

The Mental Foramen: Part I. Size, Orientation, and Positional Relationship to the Mandibular Second Premolar

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Seventy-five adult human mandibles were examined to determine the size, orientation, and position of the mental foramen. The average size of the foramen was found to be larger on the left side of the mandible and its usual direction of exit was in a posterior-superior direction. The most common location of the mental foramen was inferior to the crown of the second premolar and approximately 60% of the distance from the buccal cusp tip of that tooth to the inferior border of the mandible.

The mental foramen is an important anatomical structure located on the lateral surface of the mandible. It represents the termination of the mental canal which opens onto the surface in an oblique direction (1, 2). The mental bundle passes through the mental foramen and supplies sensory innervation and nutrition to the soft tissues of the chin, lower lip, and gingiva on the ipsilateral side of the mandible (3).

The accurate identification of the location of the mental foramen is important for both diagnostic and clinical procedures. The radiographic appearance of the mental foramen may result in a misdiagnosis of a radiolucent lesion in the apical area of mandibular premolar teeth. Clinically, the mental bundle could be traumatized during surgical procedures resulting in paresthesia or anesthesia. Additionally, local anesthesia of the terminal incisive branches of the inferior alveolar nerve and the mental nerve can be obtained if the mental canal is located and anesthetic solution deposited within it. All of these procedures require an accurate knowledge of the location and orientation of the mental canal and its foramen.

Frequently, the mental foramen is difficult to locate. There are no absolute anatomical landmarks for reference and the foramen cannot be clinically visualized or palpated. As a result, the reported anatomical position of the foramen has been variable (1, 4-6). Direct observation and measurements on dry specimens have identified the vertical position of the foramen to be generally inferior to the second premolar tooth (Table 1). However, these studies did not specifically define the anatomical boundaries or the linear dimensions of the foramen. These factors could have affected its reported verti-

cal position relative to the premolar teeth. Matsuda (4) measured the vertical position of the mental foramen related to the alveolar ridge and the base of the mandible. He concluded that the superior border of the foramen was commonly 10.5 to 18.0 mm below the alveolar process. The inferior border of the foramen was usually 11.5 to 16.0 mm from the inferior border of the mandible. Montagu (1) stated that most observers report the vertical position of the mental foramen to be midway between the alveolar process and the base of the mandible.

The horizontal position of the foramen has also been studied and has been reported to be about one fourth the distance from the mandibular symphysis to the posterior border of the ramus (5).

The orientation of the mental canal as it exits at the mental foramen onto the lateral surface of the mandible has also been the subject of previous investigations. Montagu (1) reported a posterior direction of exit 51% of the time and a lateral direction 32% of the time. de Freitas et al. (2) reported a posterior-superior direction of exit about 61% of the time in males and 50 to 54% in females.

Because of the variations in measurements previously reported for the position of the mental foramen, and since the size of the foramen itself has not been reported, a more exact study was undertaken. The purpose of this study was to report the size and orientation of the mental foramen as well as its positional relationship to the mandibular second premolar.

MATERIALS AND METHODS

Seventy-five dry, adult, human mandibles were obtained from an anatomy collection. The age, sex, and race of the specimens were unknown. The mandibles were chosen according to the following criteria:

1. As a minimum, all mandibular teeth from right second premolar to left second premolar were present.
2. The second premolars were in a reasonably normal position and alignment.
3. The buccal cusps of the second premolars were intact and without excessive wear.

The following measurements or observations were performed directly on each dry mandible for both left and right sides. Measurements were made to the nearest 0.1 mm using a Boley gauge.

TABLE 1. Anatomical location of the mental foramen (%)

Author	Between First and Second Premolar	Below Second Premolar	Between Second PreMolar and First Molar
Matsuda (4)	17.0	68.6	6.1
Tebo and Telford (5)	23.0	49.4	24.1
Miller (6)	38.0	40.0	20.0
Montagu (1)	22.0	63.0	3.0
Average	25.0	55.2	13.3

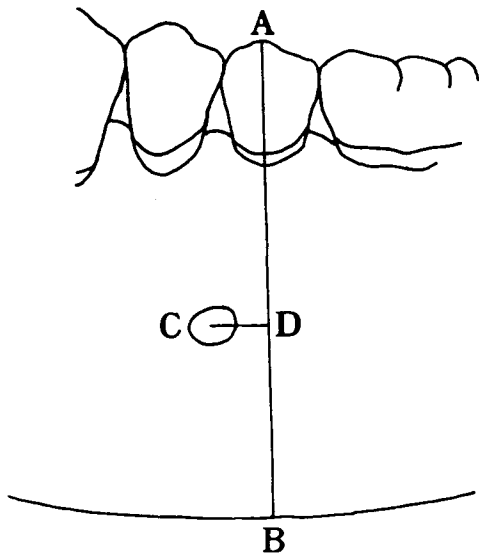


FIG 1. Line AB was drawn from the buccal cusp tip of the mandibular second premolar through the long axis of the clinical crown to the inferior border of the mandible. The distance CD was measured from the center of the mental foramen perpendicular to line AB.

The external circumference of each mental foramen was outlined in pencil on the lateral surface of the mandible. A vertical line (AB) was drawn from the buccal cusp tip of the mandibular second premolar through the clinical long axis of the crown to the inferior border of the mandible (Fig. 1).

Size. The greatest horizontal and vertical dimension of each mental foramen was recorded.

Orientation. The direction of exit of each mental canal through the lateral surface of the mandible was visually determined and recorded.

Horizontal position. The position of the mental foramen was recorded as mesial, intersecting, or distal to the reference line AB. The distance CD was measured from the center of the foramen perpendicular to line AB and this distance was recorded as being either mesial, intersecting, or distal to the reference line.

Vertical position. The distance from the buccal cusp tip of the mandibular second premolar to the level of the center of the foramen (line AD) and from the cusp tip to the inferior border of the mandible (line AB) was measured and recorded. The average ratio of the distances (AD/AB) was calculated.

RESULTS

The size of the mental foramina is shown in Table 2. The average horizontal dimension was 4.6 mm with a range of 2.4

TABLE 2. Size of the mental foramen (mm)

	Left		Right		Both	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Minimum	2.4	2.1	2.4	2.2	2.4	2.1
Maximum	6.9	5.8	7.3	5.2	7.3	5.8
Average	5.0	3.5	4.2	3.3	4.6	3.4

TABLE 3. Direction of exit of the mental foramen

Direction	No.	%
Posterior-superior	103	68.7
Superior	33	22.0
Lateral	8	5.3
Anterior-superior	4	2.6
Posterior	1	0.7
Anterior	1	0.7
Total	150	100.0

TABLE 4. Position of the mental foramen relative to a line drawn through the long axis of the second premolar crown

Side	Totally Mesial	Intersect	Totally Distal
Left	12 (16.0)	48 (64.0)	15 (20.0)
Right	15 (20.0)	46 (61.3)	14 (18.7)
Both	27 (18.0)	94 (62.7)	29 (19.3)

to 7.3 mm. The average vertical dimension was 3.4 mm with a range of 2.1 to 5.8 mm. The foramen was usually found to be larger on the left side than on the right side of the mandible.

The most common direction of exit of the mental canal was posterior-superior 68.7% of the time and superior 22.0% of the time (Table 3). No specific differences were observed between the left or right sides.

The horizontal position of the foramen is presented in Table 4. The line through the long axis of the clinical crown of the second premolar (line AB) intersected the mental foramen on 62.7% of the specimens examined. The average distance from the reference line to the center of the foramen was 1.9 mm to the mesial and 2.2 mm to the distal (Table 5).

The average vertical distance from the buccal cusp tip of the mandibular second premolar to the inferior border of the mandible was 36.0 mm on both right and left sides (Table 6). The average distance from the cusp tip to the center of the foramen was 21.5 mm on the left side and 22.1 mm on the right side. The average for both sides was 21.8 mm. The average ratio of the distance from the buccal cusp tip to the

TABLE 5. Horizontal distance of the mental foramen from a line drawn through the long axis of the second premolar crown (mm)

	Left			Right			Both		
	Mesial (33)	Intersecting (12)	Distal (30)	Mesial (32)	Intersecting (5)	Distal (38)	Mesial (65)	Intersecting (17)	Distal (68)
Minimum	0.2	0.0	0.3	0.5	0.0	0.2	0.2	0.0	0.2
Maximum	5.6	0.0	5.5	6.6	0.0	5.8	6.6	0.0	5.8
Average	1.8	0.0	2.3	2.0	0.0	2.1	1.9	0.0	2.2

TABLE 6. Vertical position of the mental foramen in relation to the buccal cusp tip (BCT) of the second premolar (mm)

	BCT to Inferior Border of mandible		BCT to Center of Foramen		Average Ratio (%)	
	Left	Right	Left	Right	Left	Right
	Minimum	27.7	26.9	13.0	16.0	46.9
Maximum	44.5	46.2	28.7	29.8	64.5	64.5
Average	36.0	36.0	21.5	22.1	59.7	61.4

center of the foramen versus the distance to the inferior border of the mandible (AD/AB) was 60.6%.

DISCUSSION

Comparisons of this study with past anatomical investigations of the mental foramen are difficult. A clear anatomical definition of the boundaries of the mental foramen was not presented in those investigations. Also, the position of the mental foramen has not been related to one specific structure.

The definition of the mental foramen used in this study is the entire funnel-shaped opening of the mental canal onto the lateral surface of the mandible. This structure is located entirely in buccal cortical bone. The largest diameter of the foramen is found at the lateral surface of the mandible. Using this definition, the average size of the foramen was found to be 4.6 mm horizontally and 3.4 mm vertically. The outline of the foramen was generally oval and directed posterior-superiorly. This corresponded to the general direction of exit of the mental canal.

Both the horizontal and vertical position of the mental foramen were measured relative to a line drawn from the buccal cusp tip of the clinical crown of the second premolar, through the long axis, to the inferior border of the mandible. The mental foramen intersected this line 62.7% of the time. The remaining foramina were totally mesial or distal to this line. However, it should be noted that the average distance to the center of these foramina was within 2.0 mm on either side of the line.

The vertical position of the mental foramen was measured from the buccal cusp tip of the second premolar. In contrast, Matsuda (4) used the height of the alveolus as his superior

point of reference so direct numerical comparisons cannot be made. Matsuda's measurements were also not usually clinically relevant due to the wide range of values in superior-inferior dimensions of mandibles. However, a ratio could be useful clinically in locating the mental foramen. The average ratio of the distance from the cusp tip of the second premolar to the center of the foramen and the distance to the inferior border was relatively constant at 60% in this investigation.

The accumulated data from this study can also be useful in administering local anesthetic for a mental block. The needle should enter the soft tissue posterior and superior to the mental foramen at a point located below the clinical crown and along the long axis of the second premolar. That point is usually located 60% of the distance from the buccal cusp tip of that tooth to the inferior border of the mandible. The needle should be advanced in an anterior and inferior direction until the funnel-like opening of the mental foramen directs it into the mental canal where the solution should be deposited.

An area not covered in this study is the contribution of radiography in accurately locating the mental foramen. Do the anatomical and radiographic positions coincide? Radiographic studies of this same group of mandibles are being undertaken which may help to answer this question.

The opinions expressed herein are those of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or Department of Defense.

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