Original article:

Mental foramen: a morphological and morphometrical study

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Abstract:

Introduction: Studying the position of mental foramen and its morphological variations help to localize the mental nerve and thus prevent complications during surgical procedures.

Materials and Methods: This study was conducted in 40 dry adult human mandibles in the department of anatomy, Teerthanker Mahaveer Medical College and Research Center. Parameters like incidence, position, direction, shape and diameters of mental foramen were studied. Direction was determined using an office pin and diameters using vernier caliper.

Results: Mental foramen was present bilaterally in all the mandibles studied. The most prevalent shape was found to be round on both sides (75% on right and 60% on the left sides). The most common position was between the 2nd premolar and 1st molar on the right (P5 65%) and between 1st and 2nd premolars on the left side (P3 40%). We found the higher incidence of anteriorly directed mental foramen on both sides (62.5% on right and 57.5% on left). The mean vertical diameters were 2.3±0.64mm on right and 2.29±0.6mm on left sides whereas the mean horizontal diameters were 2.63±0.85mm and 2.61±0.85mm on right and left sides respectively.

Conclusion: Our data may provide useful information to the dental surgeons to carry out nerve block and surgical procedures like apical curettage of mandibular premolars and periodontal surgery. We could not observe accessory mental foramen (AMF) in any of the 40 mandibles studied. It might be due to less number of samples.

Key words: Mental foramen (MF), Vertical diameter (VD), Horizontal diameter (HD), premolar, molar, Accessory Mental Foramen (AMF)

Introduction

The mental foramen is located on the anterolateral aspect of the body of mandible, somewhat midway between the superior (alveolar) and inferior borders . It has been shown to be located precisely at the same levels in most humans (13-15mm superior to inferior border of the mandible ). While some showed the most prevalent position to be between the premolars, others reported it to be in the line with long axis of second premolar . Standard anatomical and radiological text books contain conflicting statements regarding the location of mental foramen. Schaeffer stated that mental foramen was located between the spaces of mandibular premolars. The position of mental foramen may be between the apex of lower premolars or below the apex of second premolar. According to Tebo and Telford, location of mental foramen is below the apex of second
mandibular premolar which was similar to the finding of Suresh et al [4]. Mental foramen transmits mental nerves and vessels [5]. 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 bundle passes through the mental foramen and supplies sensory innervations and blood supply to the soft tissues of the chin, lower lip and gingival on the ipsilateral side of the mandible [6]. The shape, size, location and direction of the opening of mental foramen have many variations and these variations are largely influenced by individual, gender, age, race, accessing technique used and degree of edentulous alveolar bone atrophy [7]. Studying position and its morphological variation of mental foramen is very important because it will be helpful to localize the important maxillofacial neurovascular bundle through the mental foramen. Mental foramen acts as the important anatomical landmark to facilitate the surgical, local anaesthetic and other invasive procedures for dental surgeons performing peri-apical surgery in the mental region of the mandible [8]. Any foramen in addition to mental foramen in the body of mandible is known as accessory mental foramen (AMF). AMF tend to exist in the apical area of the first molar and posterior or inferior area of the mental foramen. It is situated below first molar tooth according to Cagirankaya and Kasu [9]. Ethnic variation in relation to AMF have also been reported [10]. Hence location, size and shape of mental foramen and AMF would facilitate dental surgeons to apply nerve blocks in different surgical procedures involving lower jaw. As AMF is due to branching of mental nerve before passing through the MF, its shape, size 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 [11]. Hence this study was conducted to assess the morphological features of both mental and accessory mental foramen in moradabad region.

Materials and Methods

The study was carried out in the Department of Anatomy, Teerthanker Mahaveer Medical College and Research Center. 40 dry adult human mandibles were selected for the study. The incidence, shape and direction of MF were observed. The distance of mental foramen from symphysis menti, alveolar crest, posterior border of ramus of mandible and lower border of mandible were measured using digital vernier caliper. Then the size of MF was determined. The parameters measured and studied are as follows:

1. **Distance and diameter**
   - H1= distance be of between lateral margin of mental foramen and posterior border of ramus of mandible
   - H2= distance between symphysis menti and medial margin of mental foramen
   - H3= distance between symphysis menti and posterior border of ramus of mandible
   - HD= horizontal diameter=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= V3-(V1+V2)

2. **Position**
   - P1= anterior to the first premolar
   - P2= below first premolar

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P3=between the first and second premolar
P4= below the second premolar
P5= between the second premolar and first molar
P6=below the first molar

3. Direction

The direction of the mental foramen was measured by inserting an office pin into the foramen from the lateral part of the mandible. 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 5 as follows [3]:

D1= Anteriorly
D2= Anterosuperiorly
D3= Posteriorly
D4= Posterosuperiorly
D5= Superiorly

Results

Table 1. Incidence and shape of mental foramen (MF)

<table>
<thead>
<tr>
<th>Incidence</th>
<th>Right</th>
<th>Left</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round</td>
<td>30(75%)</td>
<td>24(60%)</td>
<td>9(22.5%)</td>
</tr>
<tr>
<td>Oval</td>
<td>10(25%)</td>
<td>16(40%)</td>
<td>4(10%)</td>
</tr>
</tbody>
</table>

Mental foramen was present bilaterally in all the 40 mandibles. AMF was not present in any of the mandibles studied. The most common shape was round shape in both right and left sides. Round mental foramen was present bilaterally in 22.5% cases and oval in 10% cases.

Table 2. Position of the mental foramen

<table>
<thead>
<tr>
<th>Position</th>
<th>Right(40)</th>
<th>Left(40)</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>-</td>
<td>3(7.5%)</td>
<td>-</td>
</tr>
<tr>
<td>P2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>P3</td>
<td>9(22.5%)</td>
<td>16(40%)</td>
<td>4(10%)</td>
</tr>
<tr>
<td>P4</td>
<td>5(12.5%)</td>
<td>9(22.5%)</td>
<td>2(5%)</td>
</tr>
<tr>
<td>P5</td>
<td>26(65%)</td>
<td>12(30%)</td>
<td>4(10%)</td>
</tr>
<tr>
<td>P6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The most prevalent position was P3 in case of left MF and P5 for right side mental foramen.
Table 3. Direction of mental foramen

<table>
<thead>
<tr>
<th>Direction</th>
<th>Right (40)</th>
<th>Left (40)</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>25 (62.5%)</td>
<td>23 (57.5%)</td>
<td>5 (2%)</td>
</tr>
<tr>
<td>D2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D3</td>
<td>10 (25%)</td>
<td>17 (42.5%)</td>
<td>4 (10%)</td>
</tr>
<tr>
<td>D4</td>
<td>5 (12.5%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Most of the MFs were directed anteriorly in both right and left sides.

Table 4. Distance of mental foramen from various parts of mandible

<table>
<thead>
<tr>
<th>Side</th>
<th>Distance (mm)</th>
<th>H1 (mean±sd)</th>
<th>H2 (mean±sd)</th>
<th>H3 (mean±sd)</th>
<th>HD (mean±sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>Distance (mm)</td>
<td>H1 (mean±sd)</td>
<td>H2 (mean±sd)</td>
<td>H3 (mean±sd)</td>
<td>HD (mean±sd)</td>
</tr>
<tr>
<td>Left</td>
<td>63.67±7.36</td>
<td>22.41±2.57</td>
<td>88.72±8.19</td>
<td>2.63±0.85</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>63.73±7.39</td>
<td>22.23±2.48</td>
<td>88.58±8.85</td>
<td>2.61±0.85</td>
<td></td>
</tr>
</tbody>
</table>

[ The horizontal diameter of MF was found to be 2.63±0.85mm and 2.61±0.85mm on right and left sides whereas vertical diameter was 2.33±0.64mm on right and 2.29±0.60mm on left sides.]

Discussion

The precise identification of position of mental foramen is important in both diagnostic and clinical procedures [12]. The accurate knowledge of the various morphologic and morphometric parameters of MF can be of immense help in proper localization of the important maxilla-facial neurological structures in and around the mental foramen [13].

In our study the MF was present in all 40 mandibles and it was bilateral. Singh R et al and Olivera J et al also found bilateral presence of mental foramen in all the mandibles studied [11]. We found the most common shape of the MF to be round on both right (75%) and left (60%) sides. Singh R et al observed round MF in 94 of cases in right and 87% of cases in left sides whereas Rastogi R et al showed round MF in 51.7% cases on right and 43.8% cases on the left sides [14]. However according to Parmar A et al, the predominant shape of MF was oval (69%) followed by round shape (31%) [8] which was in accordance with Olivera Junior et al who reported oval shaped MF on right side 73.8% and 71.3% on the left side [15].

The most common position of MF in our study was P5 (65%) on the right and P3 (40%) on the left side of mandible. Haghanifar and Rokouei in their radiological study of MF reported the most common position to be P3 (42.7%) [2]. Parmar A et al showed the most common position to be P4 in 64.7% cases on right and 66.7% cases on the left sides which was
similar to the findings of Singh R et al. Wang et al. and Apinhasmit et al. In other various studies this position (P4) has been shown to be prevalent in 52.94% of Sri Lankan, 44.08% (right) and 46.23% (left) of cases in western Indian, 55.7% (right) and 61.4% (left) of cases in Turkish, 45% cases in Tanzanian, 64.3% in Korean and 69.2% cases in Malay populations. These results differed significantly from that of Gershensen et al. who reported the higher incidence of positions P1, P2 and P6 between Indian and Sinai populations. Also in the studies in Nigerians and Kenyans, the most common position was found to be P3 followed by P2. Yesilyurt et al. demonstrated the most common position to be (P4) in Chinese, Kenyan Africans and Mongoloid populations; P5 in Caucasians and Zimbabweans; and P3 in Negroid, British central Anatolian and North American white populations.

In the present study the most common direction of Mf was anteriorly (D1) on both right (62.5%) and left (57.5%) sides. Agarwal et al. found the most prevalent direction to be posterosuperiorly (D4) which was in agreement with the studies of Boonpiruk and Mwaniki and Hassonali. In our study, the lateral margin of MF was at a distance of 63.67±7.36mm and 63.73±7.39mm from the posterior border of the ramus of the mandible (H1) on right and left sides respectively whereas the medial margin (H2) of MF was 22.41±2.57mm and 22.23±2.48mm far from symphysis menti on the right and left sides. According to Siddiqui et al., mean H1 were 48.8mm and 47.9mm whereas mean H2 were 18.8mm and 19.8mm on the right and left sides respectively. Similarly Parmar et al. showed H1 to be 61.3mm on right and 62.6mm on left sides whereas H2 to be 23.3mm on right and 22.5mm on left sides.

We also observed the mean distance between alveolar crest and upper margin of MF (V1) to be 11.48±1.58mm and 11.41±1.43mm on right and left sides. Similarly the average distance between lower border of mandible and lower margin of MF (V2) were 12.43±1.95mm on right and 12.17±1.72mm on left sides. As per Siddiqui et al., mean V1 were 10.2mm (right) and 10mm (left) whereas V2 were 9.9mm and 10.1mm respectively. According to Parmar A et al. V1 were 10.6mm (right) and 10.3mm (left) whereas V2 was 10.7mm on both the sides.

The mean horizontal diameters (HD) of MF were 2.63±0.85mm and 2.61±0.85mm on right and left sides whereas the mean vertical diameters (VD) were 2.33±0.64mm and 2.29±0.60mm on the right and left sides respectively. Our results were much less than that of Rastogi R et al. who showed mean HD to be 4.57±20.19mm on right and 4.61±0.17 on left sides and mean VD to be 3.58±0.17mm and 3.55±0.18mm on right and left sides respectively. According to Lebona et al. mean VD are 2.43mm (right) and 2.71mm (left) whereas mean HD were 5.05mm (right) and 5mm (left). There was a large difference between HD and VD in their study and it was because of higher number of oval shaped MF. However Ogus et al. found a mean HD of 2.93mm on right and 3.14 on left sides and mean VD of 2.31mm and 2.64mm on right and left sides respectively. There was a small gap between the horizontal and vertical dimensions and this was attributed to a greater number of round-shaped foramen.

Conclusion
Damage to mental nerve is one of the major complications of the surgery of mandibular canal and mental foramen regions. Thus it becomes very important for dental surgeons to have adequate
knowledge about the morphometry of MF. Hence our study may provide the necessary data of MF among Indian population and may be useful for the surgeons, anaesthetists, neurosurgeons and dentists to carry out nerve block and surgical procedures like apical curettage of mandibular premolars and periodontal surgery.

References

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