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Morphometric Study of Mental Foramen in Dry Human Mandibles

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Abstract
The recent trend of replacement of missing teeth by dental implants and the increasing frequency of orthognathic surgeries have highlighted the clinical significance of the mental foramen. The mental foramen is a small foramen which is located in the anterolateral aspect of the body of the mandible. It transmits the mental nerve and the vessels. This study was conducted on 109 dried adult human mandibles in the Department of Anatomy, Vijaynagar Institute of Medical Sciences,Ballari, Haveri Institute of Medical Sciences, Haveri, Karnataka, India. Parameters like incidence, shape, distance from surrounding landmarks, diameters (horizontal and vertical diameters), position and direction of the mental foramen were recorded. The incidence, position and the distance of accessory mental foramen from the mental foramen were noted. Mental foramen was present bilaterally in all the mandibles studied. The most prevalent shape was found to be oval shape. 67.89% of the foramen were oval on the right side and 74.31% on the left side. The mean horizontal diameter of mental foramen(HD) was 2.12±0.65mm on the right side and 2.97±0.72mm on the left side and the mean vertical diameter of mental foramen(VD) was 2.85±0.82mm on the right side and 2.60±0.89mm on the left side. The most commonly present position of the MF was position 4 followed by position 3. Majority of the foramen were directed anteriorly followed by posteriorly directed foramen. The accessory mental foramen was found in 14(12.84%) mandibles on the right side and 6(5.5%) mandibles on the left side. No specimen showed bilateral accessory mental foramen. The accessory mental foramen was situated below the apex of the first molar tooth. Average distance between mental foramen and accessory mental foramen was 0.59mm lateral to mental foramen. Prior knowledge of mental foramen variations helps surgeons in planning surgery in that region to avoid nerve damage and also enable effective mental nerve block anesthesia.

INTRODUCTION

The mental foramen is located on the anterolateral aspect of the body of mandible[1]. Mental foramen transmits mental nerves and vessels[2]. It marks the termination of mandibular canal in the mandible through which the inferior alveolar nerve and vessels pass. At this point mandibular canal bifurcates and forms the mental incisive canals. The mental neurovascular bundle passes through the mental foramen and supplies sensory innervations and blood supply to the soft tissues of the chin, lower lip and gingiva on the ipsilateral side of the mandible[3]. The intra osseous anatomy of the mental nerve is of particular importance in dental implant surgery, the nerve may be damaged if the interforaminal area of the mandible is invaded during surgery or while harvesting block grafts from the symphysial region[4]. Any foramen in addition to the mental foramen is known as the accessory mental foramen[5]. As accessory mental foramen is due to branching of mental nerve before passing through the mental foramen, its morphometry and verification of its existence would prevent accessory nerve injury during periapical surgery. In addition to this, if this nerve is not blocked parasthesia will be less in the structures supplied by it[6]. Both the mental and accessory mental foramen show ethnic variations. The precise knowledge on the variations in the position, size and shape of the mental foramen and the presence of the accessory mental foramen would be of much use for dental surgeons while they do surgical procedures on the mandible, such as the curettage of the premolars, filling procedures, dental implants, root canal treatments, orthognatic surgeries, etc[7].

MATERIALS AND METHODS

109 dried adult human mandibles of unknown sex obtained from the Department of Anatomy, Vijaynagar Institute of medical sciences,Ballari, Haveri Institute of Medical Sciences, Haveri, Karnataka, India constituted the material for the present study. Damaged and deformed mandibles were excluded from the study. The incidence, shape, position, direction of the mental foramen were observed. The horizontal and vertical diameters of the mental foramen were determined. The incidence, position, distance of accessory mental foramen from the mental foramen were noted.

The following parameters were recorded and these parameters were measured by using vernier calipers scale. The SPSS 15 version software were used for the statistical analysis to find out the incidence, minimum, maximum, mean and the standard deviation.

Distance and diameter of mental foramen:

- H1= distance between symphysis menti and medial margin of mental foramen
- H2= distance between lateral margin of mental foramen and posterior border of ramus of mandible
- H3= distance between symphysis menti and posterior border of ramus of mandible
- HD= horizontal diameter of mental foramen= H3-(H1+H2)
- V1= distance between alveolar crest to upper margin of mental foramen
- V2= distance between lower margin of mental foramen to lower border of mandible
- V3= distance between alveolar crest to lower border of mandible
- VD= vertical diameter of mental foramen= V3-(V1+V2)

Position of mental foramen: The position of MF was classified in relation to teeth of the lower jaw in accordance with Tebo and Telford8 (Figure 2).

- Foramen lying on a longitudinal axis passing between canine and first premolar;
- Foramen lying on the longitudinal axis of first premolar;
- Foramen lying on a longitudinal axis passing between first and second premolars;
- Foramen lying on longitudinal axis of second premolar;
- Foramen lying on a longitudinal axis passing between second premolar and first molar;
- Foramen lying on a longitudinal axis of first molar.

Direction of mental foramen: The direction of the mental foramen was measured by inserting an office pin into the foramen. The direction to which the office pin pointed was visually inspected. The results of the different directions or courses of the foramina were then grouped into five as follows[9].

- D1 - Anteriorly D2 - Anterosuperiorly D3 - Posteriorly
- D4 - Posterosuperiorly D5 – Superiorly

RESULTS AND DISCUSSIONS

In the present study, the most common shape of mental foramen was oval shape in both the right and left sides. The incidence of oval shape was 67.89 % and round shape was 32.11% on the right side. Similarly, the incidence on the left side, 74.31% were oval shaped and 25.69% were round shaped. The incidence of bilateral oval and round shapes were 28.44% and 10.09% respectively (Table 1).

In our present study, the mean distance between symphysis menti and medial margin of mental foramen (H1) was 25.68±1.87 mm on the right side and 25.32±2.41 mm on the left side. Mean distance between lateral margin of mental foramen and posterior border of ramus of mandible (H2) was

Fig. 1: Showing 109 dry adult human mandibles

Fig. 2: Relation of mental foramen to the body of mandible

Fig. 3: Position of Mental Foramen in Relation to Lower Teeth (Tebo And Telford Classification[8])

Fig. 4: Showing an accessory mental foramen

66.12±4.28mm on the right side and 65.25±4.64 mm on the left side. Mean distance between symphysis menti and posterior border of ramus of mandible(H3) was 93.92±4.65mm on the right side and 93.54±5.15mm on the left side. Mean horizontal diameter of mental foramen(HD) was 2.12±0.65mm on the right side and 2.97±0.72mm on the left side (Table 2 and 3).

The mean distance between alveolar crest to upper margin of mental foramen(V1) was 12.03±2.45mm on the right side and 11.98±2.59mm on the left side. Mean distance between lower margin of mental foramen to lower border of mandible(V2) was 13.11±1.78mm on the right side and 13.05±1.81mm on the left side. Mean distance between alveolar crest to lower border of mandible(V3) was 27.99±3.09mm on the right side and 27.63±3.21mm on the left side. Mean vertical diameter of mental foramen(VD) was 2.85±0.82mm on the right side and 2.60±0.89mm on the left side (Table 2 and 3).

In the present study, the most commonly observed position of the mental foramen as related to the lower set of teeth was in line with the second premolar, i.e., Type 4. This position was observed in 65.14 % on the right side, 64.22 % on the left side and10.09% bilaterally. Next common position was Type 3, i.e., between the premolars, its incidence was 22.94% on the right side, 17.43% on the left side and 6.42% bilaterally followed by Type 5 i.e., between the second premolar and first molar 11.93% on the right side, 11.01% on the left side and 5.50% bilaterally (Table 4).

In our present study, majority of the foramen were directed anteriorly i.e., 64.22% on the right side and 58.71% on the left side followed by posteriorly directed foramen i.e., 23.85% on the right side and 41.28% on the left side (Table 5).

The accessory mental foramen was found in 14 mandibles on the right side and 6 mandibles on the left side. No specimen showed bilateral accessory mental foramen. The incidences were 12.84% on the right side and 5.5% on the left side. The accessory mental foramen was situated below the apex of first molar tooth. Average distance between mental foramen and accessory mental foramen was 0.59mm lateral to the mental foramen.

The restoration, form and function without violating important anatomic structures are the fundamental goal in the surgical management of any patient. One of these is the mental foramen. The identification and preservation of the mental foramen in periapical surgery, implant surgery, maxillofacial surgery and orthographic procedures is of utmost importance[10].

In the present study, the most common shape was oval shape in both the right and left sides. The incidence of oval shaped mental foramen was 67.89 % and round shape was 32.11% on the right side. Similarly, the incidence on the left side, 74.31% were oval shaped and 25.69% were round shaped. The incidence of bilateral oval and round shapes were 28.44% and 10.09% respectively. In a study conducted on 50 mandibles by Ajay parmar *et al*., they reported that the predominant shape of mental foramen was oval (69%) followed by round shape (31%)[11]. According to Siddiqui *et al*., who conducted a study on 93 mandibles, oval shaped foramen were observed in

Table 1: Incidence and shape of mental foramen

		Right	Left	Bilateral
Incidence		109	109	109
Shape	Oval Shape	74(67.89%)	81(74.31%)	31(28.44%)
	Round shape	35(32.11%)	28(25.69%)	11(10.09%)

Table 2: Statistical analysis of position of mental foramen and its size in relation with borders of right side

Parameters (mm) (Right side)	H1	H2	H3	HD	V1	V2	V3	VD
Minimum	20.79	53.88	79.48	1.79	5.39	8.11	20.39	1.11
Maximum	29.19	74.32	101.2	3.94	18.41	16.91	34.92	4.62
Mean	25.68	66.12	93.92	2.12	12.03	13.11	27.99	2.85
SD	1.87	4.28	4.65	0.65	2.45	1.78	3.09	0.82

Table 3. Statistical analysis of position of mental foramen and its size in relation with borders of left side

Parameters (mm) (Left side)	H1	H2	H3	HD	V1	V2	V3	VD
Minimum	20.84	55.21	79.64	1.89	3.72	8.92	18.21	1.09
Maximum	33.21	74.01	103.21	3.96	22.57	17.01	34.87	4.68
Mean	25.32	65.25	93.54	2.97	11.98	13.05	27.63	2.6
SD	2.41	4.64	5.15	0.72	2.59	1.81	3.21	0.89

Table 4: Position of mental foramen in relation to lower teeth

Position	Right	Left	Bilateral
1	Nil	8(7.34%)	Nil
2	Nil	Nil	Nil
3	25(22.94%)	19(17.43%)	7(6.42%)
4	71(65.14%)	70(64.22%)	11(10.09%)
5	13(11.93%)	12(11.01%)	6(5.50%)
6	Nil	Nil	Nil

Table 5: Direction of mental foramen

Direction	Right	Left	Bilateral
D1	70(64.22%)	64(58.71%)	15(13.76%)
D2	Nil	Nil	Nil
D3	26(23.85%)	45(41.28%)	10(9.17%)
D4	13(11.93%)	Nil	Nil
D5	Nil	Nil	Nil

70% of the mandibles and round shape foramen in 30%[12]. Our results are in agreement with the above studies.

In our present study, the mean horizontal diameter of mental foramen(HD) was 2.12±0.65mm on the right side and 2.97±0.72mm on the left side and the mean vertical diameter of mental foramen(VD) was 2.85±0.82mm on the right side and 2.60±0.89mm on the left side. Our results are in agreement with Udhaya K et al., they reported that the average horizontal diameter of the mental foramen was 2.28 ± 0.71 mm on the right side and 2.95 ± 0.68 mm on the left side; the vertical diameter was 2.86±0.83 mm on the right side and 2.52 ± 0.87 mm on the left side[13].

In the present study, the most common position of the mental foramen was in line with the second premolar, i.e., Type 4. This position was observed in 65.14 % bones on the right side and 64.22 % bones on the left side. Next common position was Type 3, i.e., between the premolars, it was observed in 22.94% bones on the right side, 17.43% bones on the left side. Our results are in agreement with Budhiraja V et al., who conducted a study on 105 mandibles, they reported that the most common position was on the longitudinal axis of second premolar 61.0% on right side and 59.1% on left side[14].

In the present study, majority of the foramen were directed anteriorly i.e., 64.22% on the right side and 58.71% on the left side followed by posteriorly directed foramen i.e., 23.85% on the right side 41.28% on the left side. Our results are in agreement with Raman RK and Choudary G, in their study they reported that out of 45 mandibles, 60% and 57.77% were directed anteriorly on right and left sides respectively. 31.11% and 42.22% were directed posteriorly on right and left sides respectively[15].

In our present study, the accessory mental foramen was found in 14(12.84%) mandibles on the right side and 6(5.5%) mandibles on the left side. No specimen showed bilateral accessory mental foramen. The accessory mental foramen was situated below the apex of first molar tooth. Average distance between mental foramen and accessory mental foramen was 0.59 mm lateral to the mental foramen. In a study conducted by Raman RK and Choudary G on 45 mandibles, the accessory mental foramen was found in 11.11 % on the right side and 4.44% on the left side. No specimen showed bilateral accessory mental foramen[15]. Cagiranbaya and Kansu observed that the accessory mental foramen was most commonly situated below the apex of the 1st molar tooth16. In a study conducted by Raman RK and Choudary G on 45

mandibles, the distance between the mental and accessory mental foramen was 0.65 mm[15]. Our study results are similar to the studies conducted by the above-mentioned authors.

CONCLUSION

Morphological and morphometric analysis of mental foramen may be useful for the surgeons, anesthetists, neurosurgeons and dentists to carry out nerve block and surgical procedures preventing injury to the related neurovascular structures.

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