

Age-related variations in the location of the mental foramen: a retrospective panoramic radiographic study in children

Zahra Gholami Taqanaki^{1†}
Maryam Tofangchiha^{2†}
Melina Targholi²
Zeinab Tadayon¹
Mehdi Ranjbaran³
Mona Sohrabi⁴
Aida Mokhlesi⁵⁻⁹
Luca Testarelli^{10†}
Dario Di Nardo^{10†}

¹ Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran.

² Department of Oral and Maxillofacial Radiology, Qazvin University of Medical Sciences, Qazvin, Iran.

³ Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran.

⁴ Non-communicable Diseases Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran.

⁵ Department of Pediatric Dentistry, Dental Caries Prevention Research Center, Qazvin University of Medical Sciences, Qazvin, Iran.

⁶ Clinical research development unit of advanced medicine, Qazvin University of Medical Sciences, Qazvin, Iran.

⁷ Student Research Committee, School of Dentistry, Qazvin University of Medical Sciences, Qazvin, Iran.

⁸ Universal Scientific Education and Research Network (USERN), Qazvin University of Medical Sciences, Qazvin, Iran.

⁹ Network of Interdisciplinarity in Neonates and Infants (NINI), USERN, Tehran, Iran.

¹⁰ Department of Oral and Maxillofacial Sciences, Sapienza University of Rome, Italy

† These authors contributed equally to this work as co-first.

Corresponding author: Mona Sohraby
email: monasohraby@yahoo.com

Abstract

Objective: The mental foramen is a crucial anatomical feature within the mandible, facilitating nerve pathways that enable the sensation of teeth and lips. Its precise location is essential for the efficacy of infiltration injections and for minimizing potential injury during dental interventions. Panoramic radiography is frequently employed to evaluate oral structures in pediatric patients. This study sought to determine the vertical and horizontal positions of the mental foramen in children aged 4 to 18 years, utilizing panoramic radiographs.

Methods: A retrospective analysis of 283 panoramic radiographs was conducted, dividing subjects into age groups of 4–6, 6–12, and 12–18 years. The horizontal and vertical positions of the mental foramen were evaluated relative to primary and permanent dentition and the mandibular body utilizing SCANORA Lite software. Differences based on age and gender were assessed using Fisher's exact test and Chi-square tests, with a significance level established at $P < 0.05$.

Results: The most frequent horizontal location was at the distal root of the first primary molar and between the first and second premolars. Vertically, the mental foramen was most commonly located in the middle third of the mandibular body, with its frequency increasing with age. No significant differences in vertical position were found across age groups ($p = 0.074$). A significant difference was noted between boys and girls in the horizontal location relative to permanent teeth ($p = 0.044$), but no significant gender differences were observed for primary teeth or vertical location.



License

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Authors contributing to *Annali Di Stomatologia* agree to publish their articles under the [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/), which allows third parties to copy and redistribute the material providing appropriate credit and a link to the license but does not allow to use the material for commercial purposes and to use the material if it has been remixed, transformed or built upon.

How to Cite

Zahra Gholami Taqanaki, Maryam Tofangchiha, Melina Targholi, Zeinab Tadayon, Mehdi Ranjbaran, Mona Sohrabi, Aida Mokhlesi, Luca Testarelli, Dario Di Nardo.

Age-related variations in the location of the mental foramen: a retrospective panoramic radiographic study in children .

Annali Di Stomatologia, 17(1) 75-82.
<https://doi.org/10.59987/ads/2026.175-82>

Conclusion: The horizontal position of the mental foramen shifts distally with age, whilst the vertical position predominantly remains within the middle third of the mandible. These age-related alterations underscore the necessity for further research involving larger sample sizes to substantiate the findings.

Keywords: mental foramen; panoramic radiograph; children.

Introduction

The mental foramen (MF) serves as a significant anatomical landmark located bilaterally in the anterior-lateral region of the mandible, near the apices of the first and second premolar teeth (1, 2). This funnel-shaped structure typically remains equidistant from the superior and inferior borders of the mandible, with approximate dimensions of 4-6 mm in width and 3-4 mm in length. Its morphology and position may be influenced by factors such as gender, race, and ethnicity (3).

Precise identification of the mandibular foramen (MF) is crucial for numerous dental and medical procedures, such as implant placement, surgical interventions, endodontic treatments, osteotomies, and anesthetic injections (1, 2). Damage to the nerves and arteries passing through this region may lead to partial or complete sensory loss in the affected area (4).

Furthermore, the position of the mental foramen (MF) can be employed to evaluate the morphometric symmetry of the mental triangle, as well as the microscopic and macroscopic morphology of the mandible, bone regeneration activity, and even paleoanthropological features of the facial skeleton across various demographic groups (2). Various imaging modalities, including computed tomography (CT), cone beam computed tomography (CBCT), periapical radiography, panoramic radiography, magnetic resonance imaging (MRI), and palpation, are used to locate the MF (3) precisely.

In clinical practice, panoramic radiography is frequently recommended because it offers a comprehensive view of the oral cavity, jaws, and temporomandibular joints. Although computed tomography (CT) scans provide more detailed anatomical information, panoramic radiography is often favored due to its cost-effectiveness, ease of acquisition and interpretation, and reduced radiation exposure (3). Precise identification of the mental foramen (MF) is essential for the successful administration of anesthesia, implant placement, surgical planning, and the prevention of postoperative complications in the premolar region (4, 5). This study aims to assess the horizontal and vertical positions of the MF across various age groups.

Material and methods:

Study Design and Sample Selection

This descriptive-analytical study retrospectively evaluated 283 panoramic radiographs of patients (136 males and 147 females), obtained from the archives of the Radiology Centre of the Faculty of Dentistry at Qazvin University of Medical Sciences and the

Specialised Maxillofacial Radiology Centre in Qazvin City. The initial sample size was set at 500 radiographs based on a previous study (6). However, 283 radiographs that met the study criteria were ultimately selected using convenience sampling.

Inclusion and Exclusion Criteria:

Panoramic radiographs were included based on the following inclusion criteria:

- Patients aged 4 to 18 years.
- No history of orthodontic treatment, trauma, or developmental disorders.
- Radiographs of acceptable quality.

The exclusion criteria were as follows:

- Blurred or unusable radiographs.
- Patients with deep proximal caries or overhangs in the proximal restoration of premolars, permanent molars, or primary molars.
- Radiographs showing extensive root resorption of primary molars, missing or impacted premolars, or periodontal lesions.
- Radiographs where the interdental surfaces or the periapical areas of the premolars, permanent molars, or primary molars were not visible.

Radiograph Evaluation:

Two observers—one an oral and maxillofacial radiologist and the other a paediatric dentist (each possessing a minimum of five years of professional experience)—independently evaluated the radiographs. The examination was performed on a Samsung monitor (Samsung, Korea) under consistent lighting conditions, utilizing SCANORA software (Armonk, NY: IBM Corp.). The observers were allowed to modify zoom, brightness, and contrast settings of the images, with no time restrictions placed on the evaluation process. Before the assessment, calibration was conducted by reviewing three panoramic radiographs (not included in the study) and comparing the results to ensure consistency. Inter-observer reliability was excellent, as evidenced by a kappa coefficient of 1.

Measurement of the Horizontal Location of the MF:

The horizontal positioning of the MF was established using the digital ruler tool (7), in accordance with the classification proposed by Chkoura and El-Wady (6). The position of the MF relative to the premolars was categorized as follows (see Figure 1):

Type 1: Mesial to the apex of the first premolar.

Type 2: In line with the apex of the first premolar.

Type 3: Between the apices of the first and second premolars.

Type 4: In line with the apex of the second premolar.

Type 5: Between the apices of the second premolar and the first molar.

For measurements involving primary molars, tangential lines were delineated on the mesial surface of both the first and second primary molars, along with lines extending from the central region of the crowns through the area situated between the two roots. It is noteworthy that primary molars generally have two roots, (6). The classification for the MF associated with primary molars was subsequently articulated as follows:



Figure 1. Horizontal position of the mental foramen relative to the primary molars.

- **Type 1m:** Mesial root of tooth D.
- **Type 2m:** Apex of tooth D.
- **Type 3m:** Distal root of tooth D.
- **Type 4m:** Between teeth D and E.
- **Type 5m:** Mesial root of tooth E.
- **Type 6m:** Apex of tooth E.
- **Type 7m:** Distal root of tooth E.

Measurement of the Vertical Location of the MF:

The vertical position of the mandibular foramen (MF) was ascertained by measuring the distance from the alveolar crest to the inferior border of the mandible. A line was constructed from the center of the MF perpendicular to the inferior border of the mandible, extending to the alveolar crest. This measurement was divided into three equal parts, and the position of the MF was documented as illustrated in Figure 2 (6):

- Upper one-third.
- Middle one-third.

- Lower one third

Statistical analyses:

The data were analyzed employing both descriptive and analytical statistical methods. Frequencies and percentage values were presented for descriptive data. Analytical data analysis utilized the Chi-squared test, Fisher's exact test, and Monte Carlo chi-squared test. All statistical procedures were conducted using SPSS version 25 (Armonk, NY: IBM Corp.), with a significance threshold set at 0.05.

Result

Table 1 delineates the distribution of various vertical positions of the mandibular foramen (MF) among patients aged 4 to 18 years. The most prevalent position was identified in the middle third, with a frequency of 93.6%. The coefficient of agreement for the vertical positioning of the MF was determined to be 0.074 ($P < 0.001$).

Table 1. Frequency of Different Vertical Positions of the MF (Ages 4 to 18)

Age (yrs)	Position of MF, N(%)			
	Middle 1/3	Lower 1/3	Total	P-value
4-6	57(89.1%)	7(10.9%)	64(100%)	0.074
6-12	144(93.5%)	10(6.5%)	144(100%)	
12-18	64(98.5%)	1(1.5%)	64(100%)	

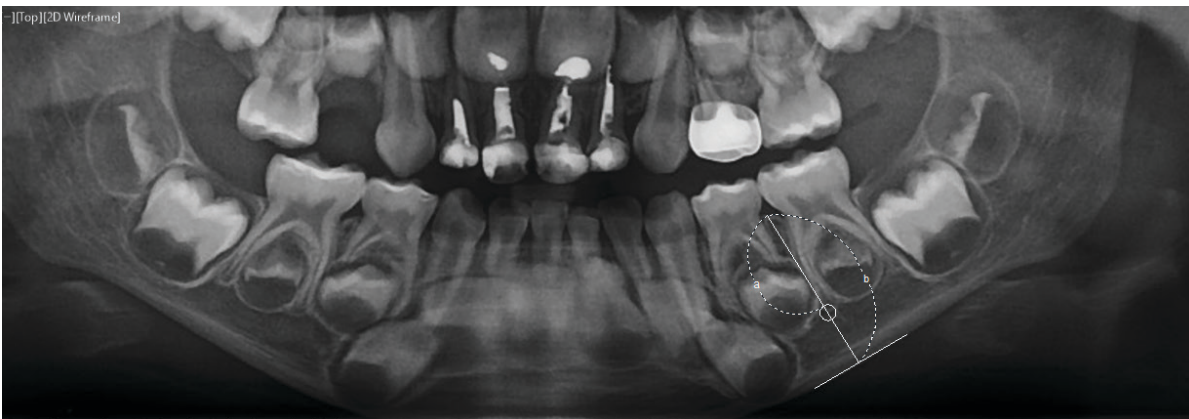


Figure 2. Vertical position of the mental foramen within the mandibular body.

Table 2 illustrates the distribution of various vertical positions of the mandibular fossa (MF) in males and females. No statistically significant difference in the vertical position of the MF was observed between

genders ($p = 0.751$). While the prevalence of middle-third positions was marginally higher in males (94.1%) than in females (93.2%), this variation did not reach statistical significance.

Table 2. Frequency of Different Vertical Positions of the MF by Gender

Gender	Position of MF, N(%)			
	Middle 1/3	Lower 1/3	Total	P-value
Male	128 (94.1%)	8 (5.9%)	136(100%)	0.751
Female	137 (93.2%)	10 (6.8%)	147(100%)	

Table 3 illustrates the prevalence of various horizontal positions of the mandibular foramen (MF) among patients aged 4 to 18 years. Type 3, located between the apices of the first and second premolars, was the most

frequently observed position, accounting for 51.6% of instances. The coefficient of agreement concerning the horizontal position of the MF was 0.75 ($P < 0.001$).

Table 3. Frequency of Different Horizontal Positions of the MF (Ages 4 to 18)

Age (yrs)	Position of MF,N(%)						P-value
	Type 1	Type 2	Type 3	Type 4	Type 5	Total	
4-6	0(0.0%)	73(57.0%)	55(43.0%)	0(0.0%)	0(0.0%)	128(100%)	<0.001
6-12	16(5.2%)	119(38.6%)	167(54.2%)	5(1.6%)	1(0.3%)	308(100%)	
12-18	6(4.6%)	20(15.4%)	70(53.8%)	34(26.2%)	0(0.0%)	130(100%)	

Table 4 illustrates the distribution of various horizontal positions of the mandibular foramen (MF) among males and females. Type 3 was present in 56.1% of females and 46.7% of males. The occurrence of Type 2 positions was

more prevalent in males than in females. Nevertheless, no statistically significant correlation was identified between the horizontal position of the MF and gender, as determined by the Monte Carlo chi-square test.

Table 4. Frequency of Different Horizontal Positions of the MF by Gender

Gender	Position of MF,N(%)						P-value
	Type 1	Type 2	Type 3	Type 4	Type 5	Total	
Male	11(4.0%)	118(43.4%)	127(46.7%)	16(5.9%)	0(0.0%)	272(100%)	0/044
Female	11(3.7%)	94(32.0%)	165(56.1%)	23(7.8%)	1(0.3%)	294(100%)	

Table 5 illustrates the frequency of different horizontal positions of the MF with deciduous teeth. Type 3 was the most common horizontal position between the ages

of 4 and 12, accounting for 35.1%. The coefficient of agreement for the horizontal position of the MF in this age group was 0.75 ($P < 0.001$).

Table 5. Frequency of Different Horizontal Positions of the MF withDeciduous Teeth

Age (yrs)	Position of MF,N(%)								P-value
	Type 1m	Type 2m	Type 3m	Type 4m	Type 5m	Type 6m	Type 7m	Total	
4-6	6(4.7%)	23(18.0%)	51(39.8%)	17(13.3%)	30(23.4%)	0(0.0%)	1(0.8%)	128(100%)	<0.001
6-12	28(9.1%)	19(6.2%)	102(33.1%)	42(13.6%)	106(34.4%)	7(2.3%)	4(1.3%)	308(100%)	

Table 6 presents the distribution of various horizontal positions of the mandibular foramen (MF) in males and females relative to deciduous teeth. Type 3 was identified in 35.6% of females and 34.5% of males.

The prevalence of Type 2 positions was greater in males compared to females. No statistically significant association was observed between the horizontal position of the MF and gender, as determined by the Monte Carlo chi-square test.

Table 6. Frequency of Different Horizontal Positions of the MF by Gender with Deciduous Teeth

Gender	Position of MF, N(%)								P-value
	Type 1m	Type 2m	Type 3m	Type 4m	Type 5m	Type 6m	Type 7m	Total	
Male	16(7.3%)	29(13.2%)	76(34.5%)	28(12.7%)	66(30.0%)	3(1.4%)	2(0.9%)	220(100%)	0.324
Female	18(8.3%)	13(6.0%)	77(35.6%)	31(14.4%)	70(32.4%)	4(1.9%)	3(1.4%)	216(100%)	

Discussion

The Mental Foramen (MF) constitutes a significant anatomical feature located in the anterior-lateral region of the mandibular bone. In the vicinity of the MF, critical neural structures exist that are instrumental in the pulpal anesthesia of the teeth and lips. Consequently, understanding the anatomical position of the MF can facilitate the investigation of infiltration injection techniques in the mandible. Additionally, knowledge of the MF's location helps reduce iatrogenic injuries during dental procedures. The position of the MF is affected by various factors, including gender, age, race, and growth patterns, (8, 9). Panoramic radiography is among the most widely used radiographic modalities for imaging oral and facial structures. Multiple studies have reported that panoramic radiography provides adequate accuracy for angular and linear measurements of the mandible (10, 11). Furthermore, this imaging technique is particularly well tolerated by pediatric patients (12, 13). Therefore, the present study aimed to determine the vertical position of the MF across different age groups ranging from 4 to 18 years, utilizing panoramic radiographic schemas.

In the present study, the most common anteroposterior position of the MF compared to permanent teeth is between the roots of the first and second premolar teeth, and after that, along the first premolar tooth.

In the study conducted by BULUT et al., which bears significant similarity to the present study regarding the age group, it was demonstrated that in the age range of 7 to 17 years, the most frequent horizontal position of the mandibular foramen (MF) is located between the first and second premolars, with the second most common position along the premolar teeth (9). One possible explanation for this observation is the higher prevalence of the 6- to 12-year age group in our study sample, which accounts for the difference in the secondary rank of frequency noted between the two studies. In our investigation, the distribution of the horizontal position of the MF by age group indicated that within the 6 to 12-year cohort, the most common position was between the first and second premolars, followed by the first premolar. Conversely, in the 6- to 12-year age group, the highest frequency

was observed in the premolars, with the second most common position in the second premolar, as identified in previous research (14-16). According to BULUT et al., multiple studies involving individuals aged 18 years or older have reported that the most frequent position of the MF is between the first and second premolars.

Numerous studies have been conducted by researchers in Iran on this issue, each involving diverse populations and ethnic groups and in a study focusing on a selected population of Rafsanjan city, comprising individuals aged 25 to 45 years, Tahakheri and Karimi concluded that the region between the first and second premolars was the most frequently observed location for a mandibular foramen (MF) in panoramic radiographs, with a prevalence of 44%. Subsequently, the area beneath the second premolar was identified as the most common site, accounting for 36%. In the studies by Niknami and Ekran et al., the most prevalent site of MF was between the fourth and fifth mandibular teeth. However, certain studies have reported the MF located along the longitudinal axis of the second premolar, findings inconsistent with our study. Among these is the research by Al-Mahlawi et al., which concluded that the most common position of the MF is beneath the apex of the second premolar in a Saudi population aged 16 to 68 years, based on CBCT radiographs. The results of Rathod et al.'s study on a population in Vijayapur, involving patients aged 15 to 40 years and employing panoramic radiography, indicated that the most frequent location for the MF was along the second premolar, accounting for 54.2%, followed by between the first and second premolars at 37.5%. Additionally, the study by Zamani et al., conducted in Isfahan and involving subjects aged 10 to 35 years, demonstrated that the most common site for MF in the Iranian population, as observed on panoramic radiographs, is beneath the apex of the second premolar, with a prevalence of approximately 56. The disparities among these studies may be attributed to variations in radiographic evaluation techniques, sample sizes, racial backgrounds, and age groups.

Furthermore, in this cross-sectional, analytical investigation, the horizontal position of the mandibular canal (MF) relative to the milk teeth was examined, as limited research exists on this topic. Lim et al., by

analyzing spatial changes in the MF during childhood, concluded that such variations are common. The most frequent horizontal position of the MF concerning the primary teeth was along the mesial root of the second primary molar. In the present study, the predominant horizontal positioning of the MF relative to milk teeth generally correlated with the extension of the distal root of the first deciduous molar, followed by the extension of the mesial root of the second deciduous molar. However, regarding age stratification within the 4 to 6-year age group, the most frequent horizontal position of the MF was along the distal root of the first deciduous molar. Conversely, in the older age cohort, the predominant position was associated with the extension of the mesial root of the second molar. These findings are consistent with Lim's study, given that Lim's age range was 5 to 16 years.

In the study conducted by Eunjeong Jo et al., the highest frequency of the MF position in the age group of 6 to 13 years was observed along the mesial root of the second molar, which is consistent with the findings for the age group of 6 to 12 years in the current study (24). In the 2022 research by Vathariparambath et al., which closely parallels the age group examined (8 to 18 years) in the present study, it was reported that, in most cases, the MF is located between the first and second molars. This variation may be attributable to differences in age ranges and sample sizes within each age group (25).

The study by Gershenson et al. also demonstrated that, in most instances, the position of the mandibular fossa (MF) was aligned with the root of the first molar. This correlation may be attributed to the younger age of the skulls examined in Gershenson's research; indeed, the study included samples before tooth eruption (26).

In the present study, the mental foramen (MF) was observed to displace distally with increasing age. The study by Vathariparambath et al. (2022) is comparable to the current investigation in terms of age group, as it examined the position of the MF in individuals aged 8 to 18 years using radiography. Cone-beam computed tomography (CBCT) concluded that the position of the MF shifts upward and posteriorly with age within this demographic (25). The findings of Azab et al.'s study on pediatric subjects also indicated that the MF in the 6- to 10-year age group is smaller than that in older children, with the younger cohort exhibiting a more posterior position (27). Furthermore, in 2011, Balcioglu et al. conducted research on fetuses and examined changes in the horizontal position of the MF before and after birth. Their results demonstrated that the MF tends to move posteriorly with human growth. Additionally, the radiographic examination in this study involved children aged 4 to 12 years, where similar results were observed (28).

In the present study, the highest frequency of the vertical position of the mandibular foramen (MF) was observed in the middle third, and with increasing age, the likelihood of the MF being situated in the middle third increased. However, these findings were not statistically significant. The findings of Vathariparambath et al., using CBCT imaging in the age range of 8 to 18 years, demonstrated that the MF shifts position with

advancing age (Campo, 25). Furthermore, Dotto and colleagues examined the position of the MF in children aged 10 to 12 years in 2006. Their results indicated that the MF was located in the lower third in children aged 10 to 11 years and in the middle third in 12-year-old children. These studies suggest that the position of the MF during the mixed dentition period varies with individual growth (29). These findings are consistent with the results of our research. As age increases and the horizontal and vertical dimensions of the mandible grow, the position of the MF tends to be located in the middle third (superiorly) and between the first and second premolars. However, Lim et al.'s study indicated that the MF shifts downward with increasing age. The discrepancies between these results may be attributed to racial differences and sample size (23).

In the current study, there was no statistically significant difference between females and males concerning the vertical position of the mandibular foramen ($p=0.751$). Conversely, in the research conducted by Bulut and Vathariparambath, gender was identified as a factor influencing the distance between the mandibular foramen and the inferior border of the mandible, which directly reflects the vertical positioning of this foramen and was found to be significantly influential (9, 25). The disparate findings across these studies may be attributable to racial and demographic variations, as different racial groups can exhibit distinct skeletal structures. Furthermore, in the present investigation, no significant difference was observed between females and males regarding the horizontal position of the mandibular foramen relative to the milk teeth ($p=0.324$). In contrast, the study by Azab et al., which analyzed 19 CBCT radiographs, reported a statistically significant difference in the horizontal positioning of the mandibular foramen relative to the milk teeth among children under 10 years of age, differentiated by gender (27). The inconsistency in findings may stem from differences in sample size, racial background, and growth patterns. Additionally, this study identified a significant difference between females and males regarding the horizontal position of the mandibular foramen relative to permanent teeth ($p=0.044$). This variation in significance between primary and permanent teeth is a novel observation in this study, potentially indicating instability in dental and skeletal growth over time and the differing effects of puberty and growth spurts on males and females.

The conclusions of this study indicate that there are significant variations in the positioning of the mandibular foramen (MF) by age and gender in pediatric and adolescent populations. The location of the MF undergoes positional shifts concomitant with mandibular growth, transitioning during the period of mixed dentition—comprising both deciduous and permanent teeth—as well as during growth spurts and puberty, which similarly impact its position across sexes. Consequently, knowledge of the MF's location is essential for treatment planning, particularly before administering local anesthesia. The most prevalent position of the MF was identified at the distal root of the deciduous first molar and within the mixed dentition, along the mesial root of the second molar in deciduous teeth. Given that infiltration injections are

administered in these regions during both childhood and mixed dentition stages, it can be hypothesized that the success of infiltration anesthesia in the treatment of mandibular deciduous teeth may be attributable, in addition to bone penetration by the anesthetic, to access through the MF and the subsequent blockade of the mental nerve and other sensory nerves supplying the deciduous teeth in this region. This hypothesis is corroborated by observations of lip numbness following numerous mandibular infiltration injections. As such, further research is warranted to compare the efficacy of infiltration anesthesia with that of the inferior alveolar nerve block. Future clinical investigations should document post-infiltration lip numbness, including its duration. Moreover, the caudal displacement of the MF with advancing age may be explained by the hypothesis that the horizontal growth rate of the mandibular bone anterior to the chin foramen exceeds that posterior to the chin, necessitating further research to validate or refute this supposition.

Conclusion

Based on the findings of this study, several important conclusions can be drawn regarding the position of the mental foramen in children and adolescents. Firstly, the position of the mental foramen exhibits significant variation with age, reflecting mandibular growth and the transition from mixed dentition to permanent dentition. The most prevalent horizontal position of the mental foramen has been identified to be between the first and second premolars, with a distal shift observed as age increases. Vertically, the mental foramen is most commonly situated in the middle third of the mandible, with this likelihood increasing with age; however, these changes were not statistically significant. These findings are in agreement with several prior studies, although some variation may be attributable to racial and demographic differences.

Regarding gender differences, no significant variations were observed in the vertical or horizontal positions of the mandibular foramen (MF) concerning deciduous teeth. However, a notable discrepancy in the horizontal positioning of the MF was identified between male and female subjects regarding permanent teeth, suggesting that mandibular growth spurts and puberty may influence MF positioning differently across sexes.

From a clinical perspective, these findings underscore the significance of comprehending the position of the mandibular foramen (MF) during the administration of local anesthesia in pediatric and adolescent populations. The placement of the MF, especially in relation to deciduous teeth, may be instrumental in the success of infiltration anesthesia for mandibular procedures. The study advocates additional clinical research to examine the potential benefits of infiltration anesthesia compared with traditional inferior alveolar nerve block techniques, particularly among younger patients. Moreover, the posterior displacement of the MF with increasing age may offer valuable insights into mandibular growth rate variability, a hypothesis warranting further exploration.

Ethical approval and consent to participate

The research Ethics committee of Qazvin University of Medical Sciences approved this study (IR.QUMS.REC.1400.245).

Data availability statement

The data presented in this study are available on request from the corresponding author.

Acknowledgments

The authors extend their gratitude to Qazvin University of Medical Science, Iran, for their generous support.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal associations that could have influenced the work reported in this paper.

Supplementary material

Supplementary Materials are available upon genuine request to the Corresponding Author.

Funding

None

References

1. Abdullah Bahamid A, Yousef Alsaif S, Mohamed Alman-souri AS, Mefawez Alshammari S, Abdullah Alshahrani F, Ali Alhusayni H. MF Position, Shape, Continuity, and Symmetry Among Malocclusion Patients: A Radiographic Study. *Cureus*. 2023;15(12):e51056. <https://doi.org/10.7759/cureus.51056>
2. Subramanian B, Anthony SN, Mubbunu L, Hachombwa C, Mlawa MS, Majambo MM, et al. Anthropometrics Analysis of MF and Accessory MF in Zambian Adult Human Mandibles. *TheScientificWorldJournal*. 2019;2019:9093474. <https://doi.org/10.1155/2019/9093474>
3. Prakash M, Kumari S, Singh AK, Kumar P, Kumar A, Kumar D. Evaluation of Position of MF in Dentulous Population by Digital Panoramic Radiography. *Journal of pharmacy & bioallied sciences*. 2023;15(Suppl 2):S916-s9. https://doi.org/10.4103/jpbs.jpbs_41_23
4. Nagarajappa AK, Alam MK, Alanazi AA, Bandela V, Faruqi S. Implications of impacted mandibular cuspids on MF position. *The Saudi dental journal*. 2021;33(7):713-7. <https://doi.org/10.1016/j.sdentj.2020.04.003>
5. Ghandourah AO, Badaoud MB, Dahlawi A, Alghamdi A, Alhazmi F, Sembawa SN, et al. A radiographic analysis of the location of the MF. *The Saudi dental journal*. 2023;35(4):354-8. <https://doi.org/10.1016/j.sdentj.2023.03.001>
6. Lim M, Lim W, Rajan S, Nambiar P, Ngeow W. Age-related changes in the location of the mandibular and MF in children with Mongoloid skeletal pattern. *European Archives of Paediatric Dentistry*. 2015;16(5):397-407. <https://doi.org/10.1007/s40368-015-0184-x>
7. Green RM. The position of the MF: a comparison between the southern (Hong Kong) Chinese and other ethnic and racial groups. *Oral surgery, oral medicine, and oral pathology*. 1987;63(3):287-90. [https://doi.org/10.1016/0030-4220\(87\)90191-5](https://doi.org/10.1016/0030-4220(87)90191-5)
8. Jasim HH. The MF and the lower premolars-A Review. *Journal of Advanced Medical and Dental Sciences Research*. 2020;8(4):46-51.
9. Bayrak S, Göller Bulut D. Evaluation of the position of lingula mandible, MF and lingual foramen of individuals in the 7-17 age groups via

- Cone-Beam Computed Tomography. Clinical and Experimental Health Sciences. 2021;11(3):375-80. <https://doi.org/10.33808/clinepxhealthsci.702860>
10. Pogrel MA, Thamby S. Permanent nerve involvement resulting from inferior alveolar nerve blocks. Journal of the American Dental Association (1939). 2000;131(7):901-7. <https://doi.org/10.14219/jada.archive.2000.0308>
11. Loudon J. Beware the MF. British dental journal. 2011;210(7):293. <https://doi.org/10.1038/sj.bdj.2011.249>
12. Bekiroglu N, Mete S, Ozbay G, Yalcinkaya S, Kargul B. Evaluation of panoramic radiographs taken from 1,056 Turkish children. Nigerian journal of clinical practice. 2015;18(1):8-12. <https://doi.org/10.4103/1119-3077.146965>
13. Gandhi JM, Govindaraju L. Evaluation of requirement of taking panoramic radiographs in children less than 6 years of age - A retrospective study. Journal of family medicine and primary care. 2022;11(5):2146-9. https://doi.org/10.4103/jfmpc.jfmpc_1556_21
14. Chappidi V, Swapna LA, Dheeraj V, Nikitha GR, Kanakagiri M. Evaluation of morphometric variations in MF and prevalence of anterior loop in South Indian population - A CBCT study. Journal of Indian Academy of Oral Medicine and Radiology. 2019;31(2):134-9. https://doi.org/10.4103/jiaomr.jiaomr_219_18
15. Bakhsh A, Abed H, Hazzazi L, Alzebiani N, Fatma W, Yaman I, et al. Anatomical Variations and Biological Effects of MF Position in Population of Saudi Arabia. Dentistry. 2016;6:373. <https://doi.org/10.4172/2161-1122.1000373>
16. AlQahtani NA. Assessment of the position and level of mental nerve for placement of implants using cone-beam computed tomography & panoramic radiograph in the Saudi population. The Saudi dental journal. 2022;34(4):315-20. <https://doi.org/10.1016/j.sdentj.2022.04.001>
17. Tafakhori Z, Karimi M. Evaluation of Horizontal Position of MF in Relation to Mandibular Premolar in the Panoramic Radiograph in Rafsanjan City in 2014. Journal of Rafsanjan University of Medical Sciences. 2016;14(11):913-22.
18. Niknami M, Esmaeeli F, Nazer A, ghogazadeh m. Radiographic Evaluation of location and shape of MF in selective Iranian Population. journal of research in dental sciences. 2011;8(2):102-8.
19. Ekran H, Ghanbarnejad A, Afsa M. The Age- and Gender-wise Assessment of the Position and Shape of MF in Patients' Panoramic Radiography. Journal of Arak University of Medical Sciences. 2020;23(6):806-17. <https://doi.org/10.32598/jams.23.6.6089.1>
20. Al-Mahalawy H, Al-Aithan H, Al-Kari B, Al-Jandan B, Shujaat S. Determination of the position of MF and frequency of anterior loop in Saudi population. A retrospective CBCT study. The Saudi dental journal. 2017;29(1):29-35. <https://doi.org/10.1016/j.sdentj.2017.01.001>
21. Rathod SB, Nimbale AV, Chhillashetti SK, Chiniwar V, Desai V, Hadimani GA, et al. Panoramic Radiographic Study on Location of MF in Patients of Orthodontic Treatment. South East Asia Journal of Medical Sciences. 2019;3(4):1-4.
22. Asieh Zamani N, Ehsan H, Laleh R. Frequency of horizontal position of mental foramina in the panoramic radiographs of patients referring to the Radiology Department of Isfahan Dental Faculty. Journal of Isfahan Dental School. 2011;6(4):720.
23. Lim MY, Lim WW, Rajan S, Nambiar P, Ngeow WC. Age-related changes in the location of the mandibular and MF in children with Mongoloid skeletal pattern. European archives of paediatric dentistry : official journal of the European Academy of Paediatric Dentistry. 2015;16(5):397-407. <https://doi.org/10.1007/s40368-015-0184-x>
24. Jo E, Lee J, Ra J. A Study on Position of the MF in Children Using Panorama. Journal Of The Korean Academy Of Pediatric Dentistry. 2019;46:183-9. <https://doi.org/10.5933/JKAPD.2019.46.2.183>
25. Vathariparambath N, Krishnamurthy NH, Chikkanarasiah N. A Cone Beam Computed Tomographic Study on the Location of Mandibular and MF in Indian Pediatric Population. International journal of clinical pediatric dentistry. 2022;15(4):422-7. <https://doi.org/10.5005/jp-journals-10005-2413>
26. Gershenson A, Nathan H, Luchansky E. MF and mental nerve: changes with age. Acta anatomica. 1986;126(1):21-8. <https://doi.org/10.1159/000146181>
27. Azab MM. Localization of MF in relation to primary molars in children. A cone-beam computed tomography study. Advanced Dental Journal. 2023;5(2):432-41. <https://doi.org/10.21608/adjc.2023.197886.1266>
28. Balcioglu HA, Kilic C, Akyol M, Ulusoy AT. Horizontal migration of pre- and postnatal MF: an anatomic study. International journal of pediatric otorhinolaryngology. 2011;75(11):1436-41. <https://doi.org/10.1016/j.ijporl.2011.08.010>
29. Dotto S, Travassos R, Filho E, Moraes L, Moraes M, Castilho J, et al. Evaluation of the MF position in pediatric patients. Brazilian Dental Science. 2010;9. <https://doi.org/10.14295/bds.2006.v9i2.480>