

ORIGINAL ARTICLE

Determination of Anatomical Variation of Mental Foramen and Evaluation of Anterior Loop in Karachi Population Using Cone Beam Computed Tomography (CBCT)

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ABSTRACT

Aim: To determine the anatomical variation in mental foramen and to evaluate the anterior loop in the population of Karachi with the use of cone beam computed tomography (CBCT).

Study Design: Prospective Study

Place and duration: Department of Dental and Maxillofacial Surgery, Dr. Ishrat-ul-Ibad Khan Institute of Oral Health and Sciences Dow University of Health Sciences Karachi during September 2021 and February 2022.

Methodology: A group of 160 subjects were included in this study and the simple convenient sampling technique was used to obtain data for the research. CBCT images of all patients were obtained.

Results: 160 CBCT scans were obtained for this study, 76 females and the remaining 84 were males. Mental foramen was present below the second premolar and between the first and the second premolars most commonly, respectively. On the right side the mental foramen was 67.5% and 68.1% on the left. The most common shape of the anterior loop was Type-I, where Anterior Loop (AL) is unnoticeable and the anatomy is Y shaped as classified by solar et al. The AL was present more commonly on the left side 65% compared to the right side which was 59.4%. No correlation was found between anterior loop presentation and incisive canal of the mandibular region according to the Shapiro Wilk normality test ($P \geq 0.05$).

Conclusion: It is evident in this study that the location of the anterior loop and mental foramen is variable in our study population. Therefore it is mandated that CBCT images should be used before any invasive procedure is undertaken in the MF region.

Keywords: Anatomical variation, Mental foramen, Anterior loop, Mental Nerve, Cone Beam Computed Tomography (CBCT).

INTRODUCTION

The situation of mental foramen is between the edge of lower mandible and premolar teeth¹. A multitude of differences exists between shapes and location of mental foramina and the anterior loop^{2,3}. The mental nerve has two anterior branches, the incisive and mental nerve⁴. The approach of this nerve to the mental foramen is found varying in multiple subjects¹. The anatomical variation in the mental foramen is a major complication in periodontal surgical procedures. During a surgical procedure or anaesthesia administration, the neurovascular bundle correlated with the mental foramen may be encountered and has the potential to compromise the outputs of a surgical procedure which can result in mental nerve injury². Dental procedures such as tooth extraction, apical surgery, implantology and filling can injure the nerve without a thorough identification of the location resulting in the likes of labio-mental paresthesia and gingiva dysfunction^{5,6}.

Cone Beam Computed Tomography (CBCT) is used to take images of the jaws and teeth in a three dimensional scanning modality in endodontics. CBCT utilizes a low power medical fluoroscopy tube that creates data of the target region by utilizing a back projection reconstruction tomography using a conical beam by roaming it around the target area. The data collected using this technique is then constructed into a usable three dimensional (3D) imagery^{7,8}.

CBCT is better than conventional two dimensional panoramic imagery because it is able to generate a 3D buccal cavity reconstruction images in all three sagittal, axial and transverse planes without super positioning and detecting the position of the overlapping anatomical structures around the mental foramen which is not possible with conventional 2D imaging. CBCT is used to detect changes in the mental foramen,

mandibular canal and mandibular foramen. Mental foramen in the general population is single, but in 1.9% to 11.9% cases an extra foramen is present, when more than one foramen is found it is called AMF (accessory mental foramen)⁹. The anatomy of the mandible and the morphology of the related areas can be accurately assessed with the use of CBCT.

There is ample literature available on the significance of the detection of anatomical positioning of the mental foramen and anterior loop before surgical and endodontic procedures. However, no significant data is available for the local population of Karachi regarding opening angle, position detection and vertical measurements of mental foramen and anterior loop. The plan of this study is to collect these measurements in subjects who belonged to Karachi using computed beam tomography (CBCT). This study explores the importance of CBCT in determining the anatomical variations in our community and will compare the results with other populations. The study is conducted to improve the standards of our healthcare system, by spreading awareness regarding importance of anatomical variations of mental foramen and evaluation of anterior loop in Karachi population via CBCT among the clinical maxillofacial and orthodontic surgeons.

METHODOLOGY

After the ethical approval, this prospective study was conducted in the Department of Dental & Maxillofacial Surgery, Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences Karachi. This research study was undertaken after the approval from Ethical Committee from 24th September 2021 to 2nd January 2022. 160 subjects were selected according to the inclusion and exclusion criteria and convenience sampling technique was used to obtain data.

Sample size is calculated using OpenEpi online software, using proportion of type 3 AL of mental nerve noticed on left side is 11.4 (Osama Saeed Alyami, Mazen Saeed Alotaibi, Pradeep

Received on 11-06-2022

Accepted on 27-10-2022

Koppolu, Abdulrahman Alosaimy, Ashraf Abdulghani, Lingam Amara Swapna, Dalal H Alotaibi, Ali Alqerban, Kizhakke Veetil Sheethi, Anterior loop of the mental nerve in Saudi sample in Riyadh, KSA. A cone beam computerized tomography study, The Saudi Dental Journal, Volume 33, Issue 3,2021,Pages 124-130,ISSN 1013-9052,https://doi.org/10.1016/j.sdentj.2020.03.001)

A sample size of 156 achieves, 5% margin of error (d), power 80% with a significance level (alpha) of 0.05.To enhance the study strength, we increased the sample size to 160. The inclusion criteria during sample collection was defined as: People residents of Karachi, age >12 years, presence of permanent teeth adjoining MF, bilaterally from the canine teeth to first molar and only the people who gave consent to be included in the study. The exclusion criteria was: People with an absence of permanent dentition, presence of any lesion at the MF region, subjects less than 12 years old and people who did not give consent to take part in the study were excluded.

Statistical Analysis: Patient's data was compiled and analyzed through SPSS Version 23. Frequency and percentage will be figured out for variables i.e. gender. P≤0.05 will be considered as significant.

The study is prospective in design and patients who fulfilled the requirements of inclusion criteria were to be chosen and a mandatory CBCT scan was conducted of all patients.

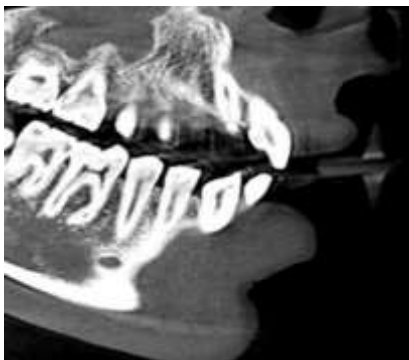
Data was obtained using a proforma where all the relevant information was gathered and then processed by the principal investigator. All CBCT scans were gathered from all panoramic planes, coronal, axial, and sagittal views. The following criteria was used to record antero-posterior position of mental foramen:

- i. below second premolar
- ii. between first and second premolar
- iii. below first premolar
- iv. between second premolar and first molar
- v. below the first molar.

Figure 1 Image showing the presence of MF below the second premolar left side.



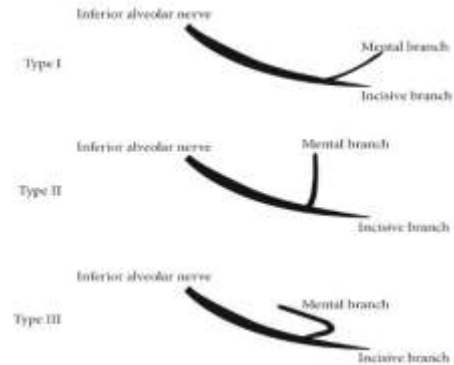
Figure 2: Image showing the presence of MF below the second premolar right side



The distance of nearest apex root of adjoining tooth, mandibular borders and mental foramen was assessed. The classification established by Solar et al. was used to assess the anterior loop. This classification divides the anterior loop into three types; Type I: AL not noticeable, and Y-shaped anatomy, Type II: AL is absent,

with T-shaped anatomy, Type III: Noticeable AL with Y-shaped anatomy¹⁰ (Figure 3).

Figure 2: Type I: AL not noticeable, and Y-shaped anatomy, Type II: AL is absent, with T-shaped anatomy, Type III: Noticeable AL with Y-shaped anatomy



RESULTS

The number of CBCT scans used in this study was 160, images of females 76 and 84 males. The mean age was 29.05±13.68 years in females and 30.86±12.35 in the male population.

The most common location where mental foramen was observed was below the second premolar and the second most common location was found to be between the first and the second premolars. The gender distribution according to the types of the MF and anterior loop are given in (Table 1).The mental foramen present on the right side was 67.5% and on the left the percentage was 68.1% (Table 2). In female subjects 51 had Type-I MF on the right side and in 53 females it was observed on the left side. The frequency or number of male subjects with type-I MF on the right side were 57 and on the left the number was 56. In type-ii MF the frequency in females on the right and left side were 13. Male frequency was 12 on the right side and 15 on the left side. In type-iii no case was observed on the right side and there was only one occurrence on the right side in females.

However, in male subjects only one subject showed occurrence on the left side. In type-iv 18 cases of MF were observed in females and 8 were on the left side of the mandible. In the case of male subjects there were 13 occurrences on the right side and 10 on the left side. The Type-v category showed occurrences in 2 cases on the right side and 2 on the left side in males and the frequency was 1 on the right and 2 on the left side for females

Table 1: Gender distribution table and pie charts

Anterior loop left side		
	Female	Male
Type 1	53	51
Type 2	12	17
Type 3	11	16
Anterior loop right side		
Type 1	47	48
Type 2	13	18
Type 3	16	18
Relation to MF (Left side)		
Type 1	53	56
Type 2	13	15
Type 3	0	1
Type 4	8	10
Type 5	2	2
Relation to MF (Right side)		
	51	57
Type 2	13	12
Type 3	1	0
Type 4	10	13
Type 5	1	2

Figure 3: Percentage of anterior loop right side

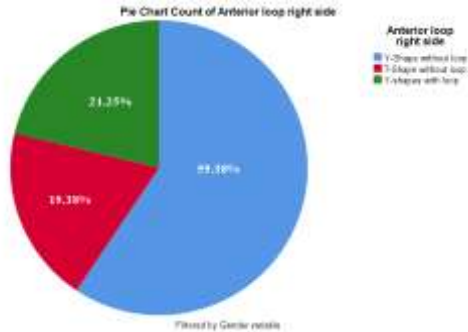


Figure 4: Percentage of anterior loop left side

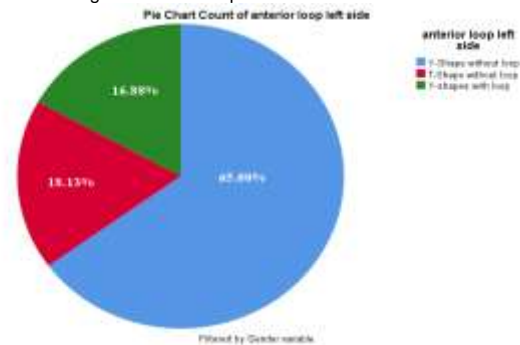


Figure 5: Frequency of Right side mental foramen relation to gender

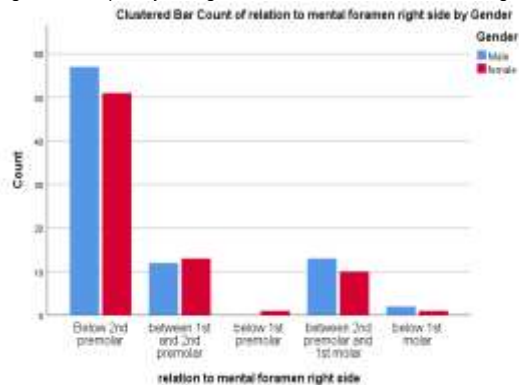


Figure 6: Frequency of Left side mental foramen relation to gender

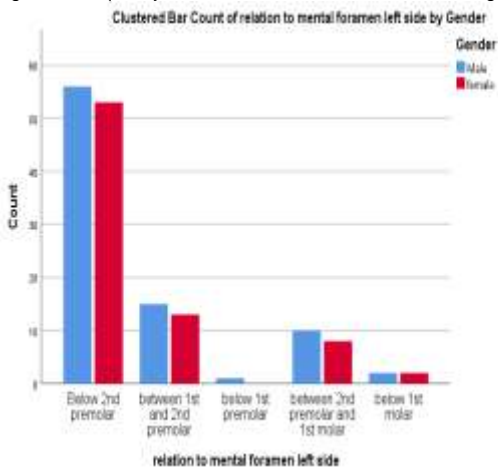


Table 2: Position distribution frequency of the MF.

Position of MF	Right	Left
i. Below the 2nd premolars	67.5%	68.1%
ii. Between the first and second premolars	15.6%	17.5%
iii. Below the 1st premolar	0.6%	0.6%
iv. Between the second premolar and first molar	14.4%	11.3%
v. Below the first molar	1.9%	2.5%

Type-I was found to be the most occurring shape of the anterior loop, where AL is not noticeable with Y shaped anatomy. The AL was present more commonly on the left side 65% compared to the right side which was 59.4% (Table 3).

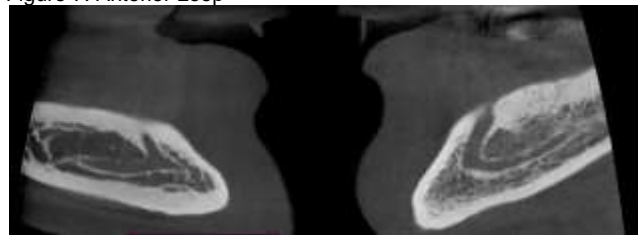
The frequency of type-I category of anterior loop in the right side was n=47 in females and n=48 in males. On the left side in the female population n=53 was observed in females and n=51 in males. In the type-II category AL was observed in females was n=13 on the right side and 17 in males and on the left side n=12 females and n=17 males. In the third category of anterior loop AL was observed in the right side in n=16 females and 18 males and on the left side AL was observed in 11 females and 16 males (Figure 8).

Table 3. Frequency distribution of the anterior loop types.

Anterior loop classification/types	Right Freq	Left freq.
Type I (AL not noticeable, Y shaped, no loop)	59.4%	65%
Type II (AL absent, T-shaped)	19.4%	18.1%
Type III (AL noticeable, Y shaped)	21.3%	16.9%

During the assessment of the location of mental foramen (MF) below the second premolar (type-i), the significant value in both left and right sides was considered as $p < 0.001$. Quantitative analysis of anterior loop (AL) indicates that Type-I (AL not noticeable, Y shaped, no loop) is considered significant if $p < 0.001$. The results were obtained via the Shapiro Wilk normality test. No correlation was found among the incisive canal of the mandibular region and anterior loop position 0.05).

Figure 7: Anterior Loop



DISCUSSION

Dental practitioners face limitations during invasive procedures due to differences in facial structures, positions of mental foramen and anterior loop which are main anatomical landmarks where nerves and arteries are located to prevent any complications. The mental foramen in our study was found to be most commonly present below the second premolar. Mental foramen between the first and second premolars was found to be the second most common position. A study conducted in Saudi Arabia (Alrahabi et al 2018), included 534 patients where 57% had MF present below the second premolar, followed by 25% occurrence of MF between the 1st and 2nd premolars, and the frequency of MF presented in line with the 1st premolar was 3.2%, these results are in accordance with our study with a slight difference in the percentage¹¹. Another study by (Deepthi) observed 63.6% presence of MF below the right

side of the 2nd premolar and 45.4% occurrence on the left side, the second most common location of MF was found to be between the second and first molar, 13.6% and 36.4% on the left.

The third most common 22.8% location was between the first and second premolars on the right, and 18.2% on the left, the results of this study are in accordance with our study as far as the most common occurrence of MF (12). Another study that is similar to our study led by (Komalsheth et al) shows that the most common occurrence of MF is below the second premolar on the right side 62% and on the left side of the mandible 71%. The common location of MF in their study was similar to our study between the first and second premolar on the right side 26% and on the left 14% was observed. However, their observation of the third most common occurrence differs from our study where they found that MF was present below the first premolar on the left 10% and on the right 6%, which is slightly higher than our results¹³.

(Om parakash et al) conducted a research in an Indian population to assess the anatomy of the anterior loop where they found 29% occurrence of type-I anterior loop location in males and 13.4% in females, type-II was found 12.2% in males and 8.8% in female subjects, in males there was 50% observation of type-III and 6.7% in females. These results are in contrast to the results we found in our study¹⁴. A study conducted in a Saudi population by (Alyami et al.) found the occurrence of 59.1% anterior loop type-I in females and 61.7% in males, type-II in 27.5% females and 26.8% in male subjects and type-III 13.4% in females and 11.4% in male subjects¹⁵ which is similar to the results of our research. A study undertaken by (ArzuDemir et al) shows that type-I was least common as 8.6% in left side of the mandible and 10.4% on the right side, type-II was 34.4% found on the left and 29.4% on the right, type-III 58.8% on the left, 60.2% on the right side of the mandible which is completely in contrast to our study¹⁶.

CONCLUSION

High variability in the location of the AL and MF was observed in our study. The use of CBCT imaging to find the location of MF and AL becomes important before any invasive procedure to avoid risk of complications.

Acknowledgments: We would like to thank the respondents for their time in participating in the research study.

Conflicts of Interest: None declared

Ethical approval: Prior to the initiation of the study an ethical approval was obtained from Dow University of Health Sciences, Karachi. Approval no. 2021/544.

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