was 90.4% in a Turkish population [15] and 79% in a Moroccan population [11]. Studies conducted in Nigeria [12] and India [6] also confirmed the symmetrical horizontal position of mental foramina in the right and left sides but this symmetry was only seen in 62% of the cases in Britain [23].

Our study revealed no significant difference in terms of horizontal position of mental foramen between males and females. Similarly, studies conducted in other cities of Iran such as Babol [13] and Yazd [19] and those of Olasoji *et al.*, [12] and Chkoura and El-Wady [11] found no significant difference in horizontal position of mental foramen between males and females. However, Gungor *et al.*, [21] in Turkey indicated that the horizontal position of mental foramen in males was mainly in alignment with the second premolar tooth while it was between the first and second premolars in females, and this difference was statistically significant.

Future studies are required to assess the position of mental foramen using cone beam computed tomography. Moreover, the accuracy of panoramic radiography for determination of the position of mental foramen should be compared with the gold standard (measurement on dry human mandible) in future studies.

**CONCLUSION**

Our findings highlighted the variability in the position of mental foramen in a subpopulation in Kermanshah city, which should be taken into account in dental practice. The current results showed that the mental foramina were mostly located in the lower mid one-fourth segment of the distance between the alveolar crest and inferior border of the mandible in Kermanshah's individuals and no significant difference existed in this regard between males and females. Horizontally, mental foramen was mainly located in alignment with the apex of the second premolar. The position of mental foramen between the apices of the first and second premolars ranked second with no significant difference between males and females. The horizontal and vertical position of mental foramina was mainly symmetrical in the right and left sides.

**Acknowledgements**

The authors gratefully acknowledge the Research Council of Kermanshah University of Medical Sciences (Grant number: 95498) for the financial support. This work was performed in partial fulfillment of the requirements for the degree of general dentistry by Saeid Alizadeh at Faculty of Dentistry, Kermanshah University of Medical Sciences, Kermanshah, Iran.

**Conflict of interest**

The authors declare no conflict of interest.

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