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ORIGINAL ARTICLE

A Retrospective CT Study to Evaluate the Horizontal and Vertical Positions of the Mental Foramen and the Prevalence of Accessory Mental Foramen in Western Tamilnadu, India

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Abstract
Introduction: The mental foramen is a small opening on the surface of mandible through which the mental nerve and vessels pass, providing sensory innervation and blood supply to the lower lip and chin. Exact identification of its position and anatomical variations, like an accessory mental foramen are important to prevent nerve injury during dental and maxillofacial procedures. This study was done to evaluate the horizontal and vertical positions of the mental foramen and to assess the prevalence of accessory mental foramen using computed tomography. **Materials and Methods:** This retrospective study was conducted in the Department of Radiology at a tertiary care hospital in western Tamil Nadu after Institutional Human Ethics Committee approval. A total of 392 computed tomography scans of head and face which included the mandible were analyzed. The horizontal position of the mental foramen was classified based on its relationship to adjacent teeth, and the vertical position was assessed in relation to the premolar apex. The presence of accessory mental foramen was also evaluated bilaterally. **Results:** The most common horizontal position of the mental foramen was position 4 on both right (56.6%) and left (53.1%) sides, followed by position 3. Vertically, position 2 was the most frequent location on both sides. Accessory mental foramen was present in 6.9% of the individuals on right-side and in 6.4% on left-side. A high degree of bilateral symmetry was observed. **Conclusion:** The mental foramen most commonly lies in the premolar region and in alignment with the premolar apex, though anatomical variations exist. Computed tomography allows precise localization of the mental foramen and its variants, aiding safer clinical and surgical practice.

Keywords: Mental Foramen, Computed tomography, Mental Foramen, Accessory Mental Foramen

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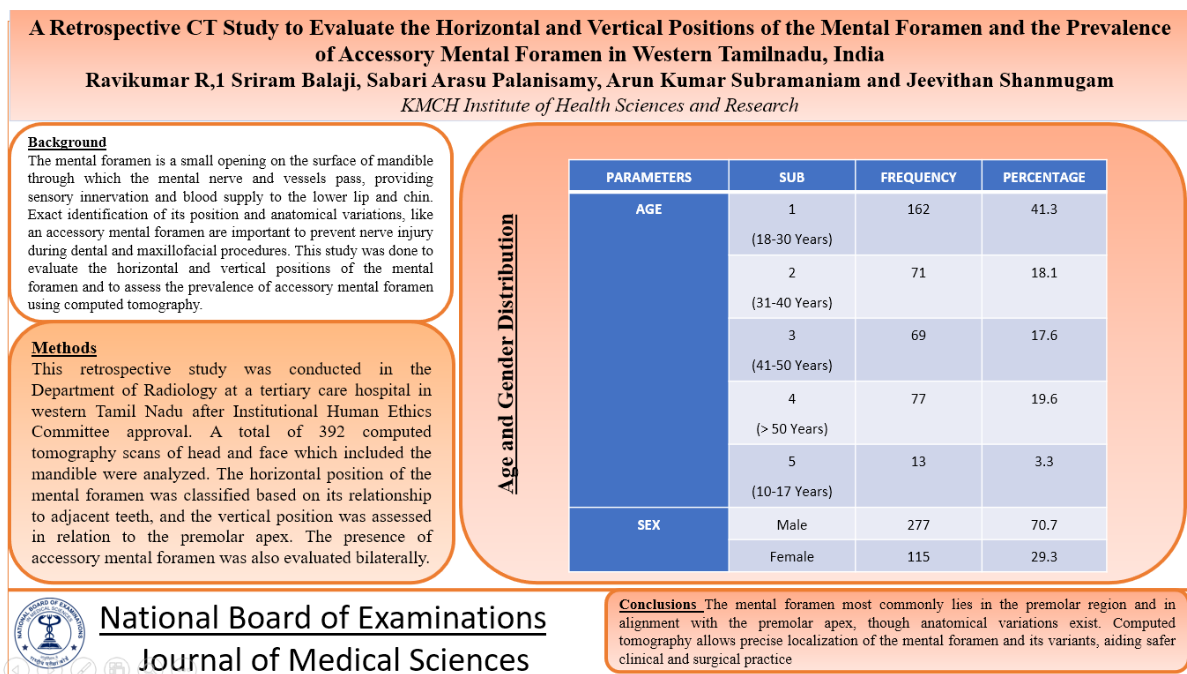
Graphical Abstract



PARAMETERS	SUB	FREQUENCY	PERCENTAGE
AGE	1 (18-30 Years)	162	41.3
	2 (31-40 Years)	71	18.1
	3 (41-50 Years)	69	17.6
	4 (> 50 Years)	77	19.6
	5 (10-17 Years)	13	3.3
SEX	Male	277	70.7
	Female	115	29.3

Introduction

The mental foramen is one of the important anatomical landmarks located on the external surface of the body of the mandible. Mental Foramen serves as the point of exit for the mental nerve, artery, and vein, which provides sensory innervation and blood supply to the lower lip, chin, and adjacent labial mucosa. The mental foramen is visualised as a round or oval radiolucent shadow and may sometimes be mistaken for a pathological lesion. In spite of being small in size, the mental foramen plays an important role in oral and maxillofacial surgery and forensic anthropology [1].

The mental foramen can be located in different places and can vary based on age, bone resorption, tooth loss, genetic makeup, and racial differences. Accurate localization of the foramen is important during procedures like mental nerve block, placing a dental implant, mandibular osteotomies and fracture fixation. Mental nerve injury can cause life long sensory disturbances and discomfort, with varied symptoms like numbness, paraesthesias and discomfort [2]. Accurate knowledge of the anatomical position of the mental foramen is important.

The mental foramen can be visualised both in horizontal and vertical planes. In the horizontal plane, position of the mental foramen was classified by Al Jasser and Nwoku. They classified it into six positions based on its relationship to adjacent teeth [2].

Position 1: Situated anterior to the first premolar, Position 2: In line with the first premolar, Position 3: Between the first and second premolar, Position 4: In line with second premolar, Position 5: Between the second premolar and first molar and Position 6: In line with the first molar.

Vertically, Fishel et al. [3] classified the foramen based on its relationship to the apex of the premolar teeth (3) as follows - Position 1: coronal to

the apex, position 2: at the apex, position 3: apical to the apex. Studies have shown variability in these positions across different populations, highlighting the importance of population-specific anatomical data [4,5]. Advanced imaging modalities such as computed tomography (CT), cone-beam computed tomography (CBCT), and panoramic radiographs play a vital role in accurately identifying these variations.

Few individuals have an accessory mental foramen (AMF) along with a primary, which is an additional anatomical opening present on the buccal surface of the mandible [6,7]. The accessory branches of the mental nerve and accompanying vessels can pass through the AMF and may cause incomplete anesthesia or nerve injury if not recognized. Though the prevalence of AMF is relatively low, its presence carries significant clinical implications during surgical and anesthetic procedures [8,9]. In view of the importance of accurate anatomical localization and lack of regional data, this study was done using computed tomography to determine the prevalence of accessory mental foramen and to evaluate the mental foramen's horizontal and vertical positions in a tertiary care hospital in Western Tamil Nadu, India

Materials and Methods

This Retrospective imaging based Cross sectional study was done in the Department of Radiology at a Tertiary care teaching hospital in Western Tamil Nadu. Prior approval was obtained from the Institutional Human Ethics Committee (IHEC). The study involved only retrospective analysis of archived computed tomography (CT) images with no direct patient contact or intervention hence no informed consent was required. Confidentiality of patient data was strictly maintained throughout the study and all images were anonymized prior to analysis in accordance with ethical guidelines.

CT images acquired during routine clinical evaluation were retrospectively reviewed over the study period (June 2023 to May 2025). All CT scans that included the mandible with facial bones were considered for inclusion. Scans showing mandibular fractures, cysts, tumors, congenital or developmental anomalies of the mandible, or poor image quality obscuring visualization of the mental foramen were excluded from the study. Both right and left sides of the mandible were evaluated independently in all included scans.

The CT images were assessed to determine the horizontal and vertical positions of the mental foramen. The horizontal position was classified according to the system described by Jasser and Nwoku [2] based on the relationship of the mental foramen to adjacent teeth, while the vertical position was classified based on the criteria proposed by Fishel et al. [3], using the relationship of the foramen to the apex of the premolar teeth. The presence or absence of accessory mental foramen was also evaluated on both sides of the mandible. All observations were recorded systematically for further analysis.

Demographic details were collected from patient records. The findings related to the position of the mental foramen and the presence or absence of an accessory mental foramen was entered into a Microsoft Excel spreadsheet for data organization, verification and coding.

A minimum required sample size of 380 scans was calculated based on previously published literature. Statistical analysis was done using SPSS 27. Categorical variables were expressed as frequencies and percentages. Continuous variables were summarized as mean and standard deviation. The chi-square test was used to find associations between categorical variables. P-values less than 0.05 were considered statistically significant.

Results

A total of 392 CT scans were included in the study. The study population mainly consisted of young adults, majorly, the 18–30 years age group (41.3%), followed by patients aged more than 50 years (19.6%). Patients aged 31–40 years and 41–50 years constituted 18.1% and 17.6% of the study population respectively. The group with the lowest number of participants was 10–17 years (3.3%). A clear cut male predominance was noted among the study population (70.7%) (Table 1).

Evaluation of the horizontal position of the mental foramen showed a consistent distribution pattern bilaterally. On the right side, the mental foramen was most commonly located at position 4 (56.6%), followed by position 3 (24.2%). Other locations were less common (position 5 (15.8%), position 6 (2.8%), positions 1 and 2 (0.3% each)). Similarly, on the left side, position 4 was the most prevalent location (53.1%), followed by position 3 (28.3%). While position 2 was found in just 1% of cases, positions 5 and 6 were noted in 15.3% and 2.3% of cases, respectively. On the left side, Position 1 was not seen. Positions 3 and 4 accounted for more than 80% of horizontal locations bilaterally.

On analysis of the vertical position of the mental foramen it was observed that second position was the most common location on either sides of the mandible. On the right side, second position was observed in nearly half (50.8%) of the study participants, followed by position 3 among 44.1% and position 1 in 5.1% of the study participants. A more or less similar pattern was noted on the left side, where position 2 was noted in 52.3% of cases, position 3 among 42.3%, and position 1 in 5.4%.

Assessment of the accessory mental foramen revealed that majority of the study participants did not exhibit this anatomical variation. Accessory mental foramen was absent in 93.1% of scans on the right side and 93.6% on the left side. The presence of accessory mental foramen was noted in 6.9% on right-side and in 6.4% on left-side of mandible, thereby indicating a relatively low but clinically relevant prevalence, with no marked lateral predominance (Table 2).

Statistical analysis using chi-square test was performed to assess the association between the position of the mental foramen on the right and left sides. However, no statistically significant difference was observed ($p > 0.05$), indicating a symmetrical distribution of the mental foramen bilaterally.

Table 1. Age and Gender Distribution

PARAMETERS	SUB	FREQUENCY	PERCENTAGE
AGE	1 (18-30 Years)	162	41.3
	2 (31-40 Years)	71	18.1
	3 (41-50 Years)	69	17.6
	4 (> 50 Years)	77	19.6
	5 (10-17 Years)	13	3.3
SEX	Male	277	70.7
	Female	115	29.3

Table 2. Anatomical distribution of mental foramen

PARAMETERS	SUB	FREQUENCY	PERCENTAGE
POSITION OF MENTAL FORAMEN IN HORIZONTAL PLANE (RIGHT)	1	1	0.3
	2	1	0.3
	3	95	24.2
	4	222	56.6
	5	62	15.8
	6	11	2.8
POSITION OF MENTAL FORAMEN IN HORIZONTAL PLANE (LEFT)	2	4	1.0
	3	111	28.3
	4	208	53.1
	5	60	15.3
	6	9	2.3
POSITION OF	1	20	5.1

MENTAL FORAMEN IN VERTICAL PLANE (RIGHT)	2	199	50.8
	3	173	44.1
POSITION OF MENTAL FORAMEN IN VERTICAL PLANE (LEFT)	1	21	5.4
	2	205	52.3
	3	166	42.3
ACCESSORY MENTAL FORAMEN (RIGHT)	Absent	365	93.1
	Present	27	6.9
ACCESSORY MENTAL FORAMEN (LEFT)	Absent	367	93.6
	Present	25	6.4

Discussion

Understanding the position of mental foramen is essential as sensitive nerves pass through it and it is of great importance in shaping the neurovascular pattern. Adequate knowledge about its precise location helps us in avoiding mistakes during nerve repair surgeries and anesthetic procedures. Since there are many variations, it is essential to take radiographs before resorting to tunneling procedures to avoid complications and improve clinical outcomes.

In horizontal plane position 4 (In line with second premolar) was observed in more than half of the study participants bilaterally. Similar report was observed in a study done by Al Jaser et al. and this destination at the second premolar site seems to be reported as a common infallible fixed point during practice [2]. Similar results were observed in other studies too.[16-18,20] The next most frequent position was at 3 (between the first and second premolars). It is found approximatively among 25% of all cases bilaterally. Overall positions 3 and 4 comprised one fourth of the sites observed thereby indicating a strong bilateral symmetry. Similar reports were observed in other studies too [10-12,16–18,20].

Position 5 in horizontal plane was observed less frequently, which was close to the second premolar/first molar area and it accounted for about 15% of cases bilaterally. Similar result was observed by a study done by Philips et al. [17] and Neiva et al. [18]. Anterior positions 1, 2 and posterior position 6 were rarely observed. Although the observations are less frequent, they can’t be neglected and are important from the clinical perspective, since the anterior position may predispose to nerve injury during procedures involving canine or premolar region, while the posterior position may pose difficulties in surgeries involving molar area. These data clearly highlights the need for individual imaging assessment before any surgical procedure.

Position 2 on vertical plane, which aligns with the premolar apex was

observed as the most common position bilaterally (more than 50%). This adds evidence to the use of the premolar apex as a reliable landmark for mental nerve block procedures and implant placement (3). The Position 3, at which the foramen is below the apex, was observed as the second most frequent position. This downward position relates to many factors like age-related alveolar bone loss and reduced bone height, especially in participants who are partially edentulous [10–12,14,16-18,20].

Position 1, which indicates a higher position when compared to the premolar apex, was rarely seen. Although this is uncommon, it may increase the risk of accidental exposure of nerves during dental procedures like extractions or surgeries in the front of the mandible. It is essential to understand and recognize this variation so as to avoid unintended complications, particularly in those with altered mandibular anatomy [10,11,16-18,20].

This current study noticed a low incidence of accessory mental foramen (AMF), seen among 6.9% on right-side and among 6.4% on left side. This aligns with the reported rates of 1.4% to 10% in various studies (15). In a study done by Naitoh et al. [19] accessory mental foramen was reported in 7% of the study population. The absence of a significant lateral preference shows that these variations are evenly distributed. Although it is observed rare, the incidence of AMF is clinically important. If accessory nerve branches are not recognized, it can lead to incomplete anaesthesia or sensory issues after surgery [6–9].

Conclusion

The findings of our study shows that while the mental foramen has a clear anatomical pattern among most people, significant variations do also occur. Advanced imaging techniques like computed tomography help us in identifying these variations, which helps us in improving our surgical precision and also lowers the risk of nerve injury. Anatomical Position data specific to certain populations, like what this study provides, are highly useful for increasing the safety during dental procedures thereby improving the patient outcomes in local clinical settings.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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