MENTAL FORAMEN AND INFERIOR ALVEOLAR CANAL- A BEACON FOR SEX DETERMINATION BY DIGITAL RADIOGRAPH IN NORTH INDIAN POPULATION OF PUNJAB REGION

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ABSTRACT

BACKGROUND

Imperative eminent landmark, the mental foramen (MF) and inferior alveolar canal share their significance in various fields of dentistry. Among various anatomical landmarks in the human skull, the mental foramen is regarded as a stable landmark on the mandible. Likewise, inferior alveolar canal is a benchmark for performing numerous procedures on the mandible. The present study is an attempt to aid not only the surgeons who plan procedures like periapical endodontic surgeries, drainage procedures and administration of local anaesthetics but also is a guiding tool for identification purposes in forensic science. The need arises in mass fatalities and disasters when expertise is required. Therefore, sound knowledge regarding the anatomical location of the MF and shape of the mandibular canal are of key importance.

METHODS

150 panoramic radiographs were randomly selected for the analysis of mental foramen and inferior alveolar canal. The radiographs were digitalized and studied. Adobe Acrobat reader software was used.

RESULTS

The average values of SMF-IBM and IMF-IBM is more in males as compared to females. The p value was found to be significant for both the genders and for both the sides. In this study, the most frequent position of the mental foramen was in the longitudinal axis of 2nd premolars and was located symmetrically. It was not significant for both males and females. Chi square test analysis and p value for the shapes of the inferior alveolar canal was not significant for both the genders. The inter mental foramen distance showed mean of 3.03 mm for males and for females, 2.89 mm. According to the chi-square test, the results show that the study is statistically insignificant since the p-value > 0.05 for both the male and female population.

CONCLUSIONS

Based on the results of this study, the distances from the mental foramen and inferior border of mandible exhibit sexual dimorphism in the North-Indian population of Punjab. Panoramic radiography is a valuable technique for evaluating the proposed measurements. The limitations should be considered and further studies with a larger sample size, along with the use of other higher modalities is required.


BACKGROUND

An imperative eminent landmark, the mental foramen (MF) and inferior alveolar canal shares their significance in various fields of dentistry. The mental foramen morphology, in terms of position, varies not only according to age, sex and ethnicity but even within the same race, in different geographic regions and within the inhabitants of the same geographic area.1 In conjunction with forensic medicine, identification is a devoir of further interpretation.

The need arises in mass fatalities and disasters when expertise is required for age and gender determination. Forensic dentists and anthropologists consider morphological characteristics of mandible as an important feature that can be used for the determination of sex. Among various anatomical landmarks in the human skull, the mental foramen is regarded as a stable landmark on the mandible.2 Moreover, the confirmation of anatomical location of the MF is critical to preclude potential injuries to mental nerve during procedures such as periapical endodontic surgery,3 drainage procedures or reflection of a full-thickness mucoperiosteal flaps.4 In addition, precautionary measures are essential during the administration of local anaesthetic via infiltration in this area,5 performing a sagittal split ramus osteotomy6 and dental implants insertion.7 The nerve injury can cause temporary or permanent paraesthesia or
Anaesthesia in the sensory distribution of the mental nerve leading to an adverse outcome and disappointment for the patient. Frequently, the mental foramen is difficult to locate. Generally, it cannot be visualized or palpated by clinical examination.

Likewise, the inferior alveolar canal is a benchmark for performing procedures on the posterior mandible. It shows variations in shapes in both sexes and in both the sides (Left, right). It is mandatory to have a thorough knowledge on position and course of MC and its relationship to posterior teeth in the mandible for Oral and Maxillofacial surgeons to obtain the desired surgical outcome of the procedures which are carried out at different levels of mandible.

The study of these two features in both genders would be a turning point and would pave a way for the surgeons, anthropologists and forensic experts.

A number of non-invasive techniques such as radiography and cone beam computed tomography have been advocated to identify various anatomical landmarks. The radiographic assessment methods (panoramic and periapical radiographs) are non-invasive, convenient for the patients and have been used to determine the location of the MF. Also the contrast and brightness enhancement and enlargement of images provide an accurate and reproducible method of measuring the chosen points.

For this purpose, the retrospective radiographic data of patients selected randomly, have been analysed. Though 3-D modalities like Cone Beam Computed Tomography have an upper edge than OPGs, but they are expensive and require higher radiation. Hence, the study was conducted using digital panoramic radiograph, which is cheaper, easy, giving a bird’s eye view and with less radiation exposure for the patient.

Objectives of the Study
1. To evaluate and compare the superior border of mental foramen to the lower border of mandible (S-L) and the inferior border of mental foramen to lower border of mandible (I-L) values in males and females.
2. To compare the S-L and I-L between right and left side in males and females.
3. To compare the shape of the inferior alveolar canal in both the genders.
4. To study the location of mental foramen in both genders.
5. To compare inter mental foramen distance in both genders.

The selected OPGs were digitalized, mental foramen was identified clearly and marked. The tangents were drawn through the superior and inferior borders of the foramen and perpendicular lines were drawn from tangents to the lower border of the mandible. Adobe Acrobat Reader was used to measure various parameters.

The measurements were tabulated on an excel sheet and analysed for mean value in males and females on both the right and left sides. Confidence interval, t-test between group comparison and p values were calculated.

METHODS
A retrospective study consisting of 150 patients in the age group between 18 and 50 years undergoing conventional OPG for diagnostic or surgical purposes recruited from the department of Oral Surgery from BJS Dental College & hospital, Ludhiana were selected for the study.

The following Inclusion Criteria were used-
1. Adult patients who were 18 years to 50 years with permanent dentition.
2. Ethnicity- North-Indian Punjabi Population
3. Diagnostic quality images with acceptable density & contrast.
4. Images with minimal positioning errors and none or minimal superimposition of structures.

Exclusion Criteria
1. Patients younger than 18 years.
2. Any pathology or congenital anomaly which might affect X-ray interpretation.
3. Blurred vision or distorted radiographs.
4. Non-visualization or absent mental foramen.
5. X-rays of patients with imperfect positioned teeth in the relation between the MF.

The total number of 150 X-Rays were evaluated by Orthopantomograph (OPG) by machine Villa India and set at 60-65, 8 mA with 14 seconds exposure. The effects caused by the horse shape of dental arches were fixed by this panoramic machine.

RESULTS
Out of the 150 panoramic radiographs, 75 were of male patients and 75 were of female patients. Total 300 mental foramen and inferior alveolar canals were studied. Descriptive statistics of the male and female subjects are presented in the following tables.

The results showed distance between superior border of Mental Foramen and lower border of mandible in males- 0.80 inches (20.32 mm) on right side and 0.78 inches (19.81 mm) on left side. The inferior border of mental foramen and lower border of mandible in males showed 0.66 inches (16.74 mm) on right side and 0.63 inches (16.00 mm) on left side. Correspondingly, for females, distance between superior border of Mental Foramen and lower border of mandible on right side showed 0.70 inches (17.78 mm) and 0.68 inches (17.27 mm) on left side. The inferior border of mental foramen and lower border of mandible in females showed 0.54 inches (13.71 mm) on right side and 0.54 inches (13.71 mm) on left side.

Distance between inter mental foramen in males showed 3.03 inches (76.96 mm) and for females it is 2.90 inches (73.66 mm).

Location of Mental Foramen in males was observed maximum at the longitudinal axis of 2 Premolar, 81.33% on right side and 76% on left side. The site for location of mental foramen was observed minimum between 2 Premolar and 1 Molar, 5.33% on right side and 6.66% on left side.

Location of Mental Foramen in females was observed maximum at the longitudinal axis of 2 Premolar, 68% on right side and 70% on left side. The site for location of mental foramen was observed minimum between 2 Premolar and 1 Molar, 9.33% on right side and 4.0% on left side.
Table 1. Comparison of Superior Border of Mental Foramen (SMF)-Lower Border of Mandible (LBM) & inferior Border of Mental Foramen (IMF)-Lower Border of Mandible (LBM) in Males

<table>
<thead>
<tr>
<th>Location</th>
<th>Males</th>
<th>Females</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SMF-LBM)</td>
<td>0.80 (20.32 mm)</td>
<td>0.78 (19.81)</td>
<td>0.001</td>
</tr>
<tr>
<td>Mean (IMF-LBM)</td>
<td>0.66 (16.76 mm)</td>
<td>0.63 (16.00 mm)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 2. Comparison of Superior Border of Mental Foramen (SMF)-Lower Border of Mandible (LBM) & Comparison of inferior Border of Mental foramen (IMF)-Lower Border of Mandible (LBM) in Females

<table>
<thead>
<tr>
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<th>Males</th>
<th>Females</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SMF-LBM)</td>
<td>0.70 (17.78 mm)</td>
<td>0.68 (17.27 mm)</td>
<td>0.001</td>
</tr>
<tr>
<td>Mean (IMF-LBM)</td>
<td>0.54 (13.71 mm)</td>
<td>0.54 (13.71 mm)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 3. Distance of Inter Mental Foramen (IMF)

<table>
<thead>
<tr>
<th>Location</th>
<th>Mean</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>3.03 (76.96 mm)</td>
<td>0.054</td>
</tr>
<tr>
<td>Right</td>
<td>2.90 (73.66 mm)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Percentage of Location of Mental Foramen for Males & Females (Rt/Lt)

<table>
<thead>
<tr>
<th>Location</th>
<th>Males</th>
<th>p-Value</th>
<th>Females</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>82.66%</td>
<td>0.054</td>
<td>88.00%</td>
<td>0.66%</td>
</tr>
<tr>
<td>Left</td>
<td>95.83%</td>
<td>0.054</td>
<td>89.33%</td>
<td>0.66%</td>
</tr>
</tbody>
</table>

Table 5. Percentage of Shape of inferior alveolar Canal in Males (Rt/Lt)

<table>
<thead>
<tr>
<th>Location</th>
<th>Elliptical</th>
<th>Linear</th>
<th>Turning</th>
<th>Spoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>82.66%</td>
<td>13.33%</td>
<td>4.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Left</td>
<td>95.83%</td>
<td>1.33%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Table 6. Comparison of Present Study with Previous Literature (Distance from The Superior Border of Mental Foramen SMF, to inferior Border of Mandible IBM; Distance from The inferior Border of Mental Foramen IMF to inferior Border of Mandible IBM)

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Juboori(19) et al</td>
<td>2016</td>
<td>Indian Population- 53.49 mm</td>
</tr>
<tr>
<td>Our study</td>
<td>2019</td>
<td>Males- 3.03 inches (76.96 mm)</td>
</tr>
</tbody>
</table>

Table 7. Comparison of Present Study with Previous Literature (Distance between Inter Mental Foramina)

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fischel et al(20)</td>
<td>1976</td>
<td>Most common location between two premolars(1, 2PM) Contrary to our study</td>
</tr>
<tr>
<td>Malhotra et al(21)</td>
<td>2015</td>
<td>Most common location between two premolars (1, 2PM) Contrary to our study</td>
</tr>
<tr>
<td>Babshet M, et al(22)</td>
<td>2015</td>
<td>At 1, 2 PM- 4.3% At 2PM- 39% Contrary to our study</td>
</tr>
</tbody>
</table>
Table 8. Comparison of Present Study with Previous Literature (Position of Mental Foramen)

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu et al (28)</td>
<td>2009</td>
<td>Describes linear, spoon, elliptical and turning curve of mandibular canal. Elliptical curve is the most common (48.50%)</td>
</tr>
<tr>
<td>Yun-Hoa Jung and Bong-Hae Cho (29)</td>
<td>2014</td>
<td>Elliptical curves were most frequently observed, lowest among were the linear curves.</td>
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<td>Rai et al (30)</td>
<td>2018</td>
<td>Describes linear, spoon, elliptical and turning curve of mandibular canal. Linear type of curve is the most common. Contrary to our study.</td>
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<tr>
<td>Our study</td>
<td>2019</td>
<td>Elliptical is the most common type</td>
</tr>
</tbody>
</table>

Table 9. Comparison of Present Study with Previous Literature (Shape of inferior alveolar Canal)

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Results</th>
</tr>
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<tbody>
<tr>
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<td>2019</td>
<td>Elliptical is the most common type</td>
</tr>
</tbody>
</table>

The location of mental foramen in our study for both sides, showed at longitudinal axis of 2 Premolar (Males - 78.66%, Females - 69.23%), between 1, 2 premolars (Males 15.33%, Females - 20.66%) and between 2 Premolar and 1 Molar (Males 6%, Females 6.66%).

Shape of inferior alveolar canal for males on right side showed Elliptical (82.66%), Linear (5.25%), Turning (5.33%), Spoon (6.66%). On the left side, Elliptical (95.83%), Linear (1.33%), Turning (2.21%), Spoon (6.66%).

Shape of inferior alveolar canal for females on right side showed Elliptical (88%), Linear (1.33%), Turning (4.33%), Spoon (5.33%). On left side, Elliptical (89.33%), Linear (0), Turning (2.66%), Spoon (8.0%).

The study showed the confidence interval is 95% and level of significance is 5%.

Likewise, shape of the inferior alveolar canal corresponds with the study of Liu et al (2009), and Yun-Hoa Jung et al (2014). The most common course found in our study was Elliptical (males - 87.33%, Females - 88.66%), followed by Spoon (Males and females 6.66%), Turning (Males - 2.66%, Females 4.0%) and Linear (Males - 2.33%, Females 0.66%).
DISCUSSION
In 1974, Wical and Swoope described that despite the alveolar bone resorption above the mental foramen, the distance from the foramen to the inferior border of the mandible remains relatively constant throughout life. In the present study, the mean values of SMF to LBM and IMF to LBM were significantly higher in males as compared to females, which were in accordance with Chandra et al.’s study conducted in North Indian population. Other authors supporting the study are Mahima et al.’s study conducted in South Indian population, Thomas et al. and Catovie et al.’s studies conducted in different parts of the world. On the contrary, Vodanovic et al. found that the mean value of IMF to LBM does not exhibit sexual dimorphism. The differences observed in our study may be due to racial differences in study population.

CONCLUSIONS
Recent advancements in clinical dentistry have increased the possibility of procedures in the mental region and a detailed knowledge of the mental foramen anatomy may not only aid in the prevention of post-surgical neurovascular complications and morbidity, but also hold the potential of contributing as an identifying maxillofacial anthropologic characteristic feature for different populations. Awareness of its typical morphological features in different ethnicities is pivotal for anatomists, ortho-dentists, surgeons and paleoanthropologists.[20]

REFERENCES


