Panoramic radiographic study of mental foramen regarding the location and shape among Erbil population

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Abstract
The mental foramen is a very important anatomical landmark and knowledge about it is very important, especially in dentistry, because it transfers the mental nerve and vessels. The aim of the present research was to study the position, shape, and distance of MF from surrounding anatomical structures using a panoramic radiograph of dentate adult patients. The study was carried on 867 panoramic images of patients of 20-54 years of age. Data were collected and studied for determining the position, shape, and distance of the right and left MF in relation to the gender and age group. The most common horizontal position for mental foramen was found to be in between the apices of first and second premolar, and inferior to the apex of the related tooth. The shape was mainly round, and statistical analysis showed a significant relation with the gender and non-significant relation with the age group (p<0.05). The distance between the superior limit of the alveolar crest to the upper margin of the mental foramen, between the inferior limit of the mandible to the lower margin of the mental foramen, and between the mesial borders to the midline for females was less than the males. Statistical analysis showed a significant relation with the gender and the age group regarding these distances (p<0.05). In conclusion, The Knowledge about the exact location of the mental foramina and its variations is very important and can help the surgeon to plan surgical procedures properly.

Key Words: Mental foramen, Erbil city, panoramicX ray, Mandible.

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Introduction
The mental foramen (MF) is located on the lateral aspect of the body of the mandible and transmits mental nerves and vessels, and marks the termination of the mandibular canal in the mandible through which the inferior alveolar nerve and vessels pass. The mental bundle passes supplies blood supply and sensory innervations to the soft tissues of the lower lip, chin, and gingival tissue 1. The location and morphology of the MF may differ in relation to various factors such as age, sex, racial differences, and genetics 2,3.

Knowing the location of MF is important in all surgical procedures in the mandibular region and requires careful consideration. In a study by Kqiku et al. (2011)4, they dissected and analyzed the position of MF in 400 human cadavers and found that the most common location of the MF was between the first and second mandibular premolars. Phillips et al.5 and Budhiraja et al.6 examined dry adult human mandibles and found that the most common position was the longitudinal axis of the second premolar and inferior to the root of the second premolar. Another study found that the MF-inferior mandibular border decrease with an increase in age with females having a lower distance than males7. Using a panoramic radiograph by Bello et al 8 on African subjects, they found that most MF were positioned vertically more than 2 mm below the apex of the second mandibular premolars and horizontally between the first and second premolars, and the majority of the MF analyzed were oval in shape.

The MF is a common encounter during the administration of regional anesthesia for the mental nerve block needed for the placement of dental implants and various surgical procedures. The mental neurovascular bundle is
susceptible to injuries during these interventions, making it crucial to make sure that the position of the MF can be accurately be located to prevent any harm to the structures passing through the MF. So the aim of the present study was to investigate the variations in the locations and shape of the MF according to the gender and age in the Erbil City population.

Materials and methods
This cross-sectional descriptive study was carried on 867 panoramic images of patients, 20-54 years of age and referred for panoramic radiographs in the period from October 2017 to May 2019 from prosthodontic, surgery, and orthodontics departments to Radiology Department in College of Dentistry, Teshik University. All the OPGs were taken by a digital panoramic machine, (NewTom, Itay), with considering standard exposure parameters of 66 kv, 10 Ma, 240 mA/s, and total filtration 2.7 mm and magnification coefficient of 1.25. A total of 867 OPG were selected and reviewed.

Inclusion criteria
OPG of high quality of patients with known age and gender had a full complement of fully erupted teeth from the right to the left first molars, no radiolucent or radiopaque lesion was seen in the area.

Exclusion criteria
Unilateral or bilateral non-visualization of the MF, mixed dentition or incomplete eruption of teeth, cases with orthodontic treatment, crowding and spacing in lower arch teeth, missing upper premolars and first molars because of possibility of over eruption of lower teeth, presence of periodontal lesions, presence of benign or malignant pathologies, and mandibular fractures. Data were collected and studied for determining the position and shape of the right and left mental foramina.

MF position
Both vertical and horizontal position were made using the radiograph software measuring tools. The horizontal position of the foramen was recorded relative to the adjacent mandibular teeth as follows: (P1) anterior to the apex of the first premolar, (P2) at the apex of the first premolar, (P3) between the apices of the first and second premolar, (P4) at the apex of the second premolar, (P5) between the apices of the second premolar and the first molar, or (P6) at the apex of the first molar. But in the vertical plane, the horizontal midline was used as a standard point to mark the position of MF in relation to the apex of associated tooth and registered as superior, overlapping the apex of the related tooth or inferior.

Distance of MF
The distance between the superior limit of the alveolar crest to upper margin of MF (D1) and the distance between lower margins of MF to the inferior limit of mandible base (D2) were measured by drawing a vertical line perpendicular to the occlusive surface cutting the center of the mental foramen. The distances between the two mental foramina to the midline were also measured (D3, D4). The measurement was done from the mesial border of each mental foramen to the midline (Figure -1).

MF shape: The shape of the foramen was estimated using the elliptical tool of the radiographic software. So the mental foramina were classified into oval, round, and irregular.

Statistical analysis
Data processing and analysis were conducted using SPSS statistical software, version 20(SPSS Inc., Chicago, USA). Qualitative values were presented via frequency distribution tables, and Pearson’s chi-square tests were used to compare the difference between genders and age groups in relation to sides. All tests had a significance level of 5%.
Figure- 1: Distances of MF. D1: the distance between the superior limit of the alveolar crest to the upper margin of MF. D2: the distance between lower margins of MF to the inferior limit of the mandible base. D3 and D4: distances between the two mental foramina to the midline.

Result
The most common horizontal position for mental foramen was found to be in between the apices of first and second premolar (P3), 53.52% for the right side, and 53.86% for the left side. The second most common horizontal position for mental foramen was at the apex of the second premolar (P4), 30.91% for both the right and left sides, followed by (P2), (P5), and (P1) respectively. No cases were seen at the apex of the first molar (P6). Statistical analysis showed non-significant relation (p>0.05) with the gender and the age group regarding the horizontal position of mental foramen (Table- 1).

The most common vertical position for mental foramen was inferior to the apex of the related tooth (46.48%) for the right side and (47.29%) for the left side. The second most common vertical position for mental foramen was overlapping the apex of the related tooth, (34.95%) for right side, and (34.60%) for left side, The percentages of superior vertical position for mental foramen was (18.57%) for right side and (18.11%) for left side. Statistical analysis showed a significant relation with the gender (p<0.05) and non-significant relation with the age group (Table- 2).

Table- 1: Horizontal position of mental foramen (No& %) in relation to gender and age groups.
The result showed that the mental foramen shape was mainly round, 49.01% of cases on the right side, and 52.36% of cases on the left side, followed by the irregular and the oval shapes (Table- 3). Statistical analysis showed a significant relation with the gender and non-significant relation with the age group (p<0.05).

Table -3: Shape of mental foramen (No& %) in relation to gender and age groups.
For the right and left sides, the distance between the superior limit of the alveolar crest to the upper margin of mental foramen (D1) for males were 16.11±0.139 and 15.92±0.172 mm respectively, while for females, the distances were 15.34 ±0.185 mm and 15.22±0.16 mm respectively (Table- 4). For the right and left sides, the distance between the inferior limit of the mandible to the lower margin of mental foramen (D2) for males were 12.22 ±0.153 and 12.38±0.203 mm respectively, while for females, the distances were 11.14 ±0.123 mm and 11.7±0.352 mm respectively. Statistical analysis showed a significant relation with the gender and the age group (p<0.05).

Table-4: Distance between superior limit of the alveolar crest to upper margin of MF (D1), and the distance between lower margins of MF to the inferior limit of mandible base (D2) in relation to gender and age groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td></td>
<td>D1 (mm)</td>
<td>D2 (mm)</td>
</tr>
<tr>
<td>Male</td>
<td>16.11±0.139</td>
<td>12.22±0.153</td>
</tr>
<tr>
<td>Female</td>
<td>15.34±0.185</td>
<td>11.14±0.123</td>
</tr>
<tr>
<td>20-30</td>
<td>15.8±0.089</td>
<td>12.09±0.078</td>
</tr>
<tr>
<td>31-40</td>
<td>16.15±0.110</td>
<td>12.13±0.128</td>
</tr>
<tr>
<td>&gt;40</td>
<td>15.8±0.174</td>
<td>11.09±0.110</td>
</tr>
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S: Significant

For the right and left sides, the distance from the mesial border of the mental foramen to the midline (D3, D4) in male patients were 28.16±0.135 and 27.74±0.101 mm respectively, while for females, the distances were 26.18 ± 0.16 mm and 26.28±0.342 mm respectively (Table- 5). Statistical analysis showed significant relation with the gender and the age group (p<0.05).

Table-5: Distances from the mesial border of each mental foramen to the midline in relation to gender and age groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Right</th>
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<tbody>
<tr>
<td></td>
<td>D3 (mm)</td>
<td>D4 (mm)</td>
</tr>
<tr>
<td>Male</td>
<td>28.16±0.135</td>
<td>27.74±0.101</td>
</tr>
<tr>
<td>Female</td>
<td>26.18±0.16</td>
<td>26.28±0.342</td>
</tr>
<tr>
<td>20-30</td>
<td>28.2±0.208</td>
<td>28.12±0.16</td>
</tr>
<tr>
<td>31-40</td>
<td>27.2±0.208</td>
<td>27.4±0.063</td>
</tr>
<tr>
<td>&gt;40</td>
<td>27.03±0.286</td>
<td>27.14±0.174</td>
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</table>

S: Significant

Discussion
There is considerable debate regarding the normal position of mental foramen in different populations. In the present study, the most common horizontal position for mental foramen was found to be in between the apices of the first and second premolar. The second most common position for mental foramen was under the apex of the second premolar. Statistical analysis showed non-significant relation (p>0.05) with the gender and the age group. This result is consistent with the reports of AlJuboori et al study among Malaysian subjects, Bokhari et al study among Saudi Arabian subjects, Al-Shayyab et al study among Iraqi subjects and Olasoji et al study in Northern Nigerian subjects. In contrast, a study by Sankar et al, Gangotri et al, and Ukoha et al reported that mental foramen was mainly horizontally positioned directly in line with the second mandibular premolar. Rai et al found that 65% of MFs were present between the second premolar and first molar. Al Jasser and Nwokow found that the MF in Saudi population panoramic radiographs are most commonly positioned at P4 and the location of mental foramen was not gender dependent. Sekerci et al found that in males the most frequent horizontal position of the MF was P4, and in females was P3, and found that with advancing age there was a decrease in the frequency of more posterior locations of the MF. Juan and Eduardo found that the most frequent location of the MF in Perú population was P4, and no mental foramen was found in position P1 and a non-significant difference present between both sides.

The present study showed that the most common vertical position for mental foramen was inferior to the apex of the related tooth. The second most common vertical position for mental foramen was overlapping the apex of the related tooth, and then superior to it. Sekerci et al also found that the most frequent vertical location of the MF in the Turkish population was apical to the apex of the associated tooth (76%), followed at the apex, then coronal to apex, with no difference between genders. Sheikhi et al found that the MF in most cases appeared apical to the apex of the tooth, followed at the apex, then coronal to apex, with significant relation to side and non-significant relation with gender and age in both sides. Fishel et al studied the mental foramen’s location in occlusal-apically direction for the first and second premolar and found that most mental foraamina were located apical to the apex, followed by coronal to the apex, and then at the apex. All these variations are largely influenced by the individual age, gender, race, type of technique used, and the degree of alveolar bone resorption.

The result showed that the mental foramen shape was mainly round, followed by the irregular and oval shapes. Al-Khateeb et al and Singh et al in their study among Indian and Iraqi subjects respectively, also reported that most mental foramen studied were observed as being round in shape. Ukoha et al study involving dry mandibles in South-Eastern Nigeria also reported the round type as the most common shape of the mental foramen which is coincidence our findings. In contrast to these findings, studies by Phillips et al in American subjects, Mbajiorgu et al in Zimbabwean subjects, Budhiraja et al in North Indian subjects, and Oliveira et al in South-American subjects found that most mental foramina were ovoid in shape. All these differences may be attributed to the different number of the mental foramina analyzed as well as the multi-ethnic location of different studies.

In the present study, the females showed shorter D1 and D2 distance than males. This may be due to gender differences in mandible size. Statistical analysis showed a significant relation with the gender and the age group (p<0.05). Haghaniifar and Rokouei found that the vertical location of the MF varies according to age, and it is located closer in children to the alveolar crest before tooth eruption, and located precisely at 15 mm superior to the inferior border of the mandible in adult. Anghthong et al indicated that the foramen was 14 to 15 mm from the inferior border of the mandible. Similarly, Neiva et al reported that the mental foramen studied was 12 mm (range: 9 to 15 mm) from the most apical portion of the lower cortex of the mandible. Muiñelo-Lorenzo et al found that the D1 distance was 11.42 ± 3.34 mm and the D2 distance were 13.55 ± 1.06 mm, and, significant relation with gender was seen, in which females presented shorter distances. They also found that the D2 distance showed no significant relation with age, but the D1 distance showed significant relation and this distance was shorter in the older age group, perhaps due to bone resorption. Others found no influence of age on this distance. The differences may be due to the differences in the methods used.

For the right and left sides, the distance from the medial border of the mental foramen to the midline (D3, D4) in male patients were 28.16±0.135 and 27.74±0.101 mm respectively, while for females, the distances were 26.18 ± 0.16 mm and 26.28±0.342 mm respectively. Statistical analysis showed a significant relation with the gender and the age group (p<0.05). This distance of the MF from the midline was considerably greater than that observed by Ilyeruma et al in Sri Lankan mandibles, which they reported as 24.87 ±6.07 on the right side and 24.77 ± 6.07 mm in the left side. These data highlight racial differences in the location of the MF that should be taken into...
consideration when undertaking surgical procedures involving the anterior mandible in order to avoid trauma to the associated neurovascular bundles.

In conclusion, the resulted information about the position, distances, and shape of MF can help surgeons to localize the MF and avoid injury to neurovascular bundles, and to facilitate the local anesthetic, surgical and other invasive surgical procedures.

References