International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 8; Issue 01(C); January 2019; Page No. 16849-16852
DOI: http://dx.doi.org/10.24327/ijcar.2019.16852.3131

Research Article

THE MORPHOLOGICAL LOCATION OF MANDIBULAR AND MENTAL FORAMEN IN MIXED DENTITION PERIOD - A CBCT STUDY

Navin H.K, Nimisha V.P and Balaji P

Rajarajeswari Dental College and Hospital, No: 14, Ramohalli Cross, Mysore Road, Kumbalgodu Bangalore India

A R T I C L E I N F O

Article History:

Received 06th October, 2018
Received in revised form 14th November, 2018
Accepted 23rd December, 2018
Published online 28th January, 2019

Key words:

Mandibular Foramen, Mental Foramen, Mixed Dentition Period, Cone Beam Computed Tomography.

A B S T R A C T

Introduction: The assessment of the mandibular and mental foramen is of considerable importance for mandibular nerve anesthesia. There may be failure of mandibular nerve block due to improper evaluation of the location of mandibular and mental foramen resulting in painful treatment procedures especially in children. The location of mandibular and mental foramen shows considerable variation among different population, in different ages and even within the same individual on two sides.

Aim: To determine the location of mandibular foramen(MF) and mental foramen (MeF) in mixed dentition period using cone beam computed tomography.

Materials and Methods: A total of 100, MF and MeF (right and left) were obtained from fifty CBCT images of children (6-14years). Distance from MF to the anterior(A), posterior(P) and inferior border of the mandible(MI), mandibular notch(MN), occlusal plane of the mandibular permanent molars(O) and the distance from MeF to lower border of mandible(BM) and to the alveolar crest(AC) were measured.

Results: There was statistically increase in P-MF, MN-MF, O-MF values with age. MN-MF, MI-MF and A-MF values of females were statistically higher than those of males and there is significant difference in AC-MeF, BM-MeF values with age.

Conclusion: The location of the MF is just posterior to the middle of the ramus and MF and MeF is shifting superiorly with increasing age.

INTRODUCTION

The comfort of many dental treatments in children especially depends on achieving excellent local anaesthesia[1]. Anaesthesia in the mandible may be associated with some difficulty and success of this technique depends on the proximity between the anaesthetic needle and the mandibular anatomical landmarks[2]. The most frequent technique failure in anaesthesia of inferior alveolar nerve lies in the inappropriate setting of the needle, due to the inaccurate location of anatomic structures like mandibular and mental foramen. Similarly the accurate identification of mental foramen is important for all the clinical procedure in the anterior region of the mandible[2].

There are no anatomical landmarks for locating mental foramen and the foramen cannot be clinically visualized or palpated, as a result mental foramen is difficult to locate and the reported anatomical position of the mental foramen has been variable[3, 4].Clinically, the mental bundle could be injured during surgical procedures, resulting in paraesthesia or anaesthesia[3]. Most studies and textbook however, describe the location of mental foramen as being below the apex of the second premolar or between the apices of the first and second premolars[3, 5]. The radiographic location of the mandibular and mental foramen may not be the exact since radiographs give a two dimensional view of three dimensional objects[4]. By using conventional radiographic techniques, the appearance of the mental foramen may result in a misdiagnosis of a radiolucent lesion in the apical area of mandibular premolar teeth. CBCT has probably been one of the most revolutionary innovations in the field of paediatric dentistry, and it provides a novel platform for imaging of maxillofacial area. It provided an imaging solution that has none of the projection errors associated with magnification and none of the superimposition problems associated with traditional panoramic imaging. It is particularly suitable in the evaluation of jaws, as three dimensional visualization and high resolution analysis of the entire mandible provide adequate information to localize anatomic structures like mandibular foramen and mental foramen[6]. Previous studies have indicated that the relative position of the inferior alveolar canal and its mental and mandibular foramina may vary with age and show sexual dimorphism. Studies undertaken on the morphological location of the mandibular and mental foramen using CBCT in Indian paediatric population is very few or scarce [1].

Hence the aim of this study was to evaluate the morphological location of the mandibular and mental foramen in mixed dentition period using cone beam computerized tomography.

MATERIALS AND METHOD

This retrospective study was done using fifty CBCT images of children in the age group of 6-14 years, obtained from the institutional data base of Rajarajeswari Dental College and Hospital, Bangalore. A total of 100 mandibular and mental foramen, both right and left side, were analysed on various parameters. The subject was divided into two groups. Group 1: age 6-10 years Group 2: 11-14

Corresponding author:* **Navin H.K
Rajarajeswari Dental College and Hospital, no: 14, Ramohalli Cross, Mysore Road, Kumbalgodu Bangalore India

years. The CBCT images were reconstructed with the help of ONDEMAND 3D and Scanora software. (CBCT MACHINE: SCANORA 3D, SOREDEX, FINLAND) at 90 kVp with an exposure time of 8 seconds. The images were then evaluated to determine the location of mandibular and mental foramen. Fifty CBCT images of mandible that was taken for valid diagnostic reasons or treatment were collected and analysed. In order to ensure the integrity, good quality of the CBCT mandibular images with the following criteria were selected. CBCT images of age group 6-14 years, Premolar and molar regions of both side of the mandible, no periapical pathology of teeth, developmental or congenital anomalies in soft or hard tissues in the mandible and Presence of all mandibular teeth.

CBCT images with Pathologies such as cyst, tumors, bone loss in the mandibular premolar and molar region. Evidence of fracture or history of trauma to the mandibular premolar and molar region. Showing errors and artifacts obscuring visibility of structures in the mandible were excluded from the study.

Interpretation of Images

All the images was assessed and measured using Ondemand 3D and Scanora Software of the CBCT machine. The panoramic and coronal images were used for locating the mandibular foramen and mental foramen respectively. The following measurements were made using the measuring tool on ONDEMAND 3D software. A panoramic view was reconstructed along the inferior alveolar canal. The location of Mandibular foramen was investigated and the following measurements were recorded (Figure 1).

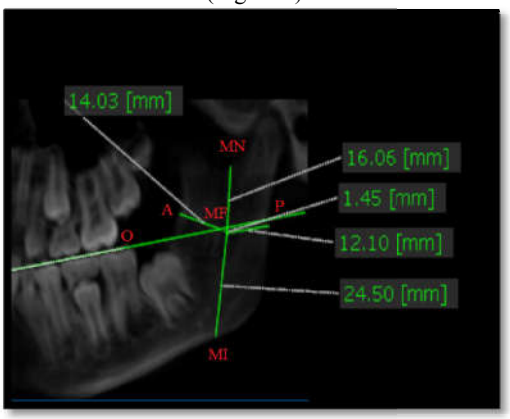

Fig 1 location of the mandibular foramenpanoramic view on cone beam computed tomography image. Landmarks used in the present study. A: Anterior border of the ramus, P: Posterior border of the ramus, MI: inferior border of mandible, MN: The most superior point of the curvature of the notch, O: The straight line of the cusps of the mandibular permanent molars, MF: Mandibular foramen.

- The shortest distance between the anterior border of the ramus (A) and mandibular foramen.
- The shortest distance between the posterior border of mandibular ramus (P) and mandibular foramen.
- The shortest distance between the inferior border of mandible (MI) to mandibular foramen.
- The shortest distance between the most superior point of the curvature of the mandibular notch (MN) and mandibular foramen.
- The distance between the straight line of the cusps of the mandibular permanent molars and mandibular foramen (O).

A coronal view was reconstructed .The location of mental foramen was investigated and the following measurements were recorded (Figure 2).

Three tangents were drawn, one at the superior margin of the mental foramen other at the crest of the alveolar bone and one at the base of the mandible. The distance between these three lines were recorded, which indicates the distance of the mental foramen from the crestal bone and the base of the mandible.

The differences, if any in morphometry of these structures with regard to age and sex were noted. All measurements were recorded in millimetres. Student Paired t test was used to compare the right & left sided linear distances related to mandibular foramen in different age groups.

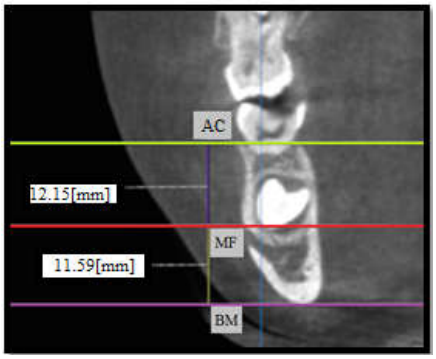

Fig 2 Location of the mental foramen. Landmarks used in the present study. MeF: Mental foramen, AC: Crest of the alveolar bone, BM: Base of the mandible.

One-way ANOVA test was used to compare the various linear distances related to mandibular foramen based on different age groups. The level of significance was set at $P<0.05$. The study data were analysed using SPSS [Statistical Package for Social Sciences] v.22 [IBM, Corp.,] for Windows.

RESULTS

There were statistically increase in P-MF ($p=0.009$), MN-MF ($p<0.001$), O-MF ($p=0.001$) values with age (Diagram 1). The MN-MF ($p=0.04$), MI-MF ($p=0.007$) and A-MF ($p=0.05$) values of males aged 6-14 years were statistically higher than those of females (Table 1). MF was found to be 4.19 mm (SD 1.68 mm) below the occlusal plane of erupted permanent molars in 6-10 year old children and it reaches occlusal plane of mandible at 13 years of age and it moves posterior-superiorly with increase in age. The distance of P-MF was found to be 11.55 mm (SD 1.74 mm) and 13.00 mm (SD 1.99 mm) and MN-MF values were 13.43 mm (SD 1.94 mm) and 15.75 mm (SD 1.76 mm) in the age group of 6-10 years and 11-14 years respectively (Diagram 1). There was significant decrease in AC-MeF value ($p=0.01$), from 11.99 mm (SD 1.14) in the group 1, to 10.66 mm (SD 1.39 mm) in group 2 and there was significant increase in BM-MeF value ($p<0.001$) from 12.01 mm (SD 1.40 mm) in group 1 to 14.28 mm (SD 1.43 mm) in the group 2 (Table 3) and there was no significant difference based on sex and side (Diagram 2).

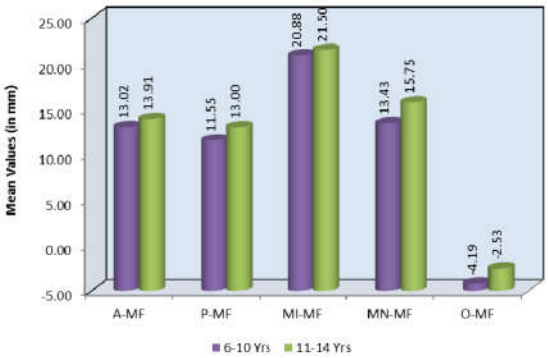

Diagram 1 Age wise comparison of different anatomical location of Mandibular Foramen among study subjects.

The MN-MF, MI-MF and A-MF values of males aged 6-14 years were statistically higher than those of females (Table 1).

Table 1 Gender sex wise comparison of different Anatomical locations of Mandibular Foramen among study subjects using Independent Student t Test.

Parameters	Gender	N	Mean	SD	Mean Diff	T	P-Value
A-MF	Males	21	14.04	2.10	1.07	1.987	0.05#
	Females	29	12.96	1.71			
P-MF	Males	21	12.37	1.80	0.31	0.548	0.59
	Females	29	12.06	2.11			
MI-MF	Males	21	22.06	2.18	1.56	2.797	0.007*
	Females	29	20.50	1.75			
MN-MF	Males	21	15.20	2.13	1.30	2.154	0.04*
	Females	29	13.90	2.08			
O-MF	Males	21	-3.70	1.92	-0.40	-0.771	0.44
	Females	29	-3.29	1.75			

There was significant difference in AC-MeF, BM-MeF values with increasing age (Table 3). AC-MeF value decrease with age where as BM-MeF value increase with age and there is no significant difference based on gender sex and side. (Diagram 2).

Table 2 Comparison of mean values of different Anatomical locations of Mandibular Foramen between right and left sides using Student Paired t Test.

Parameters	Sides	N	Mean	SD	Mean Diff	T	P-Value
A-MF	Right	50	13.30	1.94	-0.24	-2.028	0.06
	Left	50	13.53	2.02			
P-MF	Right	50	12.25	2.04	0.11	1.071	0.29
	Left	50	12.13	1.98			
MI-MF	Right	50	21.26	2.17	0.21	1.987	0.06
	Left	50	21.05	2.05			
MN-MF	Right	50	14.50	2.16	0.11	0.604	0.55
	Left	50	14.39	2.39			
O-MF	Right	50	-3.46	1.86	0.01	0.157	0.88
	Left	50	-3.47	1.77			

Table 3 Age wise comparison of different Anatomical locations of Mental Foramen among study subjects using Independent Student t Test

Parameters	Age_Grp	N	Mean	SD	Mean Diff	t	P-Value
AC-MeF	6-10 Yrs	28	11.99	1.14	1.33	3.729	0.001*
	11-14 Yrs	22	10.66	1.39			
BM-MeF	6-10 Yrs	28	12.01	1.40	-2.27	-5.651	<0.001*
	11-14 Yrs	22	14.28	1.43			

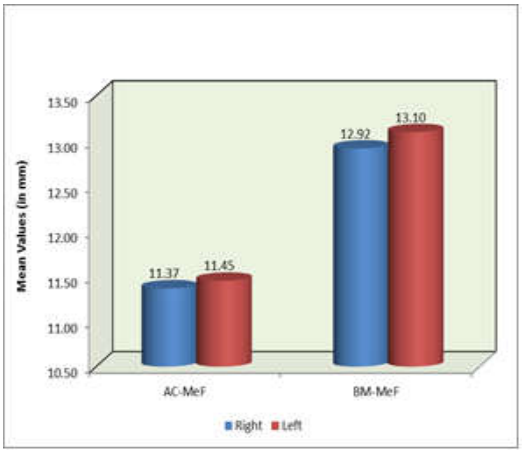

Diagram 2 Comparison of mean values of different anatomical locations of Mental Foramen between right and left sides using Student Paired t Test. MeF: Mental foramen, AC: Crest of the alveolar bone, BM: Base of the mandible.

DISCUSSION

The awareness of localization of mandibular and mental foramen is of a greater importance when administering regional anaesthesia especially in children. Its accurate position enables more effective local anaesthesia and improved child co-operation. The location of mandibular and mental foramen could change during the growth and development of the jaw especially during mixed dentition period [1, 7]. The importance of mandibular and mental foramen in the success of mandibular nerve block were revealed in previous studies, but studies undertaken on the morphological location of the mandibular and mental foramen in Indian paediatric population is very few or scarce[1, 2].

Studies for determining the localization of the MF and MeF have commonly been carried out using conventional radiographic technique like panoramic radiographs; however, they have some disadvantages, such as image magnification, loss of definition, and less accurate diagnostic value [8].

CBCT has been considered a "*Gold Standard*" as it provides clear and accurate images of structures, and therefore is extremely useful for assessing the bone component [6,9]. Thus the aim of this present study was to determine the location of mandibular foramen and mental foramen in mixed dentition period using cone beam computed tomography.

The knowledge about the location of mandibular foramen from the anterior border of ramus and from occlusal plane helps the dentist to locate the position of inferior alveolar nerve entry into the foramen accurately. Similarly the knowledge of localization of mandibular foramen from the Posterior border of the ramus and the inferior border of the mandible and condyle would be help in the advanced extra oral inferior alveolar nerve block technique[2]. Lindh *et al*. measured the distances between the superior border of the canal and the alveolar crest and between the mandibular base and the inferior border of the canal, and in addition the height of the canal in his study and concluded that tomography gave more accurate values than panoramic techniques[10]. Study conducted by Thangavelu *et al*.[2] reported that MF is 19 mm (SD 2.34 mm) from AB. In our study the mandibular foramen was found to be at a mean distance of 13.02 mm (SD 1.62 mm) at the age of 6-10 years and 13.91mm (SD 2.21 mm) from anterior border of ramus at the age of 11-14 years; with significant difference between male and female and without significant difference between the right and left side (Diagram 1).

In the present study the mandibular foramen was located posterior to the middle of the ramus and superiorly from the midpoint of vertical height (MN-MI) (table 1). Whereas in other studies it was found that mandibular foramen is located just posterior to the middle of the ramus [1, 11, 12]. Hayward *et al*. reported that the mandibular foramen was located in the third quadrant of the ramus[13]. Thangavelu *et al*. reported that MF is 3 mm superiorly from the midpoint of vertical height[2]. The distance of P-MF values were reported to be approximately 11.55 mm (SD 1.74 mm) and 13.00 mm (SD 1.99 mm) in the age group of 8-10 years and 11-14 years respectively. The distance of MN-MF values were reported to be approximately 13.43 mm (SD 1.94 mm) and 15.75 mm (SD 1.76 mm) in the age group of 8-10 years and 11-14 years respectively and there is statistically difference between genders (table 1, 2). Navin *et al*.[14] reported that MF is 13.0-13.9 mm from deepest point of coronoid notch for 9-10 year age group which supports our study. Mustafa *et al*. examined children and youth ranging from 8-18 years and study reported that P-MF, MN-MF value statistically increasing with age[1]. Afsar *et al*. reported that no significant difference between male and female value for the distance measured from the MF to the landmarks[12]. Mustafa *et al*. found that there is statistically increase in MI-MF value with age and significant difference between gender, but present study shows no significant difference in this value but shows sex difference[1].

The occlusal plane is an important anatomical landmark for identification of mandibular foramen. There is statistical difference in O-MF value with age and the location of MF is shifting superiorly from the occlusal plane. Hwang *et al*. reported that the MF was located 4.12 mm below the occlusal plane at the age of 3 years and subsequently moved upward with age. It had reached approximately the same level as the occlusal plane by 9 years and the foramen continued to move upward to 4.16 mm above the occlusal plane in the adult patients[15]. According to other study MF moves superiorly above the occlusal plane by 13 years of age[16]. A study conducted by Patricia *et al*. by examining 4-12 year children it was found that in 65% of cases MF was detected below the occlusal plane[17]. In the present study it was found that there is statistically significant difference in

the O-MF value with age and is 4.19 mm (SD 1.68 mm) below the occlusal plane of erupted permanent molars in 6-10 year old children. According to Mustafa *et al* it was found that the location of the MF is 2.5-3.6 mm above the occlusal plane of the molars and there were no statistically changes in the location of the MF with age[1]. There was significant difference in AC-MeF and BM-MeF values with age in our study. Location of MeF was bilaterally symmetric (diagram 2) and no gender difference was found. The position of mental foramen was shifting superiorly with increasing age. There was significant decrease in AC-MeF value, from 11.99 mm (SD 1.14) at the age of 6-10 years to 10.66 mm (SD 1.39 mm) at 11-14 years. There is significant increase in BM-MeF value from 12.01 mm (SD 1.40 mm) in group 1 to 14.28 mm (SD 1.43 mm) in the group 2 (table 3). MeF opens midway between upper and lower border at the age of 8-10 year because the alveolar and subalveolar part are equally developed. And in most of the cases it was located between first and second primary molars. Gershenson *et al*. reported that majority of the MeF was located opposite the first deciduous molar root[18]. Whereas a study done by Kalender *et al* found bilaterally symmetrical position of the MeFand were no sex difference[19] which was in accordance with our study.

Limitation

A limitation of this study was the sample size was less. Thus further studies have to be conducted to evaluate the location and to understand the age related changes of mandibular and mental foramen. The limitation of our study would be based on the fact that the radiographs were obtained from the database hence the nutritional status and the general health of each subject could not be assessed. Nutritional status and general health of the child does play an influence on his or her growth and development. This study also missed out to assess the location of mandibular foramen on the ethnic grounds other than the South Indian population.

CONCLUSION

Based on the values obtained it can be concluded that the location of mandibular and mental foramen varied according to age and gender, which was also determined by size, width, height, growth and development of each child in various age groups. The location of the MF is just posterior to the middle of the ramus and MF and MeF is shifting superiorly with increasing age. So a thorough knowledge of the anatomical structures is of at most important for successful treatment and prognosis especially in children.

Acknowledgments

We would like to thank Dr. Balaji.P, The Head Department of Oral Medicine and Radiology, for granting us access to the database of orthopantamographs, for successful conductance of the study.

Conflicts of Interest

The author declare that there is no conflict of interests.

Why is this study important?

The position of mandibular and mental foramen is very important when performing local anesthesia of mandible and its position changes according to age especially during mixed dentition period. Failure to achieve proper nerve block leading to repeated injection of the local anesthetic solution will not only pose a behaviour problem in children but can also lead to systemic toxic level of anesthetic solution being administered.

References

1. Altunsoy M'*et al*'. Localization of the mandibular foramen of 8-18 years old children and youths with cone-beam computed tomography. J. Pediatr Dent. 2014;2(2):44-48.
2. Thangavelu K'*et al*'. Significance of localization of mandibular foramen in an inferior alveolar nerve block. J. Nat Sci Biol Med. 2012;3(2):156-60
3. Ngeow WC'*et al*'. The location of the mental foramen in a selected Malay population. J. Oral Sci. 2003;45(3): 171-5.
4. Phillips JL'*et al*'. The mental foramen: Part1. Size, orientation and positional relationship to the mandibular second premolar. J. Endod. 1990; 16(5):221-3.
5. Philips JL'*et al*'. The mental foramen: Part II. Radiographic position in relation to the mandibular second premolar. J.Endod. 1992 Jun 1; 18(6): 271-4.
6. Cantekin K' *et al*'. Identification of the mandibular landmarks in a pediatric population. Med Oral Patol Oral Cir Bucal. 2014; 19(2):e136-41.
7. Gungor K' *et al*'. A radiographic study of location of mental foramen in a selected Turkish population on panoramic radiograph. Collegium antropologicum. Coll. Antropol.2006 Dec 13; 30(4): 801-5.
8. Ono E'*et al*'. Anteroposterior location of the mandibular foramen of 7 to 12 year-old children in panoramic radiographs. Brazilian Dental Science. 2010 Aug 11;8(2).
9. Przesmycka A'*et al*'. Differentiation of root canal morphology-a review of the literature. Anthropological review. 2016 Sep 1;79(3):221-39.
10. Lindh C'*et al*'. Measurements of distances related to the mandibular canal in radiographs. Clin Oral Implants Res. 1995;6:96-103.
11. Hetson G'*et al*'. Statistical evaluation of the position of the mandibular foramen. Oral Surg Oral Med Oral Pathol. 1988;65:32-4
12. Afsar A'*et al*'. Radiographic localization of mandibular anesthesia landmarks. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;86:234-41.
13. Hayward J'*et al*'. The mandibular foramen: its anteroposterior position. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 1977 Dec 1;44(6):837-43.
14. Krishnamurthy NH'*et al*'. Evaluation of Relative Position of Mandibular Foramen in Children as a Reference for Inferior Alveolar Nerve Block using Orthopantamograph. J. Clin Diagn Res. 2017;11(3):ZC71-ZC74.
15. Hwang TJ '*et al*'. Age changes in location of mandibular foramen. Zhonghua Ya Yi Xue Hui Za Zhi. 1990; 9:98-103.
16. Ashkenazi M '*et al*'. Age-Associated Changes of the Mandibular Foramen Position in Anteroposterior Dimension and of the Mandibular Angle in Dry Human Mandibles. The Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology, 2011 Aug; 294(8):1319-25.
17. Do Nascimento Pereira P '*et al*'. Radiographic assessment of the mandibular foramen in children: focus on anesthetic procedures. Archives of Oral Research. 2013 Nov 28;9(3).
18. Gershenson A '*et al*'. Mental foramen and mental nerve: changes with age. Acta Anat(Basel). 1986;126(1):21-28.
19. Kalender A '*et al*'. Evaluation of the mental foramen and accessory mental foramen in Turkish patients using cone-beam computed tomography images reconstructed from a volumetric rendering program. Clinical anatomy. 2012 Jul;25(5):584-92.

How to cite this article:

Navin H.K, Nimisha V.P and Balaji P (2019) 'The Morphological Location of Mandibular and Mental Foramen in Mixed Dentition Period - A CBCT Study', *International Journal of Current Advanced Research,* 08(01), pp. 16849-16852.
DOI: http://dx.doi.org/10.24327/ijcar.2019.16852.3131

****