

Morphology and Morphometric Analysis of the Mental Foramen in Dry Adult Human Mandibles from North India

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ABSTRACT

Introduction: The mental foramen is an important anatomical landmark, known to transmit mental nerve, a branch of the inferior alveolar nerve to supply the lower lip, gum and also the buccal vestibule anterior to the first mandibular molar. The position of the mental foramen has been shown to vary according to race. Therefore, this study was carried out to provide information on the location and other relative parameter of the mental foramen in mandibles of the north Indian population.

Materials and methods: Sixty four dry adult human mandibles were examined in this study. Various morphological and morphometrical parameters were measured by using vernier caliper, divider and scale on the right and left sides of the mandible.

Result: In the present study the most common position of the mental foramen was in line with the longitudinal axis of the mandibular second premolar and was found to be in 67.46 % of the cases on the right side and 65.06 % on the left side. The mean distance of the mental foramen from the symphysis menti was 26.12±6.76 mm and 25.91±7.10 mm on the right and left sides respectively and from the posterior border of the ramus was 71.71±7.10 mm and 71.78±7.92 mm on the right and left sides respectively. The mental foramen was situated at a mean distance of 15.11±2.71 mm on the right side and 14.14±3.12 mm on the left side from the mandibular base and at a mean distance of 13.01±3.21 mm on the right side and 14.13±3.00 mm on the left side from the alveolar crest. The most prevalent shape was found to be oval on both sides (71.87% on right and 60.93% on left side). The mean transverse diameters was 3.45±0.70 mm on right and 2.90±0.87 mm on left sides whereas the mean

vertical diameters was 2.33±0.56 mm and 2.23±0.94 mm on right and left sides respectively. The knowledge of the position of mental foramen helps surgeons in planning surgery in the oral and maxillofacial region to avoid nerve damage and also enable effective mental nerve block anesthesia.

Key words: Mental foramen, mandible, mental nerve, morphometric.

INTRODUCTION

The mental foramen is present on the external surface of each side of the mandible. It transmits mental nerve, a branch of the inferior alveolar nerve to supply the lower lip, gum and also the buccal vestibule anterior to the first mandibular molar. [1,2] The identification and precise location of the mental foramen is of great importance to dental surgeon during the surgical procedures on the mandible, such as the curettage of the premolars, filling procedures, dental implants, root canal treatments, orthognathic surgeries, pre-prosthetic surgery and flap operation of lower teeth region. [3-5] Schaeffer [6] observed that the mental foramen is located between the apices of the lower premolars. According to Tebo and Telford, [7] location of the mental foramen is below the apex of second mandibular premolar which was comparative to the finding of Sanker et al. [8] The variations in the shape, size, location of mental foramen have been reported, which are influenced by individual, gender, age, race and accessing technique used. Considering these factors, the present study was undertaken to provide

information on the location and other relative parameter of the mental foramen in mandibles of the north Indian population. Knowledge of the most common position of the mental foramen of a local population provides additional information in the mental nerve blocks and surgical procedures on the mandible.

MATERIALS & METHODS

The study was conducted on 64 dry human adult mandibles obtained from the Department of Anatomy, Faculty of Dentistry Jamia Millia Islamia University, Delhi, and Sudha Rustagi College of Dental Science & Research Institute, Faridabad (Haryana), India. Only complete mandibles with either all the teeth intact or with well-preserved alveolar margins were selected for the measurement. Damaged, mutilated, extensive attrition and deformed mandibles were excluded from the present study.

Before measuring, mandibles were placed on a standard horizontal plane to which the lower border of the mandible get its most contact when vertical pressure is applied to the molars. [9-11] The various parameters measured using vernier caliper, divider and scale, on the right and left sides of the mandible, are as follows: -

1) Relations of the mental foramen to the mandibular teeth: -

The position of the mental foramen in relation to the mandibular teeth was measured and expressed as a percentage for each of the six positions described by Tebo and Telford. [7] They are: -

Relation I - mental foramen situated anterior to the first premolar.

Relation II - mental foramen situated at the apex of the first premolar.

Relation III - mental foramen situated between the apices of the two premolars.

Relation IV - mental foramen situated at the apex of the second premolar.

Relation V - mental foramen situated posterior to the second premolar.

Relation VI - mental foramen situated below the root apices of the first molar.

2) Distances of the mental foramen from various mandibular landmarks:-

The following distances were measured from the most anterior portion of the anterior border of the mental foramen (point mf) as shown in Figure 1.

a) Distance between most anterior margin of mental foramen (mf) and the symphysis menti: (mf-A)

b) Distance between most anterior margin of mental foramen (mf) and posterior border of ramus of mandible: (mf-P).

c) Distance between most anterior margin of mental foramen (mf) and alveolar crest: (mf-S).

d) Distance between most anterior margin of mental foramen (mf) and inferior border of mandible: (mf-I).



Figure 1. Photograph showing measurement of mental foramen (mf) from various mandibular landmarks, (a) Symphysis menti (mf-A) (b) Posterior border of mandibular ramus (mf-P) (c) mandibular alveolar margin (mf-S) and (d) Mandibular base (mf-I).

The above measurements were taken bilaterally in all the mandibles using a divider with two fine tip ends and then transferred to a vernier caliper. The distance of the mental foramen from various landmarks was recorded as an average of two measurements which were measured independently by two different people. The mean and standard deviation for each distance were calculated individually for right and left sides.

3) Dimensions of the mental foramen: -

The transverse and vertical diameters of mental foramen passing through the center of the foramen were measured with the help of a vernier caliper. In addition the shape of

the mental foramen was also noted. All the results thus obtained were expressed as mean \pm standard deviation.

RESULT

The distributions of the position of mental foramen in relation to mandibular teeth are shown in Tables I.

Table I. Relation of the mental foramen to the mandibular teeth.

Relation	Right	Left
I	0	0
II	1 (1.20)	2 (2.40)
III	18 (21.68)	17 (20.48)
IV	56 (67.46)	54 (65.06)
V	7 (8.43)	9 (10.84)
VI	1 (1.20)	1 (1.20)

Relation I - mental foramen situated anterior to the first premolar.
 Relation II - mental foramen situated at the apex of the first premolar.
 Relation III - mental foramen situated between the apices of the two premolars.
 Relation IV - mental foramen situated at the apex of the second premolar.
 Relation V - mental foramen situated posterior to the second premolar.
 Relation VI - mental foramen situated below the root apices of the first molar.

The most common position of the mental foramen relative to the lower teeth was position IV (Figure 2) i.e. in line with second mandibular premolar and was found to be in 67.46 % of the cases on the right side and 65.06 % on the left side. It was followed by the position of mental foramen in line with the long axis between first and second premolars (Figure 3), and was 21.68

% and 20.48 % on right side and left side respectively. No foramen was observed anterior to the first premolar on both sides of the mandible (Figure 4).

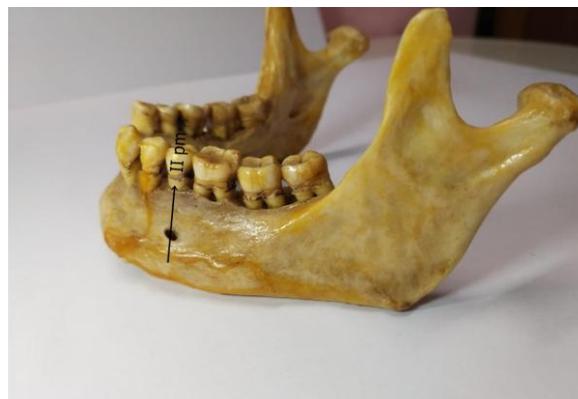


Figure 2. Left side of mandible showing mental foramen lying in position IV.
 II pm \rightarrow second premolar



Figure 3. Left side of mandible showing mental foramen lying in position III.
 Ca \rightarrow canine, I pm \rightarrow first premolar, II pm \rightarrow second premolar

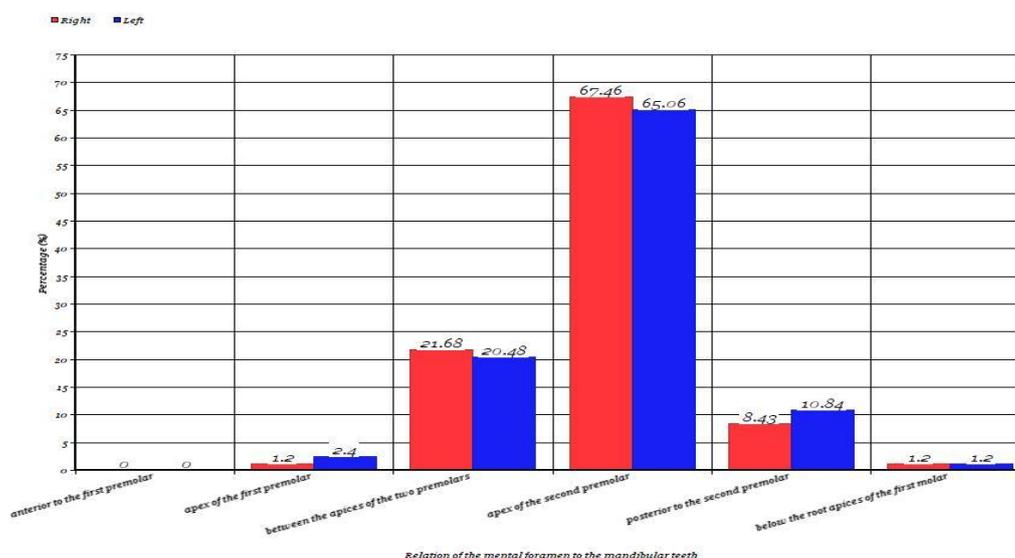


Figure 4. Bar diagram showing the distance of mandibular foramen (MF) from various mandibular landmarks on right and left sides of mandible.

The measurements of the mental foramen on both sides of the mandible from various parameters are summarized in Table II.

Table II. Distance of mental foramen from various mandibular bony landmarks.

Measurement	Right (Mean ± SD) mm	Left (Mean ± SD) mm
mf-A	26.12±6.76	25.91±7.10
mf-P	71.71±7.10	71.78±7.92
mf-S	13.01±3.21	14.13±3.00
mf-I	15.11±2.71	14.14±3.12

mf-A --- Distance between the mental foramen and the mandibular symphysis.

mf-P --- Distance between the mental foramen and the posterior border of the mandibular ramus.

mf-S --- Distance between the mental foramen and the alveolar margin of mandible.

mf-I --- Distance between the mental foramen and the base of mandible.

The distance between the most anterior margin of mental foramen to the symphysis menti was 26.12±6.76 mm on right side and 25.91±7.10 mm on left side, whereas the distance between the posterior border of ramus of mandible and anterior margin of mental foramen was 71.71±7.10 mm on right side and was 71.78±7.92 mm on left side. The distance between the most anterior margin of mental foramen and alveolar crest was 13.01±3.21 mm on right side and 14.13±3.00 mm on left side and between the most anterior margin of mental foramen and inferior border of the body of mandible was 15.11±2.71 mm and 14.14±3.12 mm on right and left sides, respectively.

The shape of mental foramen was visually observed and analyzed in all the 64 mandibles and it was predominantly found in the oval form in both right and left sides of the mandible (Table III).

Table III. Shape and size of the mental foramen in mandible.

Shape		
	Right	Left
Oval	71.87%	60.93%
Round	28.12%	39.06%
Size		
	Right (Mean ± SD) mm	Left (Mean ± SD) mm
Transverse diameter	3.45±0.70	2.90±0.87
Vertical diameter	2.33±0.56	2.23±0.94

On right side, it was oval in 71.87% cases and round in 28.12% cases, whereas on left side it was oval in 60.93% cases and round

in 39.06% cases. The mean transverse diameter was 3.45±0.70 mm on the right side and 2.90±0.87 mm on the left side, and mean vertical diameter was 2.33±0.56 mm and 2.23±0.94 mm on right and left side respectively.

DISCUSSION

The mental foramen represents the end of the mandibular canal, is usually a single opening on the anterolateral aspect of the mandible. Inferior alveolar nerves and vessels after traversing the mandibular canal, exit through the mental foramen as the mental nerves and vessels. The morphological knowledge of the position of the mental foramen is clinically critical while performing periapical surgery, cyst enucleation, endosseous implant, periodontal surgery and surgical orthodontic treatments such as a mandibular body osteotomy, in order to prevent damage to the mental nerve. [12] Moreover, while administering mental nerve block, the precise location of the mental foramen will facilitate dental surgeons to avoid injury to the neurovascular bundles followed by complications like paresthesia and trauma. [13] The present study was conducted to identify the location of the mental foramen and its distances from different bony landmarks on mandible in north Indian population.

In the present study, the most common position of mental foramen was below the apex of second mandibular premolar tooth and the interval between the two premolars was the second most common site (Table I). In relation to second premolar, the location of mental foramen was 67.46% on right side and 65.06% on left side. While between two premolars it was 21.68% on right side and 20.48% on left side. This is in accordance with Sankar et al, [8] Wang et al, [12] Budhiraja V et al, [14] Udhaya K et al, [15] Gupta S et al [16] and Singh R et al. [17] This finding differed significantly from the finding of Moogla S et al [18] and Rai R et al, [19] who reported that the most common location of mental

foramen is between first and second premolars.

In the present study, mental foramen on an average lies at a distance of 26.12 ± 6.76 mm on right side and 25.91 ± 7.10 mm on left side from the symphysis menti of the mandible and that from posterior border of the ramus of the mandible was 71.71 ± 7.10 mm and 71.78 ± 7.92 mm on the right and left side respectively. Sankar DK et al [8] studied 90 mandibles and observed that the distance of mental foramen from the symphysis menti of the mandible was 27.2 ± 2.4 mm on right side and 27.7 ± 2.4 mm on left side, whereas from posterior border of ramus it was 70.7 ± 4.2 mm on the right side and 70.7 ± 4.2 mm on the left side. According to Udhaya K et al [14] mental foramen was located at the distance of 25.79 ± 1.78 mm on right side and 25.29 ± 2.29 mm on left side from the symphysis menti, whereas it was 64.51 ± 4.06 mm and 63.92 ± 4.26 mm from the posterior border of the mandible ramus on right and left side respectively. Rai R et al [19] in 2014 did measurements on 40 adult mandibles of unknown sex, and reported the distance of the mental foramen to the symphysis menti was 22.41 ± 2.57 mm and 22.23 ± 2.48 mm on the right and the left sides, respectively, and the distance to the posterior border of the mandibular ramus was 63.67 ± 7.36 mm on the right side and 63.73 ± 7.39 mm on the left side. According to Singh R et al [17] the distance of the mental foramen to the symphysis menti of the mandible was 29.3 mm and 30.6 mm on the right and the left sides, respectively. The distance to the posterior border of the mandible was 71.8 mm on the right side and 84.7 mm on the left side. Gupta S et al [16] in their study observed that the mental foramen was located at the distance of 29.12 mm from the symphysis menti and 76.16 mm from the posterior border of the ramus of mandible.

In the study of Sankar DK et al [8] the distance between mental foramen and base of the mandible was 16.5 ± 2.1 mm on right side and 14.3 ± 2.1 mm left side, whereas it

was at a distance of 13.7 ± 2.8 mm and 16.4 ± 2.9 mm from the alveolar margin on right and left sides respectively. Udhaya K et al [14] reported that the mean distance of mandibular foramen from mandible base was 12.65 ± 1.59 mm on right side and 12.77 ± 1.73 mm on left side and from alveolar margin was 12.02 ± 2.48 mm on right side and 12.21 ± 2.61 mm on left side. According to Rai R et al, [19] the mean distance between base of mandible and mental foramen on right side was 12.43 ± 1.95 mm while on left side it was 12.17 ± 1.72 mm and mean distance between mental foramen and alveolar crest of mandible on right side was 11.48 ± 1.58 mm and on left side was 11.41 ± 1.43 mm. Singh R et al [17] observed that the distance of the mental foramen to the lower border of the mandible was 17.3 mm and 13.3 mm on the right and the left sides, respectively. The distance to the upper border was 17 mm on the right side and 18.6 mm on the left side. In the study of Gupta S et al [16] mental foramen was situated at a mean distance of 14.45 mm from the base of mandible. In the present study the mandibular foramen was situated from base of the mandible at an average distance of 15.11 ± 2.71 mm on the right side and 14.14 ± 3.12 mm on the left side and from alveolar margin of mandible was 13.01 ± 3.21 mm and 14.13 ± 3.00 mm on right and left side respectively.

Slight variations in the findings were observed, probably due to the standardization of the location of the mental foramen, which was the most anterior portion of the anterior border of the mental foramen. Besides the variability in the methodology, it may be due to the variation in size and form of the studied mandibles.

In the present study, we observed that the mental foramen was oval shaped in 71.87% on the right side and 60.93% on the left side of the mandible. It was round shaped in 28.12% and 39.06% on the right and left side of the mandible respectively. These values are in congruence with Budhiraja V et al [14] and Udhaya K et al, [15] who also observed majority of mental

foramen were oval shaped. However Moogla S et al, [18] Sankar DK et al, [8] Gupta S et al, [16] Rai R et al [19] and Singh R et al [17] in their study observed predominantly round shaped mental foramen.

The present study demonstrated the mean transverse diameter of the mental foramen was 3.45 ± 0.70 mm for the right side and of 2.90 ± 0.87 mm for the left side, while the vertical diameter was 2.33 ± 0.56 mm on the right side and 2.23 ± 0.94 mm on the left side. A study which was done on south Indian population [14] reported the horizontal diameter of the mental foramen to be 2.28 ± 0.71 mm on the right side and to be 2.95 ± 0.68 mm on the left side, and the vertical diameter was 2.86 ± 0.83 mm on the right side and 2.52 ± 0.87 mm on the left side. Rai R et al [19] described the mean horizontal diameter of the mental foramen to be 2.63 ± 0.85 mm on the right side and to be 2.61 ± 0.85 mm on the left side along with the vertical diameter as 2.33 ± 0.64 mm on the right side and 2.29 ± 0.60 mm on the left side. According to Budhiraja V et al [14] horizontal diameter of mental foramen was 5.19 ± 0.24 mm on the right side and 5.12 ± 0.28 mm on the left side. The vertical diameter was 2.61 ± 0.17 mm and 2.53 ± 0.14 mm on right and left sides respectively. Sankar DK et al [8] measured the average size of the mental foramen and it was 2.8 mm on the right side and 3.3 mm on the left side of the mandible. There are divergences in studies regarding the location, shape and size of mental foramen in human mandibles. This may be related to naturally occurring differences in facial structure, feeding habit induced bone remodelling and difference in strategies used to record mental foramen data.

In conclusion, this study adds information to the literature concerning the location of the mental foramen in the north-Indian population. The knowledge may assist surgeons to localize the mental foramen and avoid injury to the neurovascular bundles in local anesthesia,

surgical and other invasive procedures of the oral and maxillofacial region.

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