

# Morphological and morphometrical study of mental foramen in dry adult human mandible and its clinical relevance

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## Abstract

**Background:** Mental foramen is situated in the anterolateral aspect of the body of the mandible. It lies below either the interval between the premolar teeth or the second premolar tooth, midway between the upper and lower borders of the body of the mandible. It transmits mental nerves, arteries, and veins. The mental nerve is a branch of the inferior alveolar nerve which supplies sensation to the lower lip, labial mucosa, lower canines, and premolars. The most useful injection for anaesthetizing the mandibular teeth is the inferior alveolar nerve block. To anaesthetize the anterior teeth including canines and premolars it is better to inject the anesthetic solution adjacent to the mental foramen instead of giving inferior alveolar nerve block. **Aim:** To Study the Morphological and Morphometrical Study of Mental Foramen in Dry Adult Human Mandible and Its Clinical Relevance in dental practice. **Materials and methods:** A total of 100 numbers of dry adult mandibles of unknown sex with complete dentition and intact alveolar sockets collected from the Department of Anatomy, Meenakshi Medical College Hospital and Research Centre, were used for this study. The shape, size, location, number of the mental foramen, direction of opening of mental foramen was measured on both sides of the mandible by using a vernier caliper. **Results:** The most frequent position of mental foramen was in line with the apex of the 2nd premolar (right side 86.1% and left side 84.75%). The second common position was between 1<sup>st</sup> and 2<sup>nd</sup> premolar (Right side 5.2% and Left side 5.85%). The shape of the mental foramen was oval in 63.3% and rounded in 36.7% respectively. The direction of opening of mental foramen in most of the mandible was posterosuperior. The mean distance from mental foramen to symphysis menti, lower border of the mandible, and posterior ramus of the mandible was 26.67mm, 11.76 mm, and 62.95mm respectively. The mean measurement of the angle of the mandible was 128°. **Conclusion:** Knowledge about the Morphometric measurement of mental foramen is important during various surgical dental procedures.

**Keywords:** Mandible, Mental foramen(MF), morphometry, Dental Procedures.

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## INTRODUCTION

The mental Foramen (MF) is an important anatomical landmark to facilitate surgical, local anesthetic, and other

invasive procedures for dental surgeons performing periapical surgery in the mental region of the mandible. Its location and the possibility that an anterior loop of the mental nerve may be present mesial to the MF and need to be considered before any surgery in the foramina area to avoid any nerve damage. The MF is situated bilaterally on the anterolateral aspect of the mandible, down to the alveolar margin. The mental nerve and vessels emerge through the mental foramen and supply sensory innervation and blood supply to the soft tissues of the chin, lower lip, and gingiva.<sup>1,2</sup> But the position of MF varies among racial groups and genders.<sup>3,4,5</sup> To anaesthetize the anterior teeth including canines and premolars it is better to inject the anesthetic solution adjacent to the mental

foramen instead of giving inferior alveolar nerve block.<sup>6</sup> Any foramen in addition to mental foramen in the body of the mandible is called accessory mental foramen. It transmits Auxillary nerves to the teeth (from facial, mylohyoid, buccal, and transverse cervical cutaneous and other nerves.<sup>7</sup> The junction between the lower part of the body of the mandible and the posterior border of the ramus of the mandible forms the angle of the mandible. It measures about 110° – 115° in adults [8]. The mental foramen is an important landmark to facilitate diagnostic, surgical, local anesthetic, and other invasive procedures of the oral and maxillofacial region. Knowledge of mental foramen and accessory foramen position is helpful to dental surgeons to achieve complete anesthesia and also helps to avoid injury during periapical surgery. The gonial angle can be used as a tool in forensic odontology but has received less attention. Hence this study has been conducted to investigate the number, size, shape, dimensions, and location of MF concerning the surgically encountered anatomical landmarks.

### MATERIALS AND METHODS

100 dried adult human mandibles with complete dentition and intact alveolar margin of unknown sex obtained from the Department of Anatomy, Meenakshi Medical College Hospital and Research Centre, were used for this study. The shape (oval and round), size, location, number of MF, the direction of opening of mental foramen were measured on both sides of the mandible by using Vernier caliper. The shape of MF observed was either oval or rounded. Mean

horizontal and vertical diameters were measured. Location of MF was identified by using the following parameters: (i) Distance from mental foramen to mental symphysis; (ii) Distance from mental foramen to alveolar margin and (iii) Distance from mental foramen to the inferior border of the mandible (iv) Distance from the posterior border of the ramus of mandible to the mental foramen. The position of MF was noted about mandibular teeth. The direction of opening of MF was recorded as posterosuperior, superior, lateral, anterosuperior, posterior or anterior [9]. The location of mental foramen about anatomical landmarks was recorded : (i) in line with the second premolar (ii) Between the first molar and second premolar (iii) in between the first and second premolar (iv) in line with the first molar (v) in line with the first premolar. The angle of the mandible was measured with the help of a protractor. The angle of the mandible was taken as the angle between the base and a tangent drawn along the posterior border of the ramus, touching the posterior-most point on the condyle and the posterior-most point on the posterior border. A comparison of the mean values between sides was performed using the t-test, p-value<0.05 was considered statistically significant.

### RESULTS

Morphometric features of 100 dried human mandibles revealed that the number of MF on each side was single in all the cases, no double foramen or accessory foramen were recorded in this study. The mean measurement of the angle of the mandible was 128°. (fig-1).



Figure 1: Measurement of the angle of mandible

The shape of foramen was oval in 63.3% of cases ( fig – 2 ) and rounded in 36.7% of cases ( fig -3 ). The mean horizontal diameter was 3.32mm on the right side and 3.24mm on the left side with a range of 2.1-6.2mm, whereas the mean vertical diameter was 2.14mm on the right side and 2.14mm on the left side with a range of 1.8-3.1mm. The linear measurements of MF concerning anatomical landmarks are given in Table I.



Figure 2: Showing oval-shaped mental foramen Figure 3: Showing round-shaped mental foramen

**Table 1:** Morphometric measurements of the mental foramen between two sides

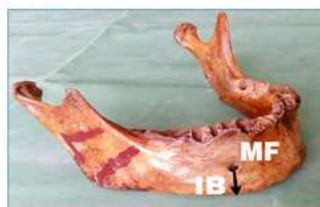
Characteristic	Right Side (mean±SD) in mm	Left Side (mean±SD) in mm
Distance between MF and symphysis menti ( fig – 4)	25.52 ± 5.03	26.67 ± 5.03
Distance between MF and alveolar margin (fig-5)	14.08 ± 3.02	14.05 ± 3.03
Distance between MF and the lower border of the mandible (fig-6)	11.25 ± 2.98	12.28± 3.10
Distance between MF and posterior border of the ramus of Mandible (fig -7)	65.35 ± 5.45	64.75± 5.42



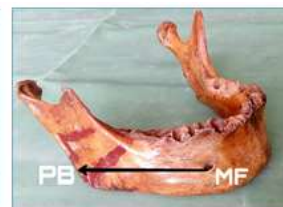
**Figure 4**



**Figure 5**



**Figure 6**



**Figure 7**

**Figure 4:** Showing Distance between MF; **Figure 5:** Showing Distance and Symphysis Menti between MF and alveolar margin; **Figure 6:** Showing Distance between MF and lower border of Mandible of Ramus of Mandible; **Figure 7:** Showing Distance between MF and posterior border of Ramus of Mandible

The position of mental foramen about mandibular teeth on the two sides is shown in Table II. The most frequent position of a foramen about the teeth was in line with the longitudinal axis of the 2nd premolar for both right (86.1%) and left (84.75%) sides. The second common position was between first and second premolar (right 5.2%; left 5.85%), followed by inline with the first premolar between (right 4.4 %; left 5.35 %) and between the second premolar and first molar ( Right 3.2% and Left 2.65%); the least common position was in line with the first Molar (right 1.1 %; left 1.4 %)

**Table II:** Frequency of the location of mental foramen about mandibular teeth between the two sides

Location	Right Side	Left Side
In the line with the second premolar (fig -8)	86.1%	84.75%
Between the second premolar and first molar ( fig -9)	3.2%	2.65%
Between first and second premolar (fig-10)	5.2%	5.85%
In line with the first molar (fig-11)	1.1%	1.4%
In line with the first premolar (fig-12)	4.4%	5.35%



**Figure 8**



**Figure 9**



**Figure 10**



**Figure 11**



**Figure 12**

**Figure 8:** Showing the MF in the line with the second premolar; **Figure 9:** Showing the MF between second premolar and first molar; **Figure 10:** Showing the MF between the first and second premolar; **Figure 11:** Showing MF in line with first molar; **Figure 12:** Showing MF in line with first premolar

The direction of exit of the MF was posterosuperior in 50.7%, followed by superior in 34.07%, Posterior in 8.2% and Laterally in 7.03% of the mandibles.( fig 13 ,14,15,16).



**Figure 13**



**Figure 14**



**Figure 15**



**Figure 16**

**Figure 13:** Showing posterosuperior exit of MF; **Figure 14:** Showing Superior exit of MF; **Figure 15:** Showing posterior exit of MF; **Figure 16:** Showing Lateral Exit of MF

**Table 3: Comparison of shapes of mental foramen**

Shape	Prabodha et.al., 2006 <sup>[15]</sup>	Deepa Rani Agarwal et.al., 2011 <sup>[16]</sup>	Priya et.al., 2014 <sup>[17]</sup>	Vimala et.al., 2015, <sup>[18]</sup>	Present Study
Oval	66.67%	92%	53.3%	61.2%	63.3%
Round	33.33%	8%	34.7%	38.5%	36.7%

**Table 4: Comparison of position of mental foramen**

Mean distance from	Prabodha et.al., 2006	Deepa Rani Agarwal et.al., 2011	Summit et.al., 2012 <sup>[6]</sup>	Vimala et.al., 2015	Oliverira et.al.,2009	Present Study
Symphysis Menti	26.67mm	25.28mm	26.71mm	26.67mm	-	26.69mm
Posterior Border of ramus of Mandible	62.35mm	65.58mm	65.34mm	62.35mm	-	65.95mm
Inferior Border of Mandible Alveolar margin	11.25mm	12.13mm	12.26mm	11.25mm	12.95mm	11.76mm
	-	-	-	-	13.84mm	14.08mm

**Table 5: Comparison of exit of mental forame**

Direction	Ilayperuma et al.,2009 <sup>[13]</sup>	Deepa Rani Agarwal et.al., 2011	Present Study
Posterosuperior	49.01%	92%	50.7%
superior	33.33%	3.3%	34.07%
Lateral	9.8%	3.3%	7.03%
Posterior	3.92%	1.4%	8.2%
Anterior	3.92%	0%	0%

**Table 6: Comparison of location of mental foramen with anatomical landmarks**

Location	Side	Ilayperuma et al., 2009	Deepa Rani Agarwal et.al., 2011	Present Study
In the line with the second premolar	Right	58.82%	81.55%	86.1%
	Left	47.06%	81.50%	84.75%
Between second premolar and first molar	Right	0%	2.75%	3.2%
	Left	0%	3.1%	2.65%
Between the first and second premolar	Right	11.76%	7.8%	5.2%
	Left	11.76%	7.6%	5.85%
In line with the first molar	Right	5.88%	7.9%	1.1%
	Left	11.76%	7.8%	1.4%
In line with the first premolar	Right	23.53%	0%	4.4%
	Left	29.41%	0%	5.35%

**DISCUSSION**

The precise identification of the position of the mental foramen is important in both diagnostic and clinical procedures of the mandible. Clinically, the mental nerve bundle emerging from the mental foramen may get injured during surgical procedures with resulting paresthesia or anesthesia along with its sensory distribution.<sup>9</sup> Anatomically, the mental foramen is the opening of the mental canal. According to standard textbooks, mental foramen is most commonly situated between the apices of the first and second lower premolar<sup>1,2</sup> Although this is in accord with some European populations, this is an exception to other populations.<sup>5,9, 10,11,12,13</sup> Racial variation in the position of the mental foramen is demonstrated. The position of the mental foramen in Chinese was in the line with the second premolar whereas, in Britishers, it was between the first and second premolars<sup>[14]</sup>. It was also interesting to note that the mental foramen was positioned more posteriorly in Blacks than in Whites<sup>[3]</sup>. The mean

distance from the mental foramen to the symphysis menti in the present study was 25.52±5.03mm on the right side and 26.067±5.03mm on the left side. There was no significant side difference either in the position or the morphometry of the mental foramen in the present study. From a clinical point of view, information regarding the mean distance from symphysis menti to mental foramen in a given population has a significant implication. Generally, the mental foramen is difficult to localize as there are no absolute anatomical landmarks for reference.<sup>9</sup> As the mental foramen can not be clinically visualized or palpated, in clinical situations, it is localized about the lower teeth. However, clinically there may be instances where the mental foramen can not be localized in its modal position in patients without a reference tooth or malposition of the tooth. In such cases, mental foramen can be accurately localized if the distance from the symphysis menti is known. The opening of the mental canal was posterosuperior in the majority of the subjects (50.7%).

This was in agreement with previous studies.<sup>19,20</sup> The mean horizontal diameter of 3.32 mm on the right side and 3.34mm on the left side, observed in the present study is also consistent with the corresponding figures of 2.93mm observed in west Indians,<sup>21</sup> although it was smaller than the diameters of 5.03 mm reported for Nigerians. However, the most common position of mental foramen in the present study was in the line with the long axis of the second lower premolar followed by in the line with the first molar tooth. This was in agreement with previous studies on other Asians like Asian Indians, Thai, and Malay populations.<sup>23,24</sup> During the early prenatal life mental foramen is located in the alveolar bone between the primary canine and first molar.<sup>25</sup> Therefore, it is speculated that positions other than the most common ones are due to a lag in prenatal development.

## CONCLUSION

Knowledge about the variation in the position, shape, direction of opening of the mental foramen, and presence of accessory mental foramen is important for dental surgeons in avoiding injury to mental nerve while performing the periodontal, dental implant, and endodontic procedures. The most important parameter is the distance between mental foramen to the alveolar margin and mental foramen to the lower border of the mandible plays an important role in mental nerve block.

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