

Assessment of Morphometric Variations of Mental foramen by CBCT– A study on South Indian Population

¹Dr. Anju Mathew, Senior Lecturer, Department of Oral Medicine and Radiology, Pushpagiri College of Dental Sciences, Thiruvalla.

²Dr. N Mohan, Retd. Professor and Head, Department of Oral Medicine and Radiology, Vinayaka Missions Sankarachariyar Dental College, Salem.

³Dr. Lisa Elizabeth Jacob, Senior Lecturer, Department of Oral Medicine and Radiology, Pushpagiri College of Dental Sciences, Thiruvalla.

⁴Dr. Anuna Laila Mathew, Associate Professor and Head, Department of Oral Medicine and Radiology, Pushpagiri College of Dental Sciences, Thiruvalla.

Corresponding Author: Dr. Anju Mathew, Senior Lecturer, Department of Oral Medicine and Radiology, Pushpagiri College of Dental Sciences, Thiruvalla.

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Abstract

Aim of the Study: Mental foramen is an important reference in the premolar region of mandible and precise location of the foramen is needed when any surgical or implant procedures are planned in this region. This study is carried out with an aim to evaluate the location of mental foramen with respect to apices of mandibular teeth and distance of the mental foramen from the inferior border of the mandible.

Materials and Methods: A prospective study was done on 150 subjects (300 mental foramen regions) which included 75 males and 75 females within the age group 20 -65 years. All the subjects were exposed to Cone Beam Computed Tomography Imaging. The data were

analyzed to assess the location, size and shape of mental foramen and the distance of mental foramen from inferior border of the mandible. The data obtained were subjected to statistical analysis. A value of $p < 0.05$ was chosen as level of significance.

Results: Among the male population, 45% and 49% of cases had position of mental foramen below the second premolars on right and left side respectively. Among the female population, 43% and 40% of them had mental foramen between 1st and 2nd premolar on right side and left side respectively. The mean size of mental foramen showed a vertical diameter of 3.12 mm in females, 3.45 mm in males, and a horizontal diameter of 3.31 mm in females and 3.62 mm in males. The mean value of

distance from inferior border was 11.28 mm in females and 12.32 mm in males. Majority of the study population (both males and females) had oval shaped mental foramen.

Conclusion: The presence of anatomical variations is often ignored. To prevent iatrogenic injuries during the surgical procedures, it is essential to identify these variations by imaging presurgical Ly which permits more accurate planning and contributes more successful treatment. CBCT can be an excellent diagnostic aid in imaging the exact position of mental foramen and to identify the anatomical variations.

Keywords: Mental foramen, Cone Beam Computed Tomography, Inferior border of mandible.

Introduction

The mental foramen (MF) is a bilateral funnel like opening in the anterolateral aspect of the body of the mandible through which nerve endings such as the mental nerve, a branch of the inferior alveolar nerve and corresponding arteries and veins emerge.^[1-4] As the nerve exit the foramen, it branches to innervate the mandibular anterior teeth and the neighboring structures. The blood vessels along with the nerve supply the soft tissues of the lower jaw.^[5]

During the development of mandible, the position of MF will be displaced anteriorly initially followed by posterior displacement after the second deciduous molar erupts. At times, this creates a loop that transverse anteriorly past the MF and turnabouts superiorly, distally and laterally before exiting the MF resulting in an anatomical variant called anterior loop of inferior alveolar canal.^[6-7]

Any foramen noted in addition to mental foramen in the body of mandible is called as an accessory mental foramen that usually transmits auxiliary nerves to the teeth.^[8]

Both from diagnostic and clinical point of view, MF is an important landmark. Clinically, inaccurate information regarding the position of nerve, its relationship with adjacent structure and presence/absence of AL during any surgical procedure, implant placement, anesthetic procedure can lead to injury of mental bundle leading to post-surgical neurovascular complications. Diagnostically, MF can be misdiagnosed as a radiolucent lesion near the apices of mandibular premolars.^[9]

The accurate identification of mental foramen is very challenging. Various techniques can be applicable to identify the foramen such as manual palpation, exposing the mental region during surgery, dissection of the cadaver and radiographic techniques ranging from 2 dimensional to 3 dimensional. Currently Cone Beam Computed Tomography is accurate technology available for quantitatively determining the position and variations of MF and presence of anterior loop.^[10,11]

This study was conducted to evaluate the position and shape of mental foramen, the effects of patient's gender on these variables among the South Indian population by CBCT.

Materials and methods

This was a prospective study carried out in patients visiting the Department of Oral Medicine and Radiology. The study was performed following the fundamental principles of the Declaration of Helsinki (2013). The ethical clearance for the study was obtained from the Institutional Ethical Committee [IEC/Approval No: 084]. The present study was an institution-based study carried out within a time frame of 1 year. The sample size estimation was done by using the formula $n = \frac{Z^2 P (1-P)}{d^2}$. In this formula, n is the sample size, Z is the statistic corresponding to level of confidence, P is expected prevalence (that can be obtained from same

studies or a pilot study conducted by the researchers), and d is precision (corresponding to effect size). The level of confidence usually aimed for is 99%. CBCT scans were performed using KODAK 9500 CONE BEAM 3D SYSTEM. The parameters were Field of View: 18 cm × 20 cm; voxel size of 0.3 mm; exposure parameters such as 80 kvp, 10 mA with exposure time of 14.2 seconds. The CBCT machine used flat panel amorphous silicon sensor. The sample population included 150 patients which included 75 males and 75 females within the age group 20 -65 years.

Inclusion Criteria

- Dentate patients (especially teeth confined to mental foramen region from canine to first molar)

- Clear radiographs without artifacts

Exclusion Criteria

- Pregnant Women
- Presence of mixed dentition.
- Presence of any radiolucent or radio-opaque lesion, skeletal disorders, trauma or pathology affecting/obscuring the position of the mental foramen.

CBCT data obtained were analyzed in three different planes (tangential, cross-sectional, and axial). Mental foramen was identified in cross-sectional and axial views [Figure 1]. To determine the position of mental foramen with respect to the inferior border of mandible, two parallel lines were drawn in the tangential section, one from the superior border of mental foramen and other one following the inferior border of mandible, using length measuring tool provided in the software. The distance between these two lines was measured by drawing a perpendicular line on them [Figure 2]. The height and width of mental foramen were measured using the length measuring tool [Figure 3].

The anteroposterior position of MF was recorded as (a) below 1st premolar, (b) between 1st and 2nd premolar,

(c) below 2nd premolar, (d) between 2nd premolar and 1st molar and (e) below 1st molar. The shape of the mental foramen was also analyzed [Figure 4].

All CBCT scans were evaluated independently by two observers, both specialized in oral radiology. The data obtained were entered in an excel sheet and subjected to statistical analysis. Descriptive statistics of various positions were used (mean and frequency). The results were presented according to side and gender. The mean all the measurements were assessed. Comparison of value of all measurements was made between sides and genders using Chi square -test. Differences between genders were considered significant at $p < 0.05$. Descriptive statistics of horizontal diameter, vertical diameter and distance of foramen from inferior border were presented as mean and standard deviation. Paired t test was used to measure significant differences among males and females. $p < 0.05$ was considered significant.

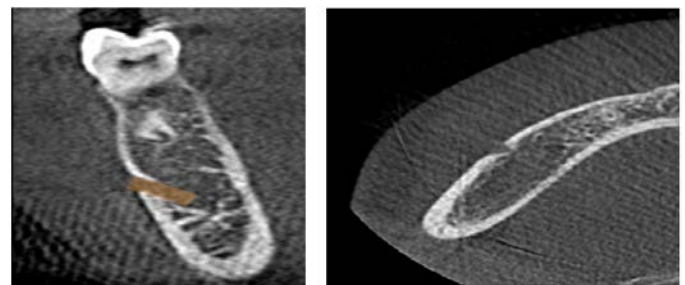


Figure 1: Mental foramen opening in sagittal and axial view

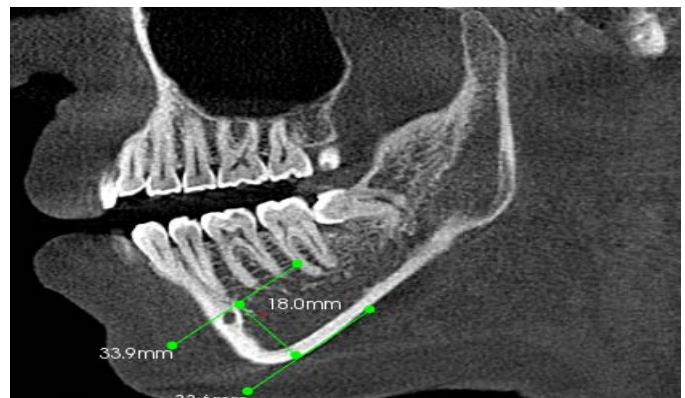


Figure 2: The distance of mental foramen from inferior border of the mandible



Figure 3: Horizontal and vertical diameter of the mental foramen

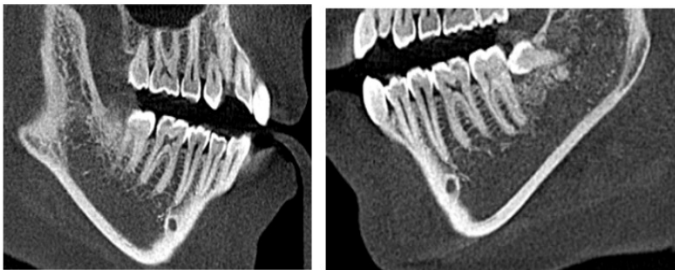


Figure 4: Shape and position of mental foramen with respect to apices of mandibular teeth

Results

On the right side, among the male population, 5 cases (7%) showed the position of mental foramen below the 1st premolar. 34 cases (45%) below the second premolar, 12 cases (16%) between first and second premolar. 21 patients had had mental foramen between 2nd premolar and 1st molar. The least number was found below 1st molar 3 cases (4%). Among the female population, 3 cases (4%) showed the position of mental foramen below the 1st premolar. 14 cases (18%) presented mental foramen below second premolar, 32 of them had mental foramen be first and second premolar. 25 females had mental foramen between 2nd premolar and 1st molar (33%). Like males, only 2 females presented with

mental foramen below 1st molar. There was statistically significant difference among male and female population regarding the position of mental foramen as shown in Table 1.

On the left side, among males, the highest frequency was noted below 2nd premolar (49%), followed by 19 cases (25%) between second premolar and first molar and the least below first molar (2%). Among females, only 1% of the study population had mental foramen below first molar while 30 cases (40%) presented mental foramen between first and second premolar followed by 32% of case below 2nd premolar. There was statistically significant difference among male and female population regarding the position of mental foramen as shown in Table 2.

Size and distance of the mental foramen from inferior border of mandible

The mean size of mental foramen showed a vertical diameter of 3.12 mm in females, 3.45 mm in males, and a horizontal diameter of 3.31 mm in females and 3.62 mm in males. The mean value of distance from inferior border was 11.28 mm in females and 12.32 mm in males. With regard to gender, there was statistically significant difference in vertical diameter of the foramen and distance of foramen from inferior border of the mandible. [Table 3]

Shape of mental foramen

Among males, majority of cases 55/75, the shape of the mental foramen was oval both in right and left side, while 20/75 had round shape. While in female population, 52/75 had oval shaped mental foramen while remaining had round shape both in right and left side.

Table 1: Position of mental foramen with respect to gender on Right Side

Position of mental foramen (Right Side)			Gender		Total
			Male	Female	
Below 1 st premolar	N		5	3	8
	%		7%	4%	5 %
Below 2 nd premolar**	N		34	14	38
	%		45%	18%	25%
Between 1 st and 2 nd premolar***	N		12	32	44
	%		16%	43%	12%
Between 2 nd premolar and 1 st molar	N		21	25	46
	%		28%	33%	30%
Below 1 st Molar	N		3	2	5
	%		4%	2%	3%

** - chi – square statistic is 6.3782. p value is .11553. The result is significant at p< 0.05

*** - chi – square statistic is 7.1046 p value is .007689. The result is significant at p< 0.05

Table 2: Position of mental foramen with respect to gender on Left Side

Position of mental foramen (Left Side)			Gender		Total
			Male	Female	
Below 1 st premolar	N		4	3	7
	%		5%	4%	5%
Below 2 nd premolar	N		36	24	60
	%		49%	32%	37%
Between 1 st and 2 nd premolar**	N		14	30	44
	%		19%	40%	30%
Between 2 nd premolar and 1 st molar	N		19	17	36
	%		25%	23%	25%
Below 1 st Molar	N		2	1	3
	%		2%	1%	2%

** - chi – square statistic is 4.5294. p value is .033317. The result is significant at p< 0.05

Table 3: Size and distance of mental foramen from inferior border of mandible

Variables	Mean value in Males	Standard Deviation in males	Mean value in Females	Standard Deviation in females	P value
Horizontal diameter*	3.45	1.32	3.08	1.12	.0001
Vertical diameter	3.47	1.17	3.37	1.21	0.08
Distance from superior border of mental foramen to inferior border of mandible**	12.24	1.04	11.36	0.98	.0008

*- p value is <.00001. The result is significant at p< 0.05

** - p value is .00008. The result is significant at p< 0.05

Discussion

The position of the MF is a crucial factor when considering the mental nerve anesthetic block, surgery and implant placement in the premolar region.^[12] It transmits the mental nerves and vessels that supply the chin, lower lip, labial and buccal mucosa of incisors, canines, and premolars. Any trauma to the nerve will cause paresthesia of the lip, chin, and oral mucosa that is often associated with occasional xerostomia.^[13,14] Assessing the accurate position of the MF in relation to inferior border of the mandible or in relation to mandibular teeth is important to prevent mental nerve injury during oral surgical procedures in this region such as cyst enucleation, apicectomy at mandibular premolar area, surgical removal of impacted teeth, fixation of mandibular fractures, and implant placement. Additionally, knowledge about the precise position of the MF can lead to more precise and more profound local anesthesia. Literatures reveal there are significant differences reported in the location of MF among different population.

In our study we tried to evaluate the position of mental foramen with respect to gender, the width and height of

mental foramen and the distance from superior border of mental foramen to inferior border of mandible.

The mean distance from mental foramen to the inferior border of mandible, in our study, was in accordance with the results of the studies conducted by Mahnaz Sheikhi et al in 2016 with a mean distance from mental foramen to the inferior border of mandible in the right side was 13.26 mm (SD ± 2.34) and in the left side was 13.37 mm (SD ± 2.19).^[15]

Neiva et al and Agthong et al. had similar results when they performed their study on skulls. They reported the mean ranges of 14-15 mm and 10.33–13.67 mm, respectively.^[16,17]

The most common position of mental foramen in our study has many variations when evaluating with other studies. According to some studies MF is most commonly located between 1st and 2nd premolars (Gungor et al., 2006; Currie et al., 2015)^[18, 19]. Our study was in accordance to study conducted by Al Mahala Wy et al in 2017 where in majority of their study sample had the position of mental foramen below second premolar.^[10]

Rakhi Rastogi et al in 2012 and Flora M Fabian in 2007 studied the shape of mental foramen in 105 and 100

dried adult human mandibles respectively and they found 74.3% and 54% of cases had oval shaped mental foramen similar to our study.^[12, 20]

While comparing the size of the mental foramen seen in our study with the literature, Rakhi Rastogi^[12] had mean vertical diameter of mental foramen as 2.61mm on right side and 2.53mm on left side and mean horizontal diameter greater than our findings 5.19 mm on right side and 5.12mm on left side. Oguz and Bozkir did measurements in 34 dry mandibles of Turkish people and found a mean HD of 2.93 mm on the right side and 3.14 mm on the left side, and a mean VD of 2.38 mm and 2.64 mm on the right and left sides, respectively which was slightly less when compared with our size.^[21] M. Shal ash et in 2020 and Kalender et al in 2012 studied the size of mental foramen and their results were similar to our findings. M Sha lash did not have any significant difference with respect to gender while Kalender et al found that males had significantly larger MF than females.^[22,23] In our study, there was significant difference in horizontal diameter with respect to gender.

Conclusion

Paresthesia of the mental nerve is one the significant complications that can occur when you do a surgical procedure or implant placement in mental foramen region. Therefore morphometric analysis of the mental foramen is essential prior to planning of any procedures. Cone Beam CT can be a reliable imaging modality in identifying the anatomical variations of mental foramen thereby preventing nerve damage and contributes more successful treatment.

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