Assessment of Position of the Mental Foramen in Relation to Mandibular Teeth: An Institutional Study

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ABSTRACT

Background: Recognizing the anatomical differences in the location of the mental foramen is crucial for various dental procedures. This study examined the position of the mental foramen in the OPGs of patients, using both old and new records from the Department of Oral and Maxillofacial Surgery at the Institute of Dental Sciences, Bareilly.

Objective: To determine the position of the mental foramina on panoramic radiographs based on gender, age, side of mandible, location of mental foramen from root apex of mandibular teeth Uttar Pradesh.

Methods: A total of 420 panoramic radiographs (PAN) were chosen for the study. The location of the mental foramen was identified by drawing imaginary lines parallel to the long axis of the lower premolars and the mesial root of the first molar on the same side. The position of the mental foramen was then categorized into six classes (Class I-VI).

Results: No significant gender differences in mental foramen positions were found in either 13-18-year-olds or 19-59-year-olds. In both groups, Class IV (mental foramen aligned with the second premolar apex) was most common: 70.6% of females and 68.4% of males in 13-18 years, and 53.3% of females and 56.8% of males in 19-59 years. Side comparisons also showed no significant differences, with similar distributions in both genders. Chi-square values for all comparisons were non-significant ($p > 0.05$). Thus, age and gender do not affect the mental foramen position.

Conclusion: For effective and safe mental nerve blocking, the anesthetic should be administered beneath the lower second premolar or between the first and second premolars. Care should also be taken when working near these areas to prevent mental nerve damage and complications during implant placement.

Keywords: Anatomical Variations and Implant Dentistry, Dental Radiology, Mental Foramen, Mandibular Teeth, Panoramic Radiographs, Orthopantomogram, Mental Nerve.

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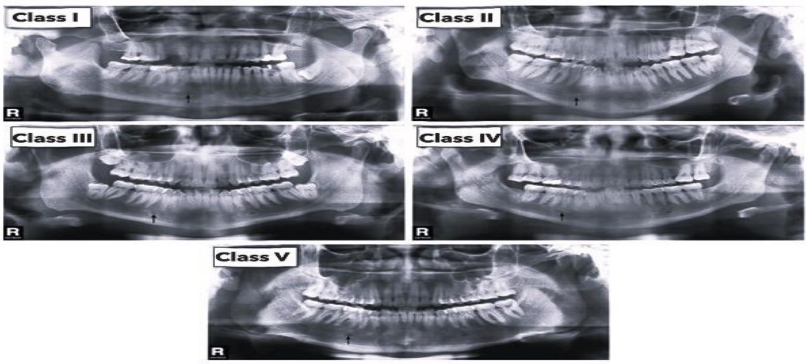
Introduction

Mental foramen (MF) is defined as funnel-like opening[1] located on an anterolateral portion of the mandible. It is highly suitable for studying bone remodelling and maturity changes in the mandible.[2] Position of MF varies according to age which ranges from apex of canine to apex of mesial root of first molar. In infants, Kjaer[3] found that the mental foramen lies between the primary canine and the first molar, located relatively closer to the inferior border of the mandible near the apices of the first molar tooth bud. In children before tooth eruption, the mental foramen is closer to the alveolar margin. During the eruption period, the position of foramen is midway between the lower border of the mandible and the alveolar crest. In permanent dentition, it shifts forward and lies at the apices of 2nd premolar. In edentulous jaw with bone resorption, the mental foramen lies closer to the alveolar crest.[3] With advancing age, there is an increase in postero-inferior shift of mental foramen. This posterior shift of foramen is apparent due to mesial tooth

drift resulting from age-related attrition at interproximal surfaces of teeth. In dentulous adults MF is closer to the inferior border and in edentulous adults with bone resorption, MF shifts toward the alveolar crest and in extreme cases, the mental nerve is exposed at the alveolar margin. The asymmetrical location of the foramen is reported more in females.[4]

Analysis of the location of mental foramina on OPG radiographs shows that they appear as solitary circular or elliptical radiolucent areas present at both the sides of premolar area. The mental foramen on OPG radiograph appears larger than on IOPAR due to the vertical angulation discrepancy of panoramic radiography which leads to a lower position of the mental foramina in the radiograph.[5]

The purpose of the study is to determine the position of the mental foramina on panoramic radiographs based on gender, age, side of the mandible, and location of mental foramen from the root apex of mandibular teeth.



Inclusion Criteria

- Presence of at least two premolars and first molar without periapical pathology on both sides.
- Anatomical landmark such as mental foramen, the radiographic apex of the 1st and 2nd premolar, the mesial and distal apexes of the 1st and 2nd molar and the mandibular midline.
- Mental foramen should be clearly visible at least on one side and a clear radiograph in terms of contrast, resolution and brightness.
- Orthopantomogram of patients with age ranging from 10 to 59 years.

Exclusion Criteria

- Malocclusion cases.
- A history of orthognathic surgery or mandibular orthodontic treatments.
- Previous mandibular fracture involving para-symphysis region or body region / severe mandibular growth retardation.
- Incomplete eruption of permanent teeth except third molar.
- Any surgery for mandibular pathologies.
- Accessory mental foramina (AMFs).
- The presence of pathology in the lower jaw anywhere from the right first molar to the left first molar.

Intervention/Procedure

All the cases requiring OPG. On the view box, each radiograph is assessed using tracing paper, and an outline sketch of both the premolar and first molar will be made. The midpoint of the radiographic mental foramen and the location of the root apex is marked. Where the premolars and first molar radiographic apex meet the occlusal line, a horizontal line is be drawn parallel to it. For the left and right foramina, a second line is drawn at the apex of the tooth, perpendicular to the horizontal line. Using a Vernier Callipers, measurements are recorded to the closest of up to 0.1 mm.[4]

The mental foramen location is classified as following:[6]

- Class I: mental foramen is located in front of the first premolar.
- Class II: mental foramen is located in line with the apex of the first premolar.
- Class III: mental foramen is located between the first and second premolars.
- Class IV: mental foramen is located in line with the apex of the second premolar.
- Class V: mental foramen is located between the second premolar and the first molar.
- Class VI: The mental foramen is located under the apex of the mesial root of the first molar.

Statistical Analysis

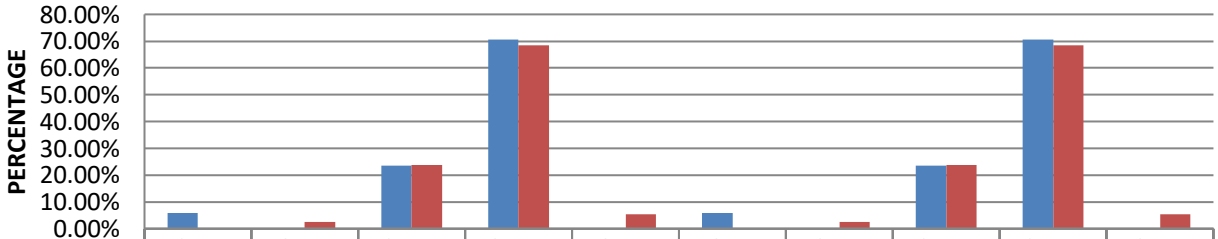
The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 23.0 Version. The descriptive statistics included frequency and percentage. Mean and standard deviation. The level of significance for the present study was fixed at 5%.

The ordinal and nominal variables will be compared using Chi Square test and Z-test for Proportions.

Result

Intergroup Comparison of mental formina positions by Gender among 13-18-year-olds.

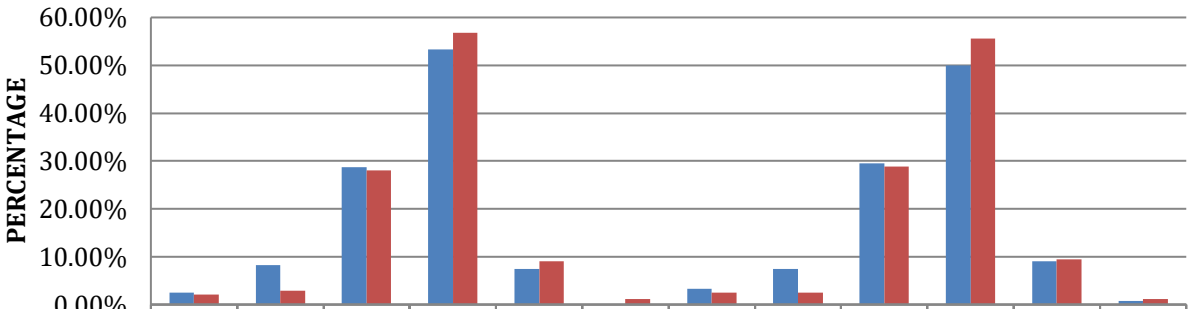
The intergroup comparison of mental foramen positions by gender in 13-18-year-olds showed no significant differences between females and males. On both sides, most participants were classified under Class IV, where the mental foramen aligns with the apex of the second premolar. For both genders, 70.6% of females and 68.4% of males were in Class IV on both the right and left sides. Other classes had minimal representation. Chi-square test results for the right and left sides were 3.556 and 3.553, respectively, with p-values of 0.464 and 0.496, indicating no statistically significant differences. Gender does not influence the mental foramen position in this age group.



	Right Side					Left Side				
	Class I	Class II	Class III	Class IV	Class V	Class I	Class II	Class III	Class IV	Class V
Female	5.90%	0.00%	23.50%	70.60%	0.00%	5.90%	0.00%	23.50%	70.60%	0.00%
Male	0.00%	2.60%	23.70%	68.40%	5.30%	0.00%	2.60%	23.70%	68.40%	5.30%

Intergroup Comparison of Mental Formina Positions by Gender among 19-59-year-olds.

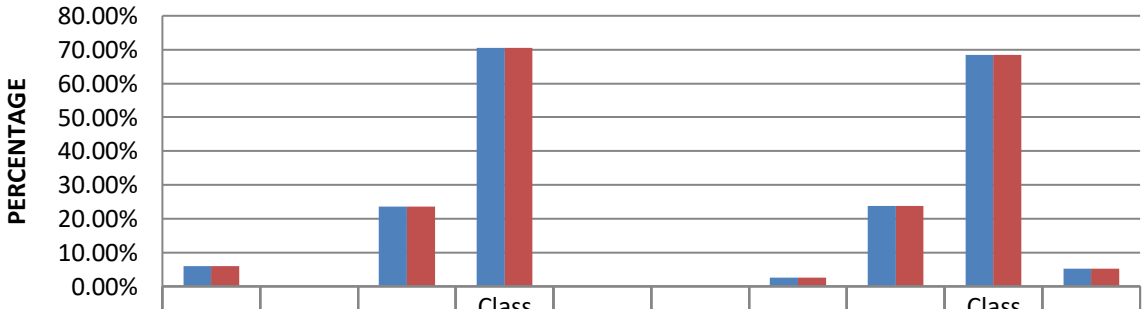
The intergroup comparison of mental foramen positions by gender in individuals aged 19-59 years showed no significant differences between females and males. Class IV, where the mental foramen aligns with the apex of the second premolar, was most common, accounting for 53.3% of females and 56.8% of males on the right side, and 50.0% of females and 55.6% of males on the left side. Other positions, such as Class III and Class V, were similarly distributed between genders. Slight differences, such as more females in Class II on the right side, were not statistically significant (p-values of 0.234 and 0.193). Gender does not influence the mental foramen position in this age group.



	Right Side					Left Side					
	Class I	Class II	Class III	Class IV	Class V	Class VI	Class I	Class II	Class III	Class IV	Class V	Class VI
Female	2.50%	8.20%	28.70	53.30	7.40%	0.00%	3.30%	7.40%	29.50	50.00	9.00%	0.80%
Male	2.10%	2.90%	28.00	56.80	9.10%	1.20%	2.50%	2.50%	28.80	55.60	9.50%	1.20%

Intergroup Comparison of Mental Formina Positions by sides among 13-18 Years Old.

The comparison of mental foramen positions by side in 13-18-year-olds showed no significant differences between the right and left sides for both females and males. For females, the distribution was identical on both sides, with 70.6% in Class IV, 23.5% in Class III, and 5.9% in Class I and Class V. Males had similar distributions, with 68.4% in Class IV, 23.7% in Class III, 5.3% in Class V, and 2.6% in Class II. Chi-square values were 0.000 with p-values of 1.000, indicating no significant side differences. This suggests the mental foramen position is consistent between sides for both genders in this age group.

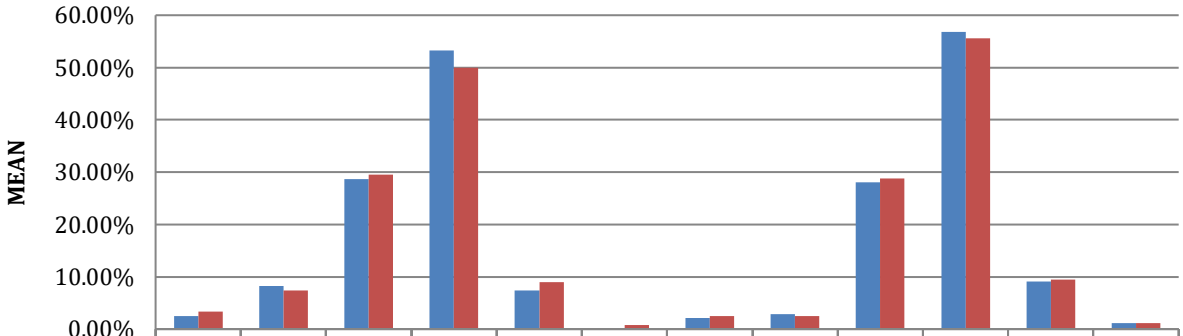


	Females					Males				
	Class I	Class II	Class III	Class IV	Class V	Class I	Class II	Class III	Class IV	Class V
Right Side	5.90%	0.00%	23.50%	70.60%	0.00%	0.00%	2.60%	23.70%	68.40%	5.30%
Left Side	5.90%	0.00%	23.50%	70.60%	0.00%	0.00%	2.60%	23.70%	68.40%	5.30%

Intergroup Comparison of Mental Formina Positions by Sides among 19-59 Years old.

The comparison of mental foramen positions by side in individuals aged 19-59 years showed no significant differences between the right and left sides for both females and males. For females, Class IV was most common (53.3% right, 50.0% left), followed by Class III (28.7% right, 29.5% left). Males showed similar distributions, with Class IV at 56.8% on the right and 55.6% on the

left, and Class III at 28.0% on the right and 28.8% on the left. Chi-square values were 0.514 and 0.494 with p-values of 0.934 and 0.993, indicating no significant side differences. The mental foramen position is consistent between sides for both genders in this age group.

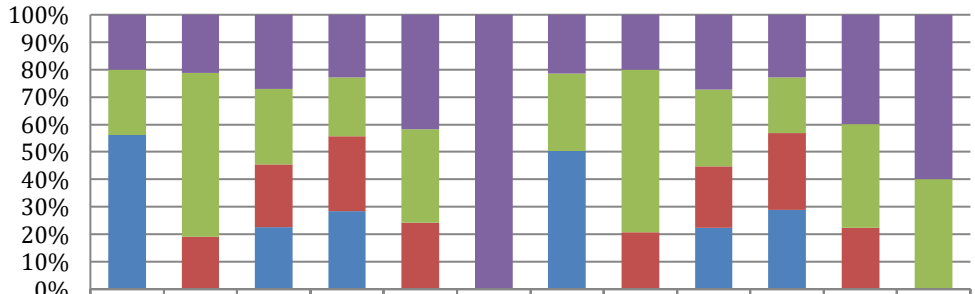


	Females						Males					
	Class I	Class II	Class III	Class IV	Class V	Class VI	Class I	Class II	Class III	Class IV	Class V	Class VI
Right Side	2.50%	8.20%	28.70%	53.30%	7.40%	0.00%	2.10%	2.90%	28.00%	56.80%	9.10%	1.20%
Left Side	3.30%	7.40%	29.50%	50.00%	9.00%	0.80%	2.50%	2.50%	28.80%	55.60%	9.50%	1.20%

Intergroup Comparison between Age Groups by Gender

The Chi-square test with a P-value of 0.393 is non-significant on the right side and the P-value of 0.467 is non-significant on the left side.

The comparison of mental foramen positions by age group and gender showed no significant differences. In both the 13-18 and 19-59 age groups, the distribution of positions was similar for both genders. Class IV, the most common position, was found in 70.6% of females and 68.4% of males in the younger group, and 53.3% of females and 56.8% of males in the older group on the right side. A similar pattern was observed on the left side. Chi-square test results showed p-values of 0.393 and 0.467, indicating no significant differences. Thus, the position of the mental foramen does not vary significantly by age or gender in this sample.



	Right Side						Left Side					
	Class I	Class II	Class III	Class IV	Class V	Class VI	Class I	Class II	Class III	Class IV	Class V	Class VI
19-59 YEARS Male	2.10%	2.90%	28.00%	56.80%	9.10%	1.20%	2.50%	2.50%	28.80%	55.60%	9.50%	1.20%
19-59 YEARS Female	2.50%	8.20%	28.70%	53.30%	7.40%	0.00%	3.30%	7.40%	29.50%	50.00%	9.00%	0.80%
13-18 YEARS Male	0.00%	2.60%	23.70%	68.40%	5.30%	0.00%	0.00%	2.60%	23.70%	68.40%	5.30%	0.00%
13-18 YEARS Female	5.90%	0.00%	23.50%	70.60%	0.00%	0.00%	5.90%	0.00%	23.50%	70.60%	0.00%	0.00%

Discussion

The exact location of the mental foramen has been a subject of debate for many years. This anatomical feature, found on both sides of the mandible, houses the mental nerve and vessels. It is crucial in various dental procedures across specialties. However, accurately pinpointing its location is challenging due to significant individual variation. Some studies suggest it is positioned between the lower first and second premolars, while others place it near the apex of the second premolar. This indicates that different populations may exhibit distinct anatomical variations of the mental foramen. Our findings indicate that the mental foramen is most frequently positioned near the apex of the second premolar (Class IV), followed by its location between the first and second premolars (Class III) in this Chi-square test.

In 2016, a study of 950 panoramic radiographs from Department of Oral Biology, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia was conducted using the same criteria and classification as in this study. The results were different, with the most common mental foramen locations being under the apex of the second premolar (Class IV) followed by between the first and second premolars (Class III). In the 13-18-year-old group, 70.6% of females and 68.4% of males had the mental foramen in Class IV on both sides. In the 19-59-year-old group, 53.3% of females and 56.8% of males had the mental foramen in Class IV on the right side, and 50.0% of females and 55.6% of males on the left side. The Chi-square tests showed no significant differences (p-values of 0.464 and 0.496 for the 13-18-year-olds, and p-values of 0.234 and 0.193 for the 19-59-year-olds), indicating that gender does not influence the position of the mental foramen in these age groups.

The comparison of mental foramen positions by side in both age groups showed no significant differences. For the 13-18-year-olds, 70.6% of females and 68.4% of males had the mental foramen in Class IV on both the right and left sides. For the 19-59-year-olds, 53.3% of females and 56.8% of males had it in Class IV on the right side, and 50.0% of females and 55.6% of males on the left side. The Chi-square values were 0.000 (p-value of 1.000) for the 13-18-year-olds and 0.514 and 0.494 (p-values of 0.934 and 0.993) for the 19-59-year-olds, confirming that there are no significant side differences in both age groups.

Additionally, the comparison of mental foramen positions by age group and gender revealed no significant differences. In the 13-18-year-old group, Class IV was observed in 70.6% of females and 68.4% of males on the right side, while in the 19-59-year-old group, 53.3% of females and 56.8% of males had it in Class IV on both right and left side. The Chi-square test results showed p-values of 0.393 and 0.467, indicating no significant differences in mental foramen positions across age groups or genders.

Other studies have reported variations in the location of the mental foramen across different populations. Class V is frequently observed in Zimbabwean populations, while Class III is commonly seen in British, Iranian, Negroid, Central Anatolian, and white North American populations. Several studies, consistent with our findings, indicate that Class IV is the most common position, as seen in Chinese, Nigerian, Mongoloid, and Kenyan African populations.

Using panoramic radiographs to identify the location of the mental foramen is more advantageous than periapical radiographs, as it provides a broader and consistent view of the oral tissues. However, a limitation of this study is that panoramic radiographs are two-dimensional, making it difficult to pinpoint the exact bucco-lingual position of the mental foramen. Therefore, additional studies utilizing cone beam computed tomography (CBCT) are necessary to accurately determine the mental foramen's location in the bucco-lingual dimension. This technique is especially recommended for implant placement.

Conclusion

In conclusion, understanding the location of the mental foramen is essential for ensuring safe and effective dental procedures and anesthesia injections. Panoramic radiographs (PANs) provide a convenient method for roughly identifying its position. In an attempt to block the mental nerve near or under the first premolar is likely to be ineffective, as the mental foramen is not located in that area. The optimal site for anesthesia injection is beneath the second premolar or between the lower first and second premolars. Extra care should be taken when working near these areas to prevent injury to the mental nerve.

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