Assessment of the Mental Foramen Location in a Sample of Fully Dentate Lebanese Adults Using Cone-beam Computed Tomography Technology

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ABSTRACT

Objective: The literature reports that the location of mental foramen shows differences among races. The aim of this study was to assess the mental foramen position in a sample of Lebanese population using cone-beam computed tomography (CBCT) technology. **Materials and methods:** In this study, we investigated CBCT images of 50 fully dentate Lebanese adults (23 males and 27 females). We assessed the horizontal position of the mental foramen in relation with the mandibular premolars in both right and left sides and the vertical position by measuring the distance from the upper border of the foramen to the inferior border of the body of the mandible. The data obtained were statistically analyzed using Chi-square test, and two-sided t-test. Statistical significance was set at $p < 0.05$. **Results:** In our sample, the mental foramen was mostly found in line with the second mandibular premolar in both sides and the mean distance from the superior border of the foramen to the inferior border of the body of the mandible was 13.0120 ± 0.98487 mm on the right and 13.0728 ± 0.96029 mm on the left. **Conclusion:** Within the limits of this study, we concluded that in our sample of Lebanese population, there was substantial variability in the mental foramen location.

Keywords: Cone-beam computed tomography, Lebanese population, mental foramen.

1. INTRODUCTION

The mental foramen (MF) is situated on the anterolateral aspect of the body of the mandible. It represents an exit to blood vessels and to the mental nerve that is a branch of the inferior alveolar nerve, which makes it an important anatomical landmark to be respected during surgical interventions in the region (1-3).

Anatomical variations in the location of the MF have been reported by many authors in different racial groups (2-4). Traditionally, the studies were conducted on dry skulls or using panoramic radiographs. In the last decade, the increased use of CBCT technology offered a high-resolution imaging and, consequently, the best possibility of detecting the three-dimensional location of the MF and make precise, magnification-free measurements (4).

The majority of the positional studies of MF have determined the vertical and horizontal positions of the foramen according to the adjacent teeth. The classification of Tebo and Telford (1950) was mainly used to assess the horizontal locations; it consists of six different positions in relation to the premolar teeth in dentate mandibles: position 1- mesial to the first premolar; position 2- in line with the long axe of the first premolar; position 3- between the first and second premolars; position 4- in line with the long axe of the second premolar; position 5- between the second premolar and the first molar; position 6- distal to the first molar (5).

As for the vertical position of the foramen, only a few studies have evaluated it according to bony landmarks (the superior border of the foramen and the inferior border of the mandible). However, this was mostly done through panoramic radiographs.

With the absence of a concrete study in a three-dimensional radiographic visualization of the MF in Lebanon, the aim of this study was to locate the radiographic position of MF using CBCT technology in a Lebanese sample.

2. MATERIALS AND METHODS

This retrospective study assessed archived CBCT scans of Lebanese adult

		N	Age	Right side		Left Side	
				Location related to inferior premolars	Distance from MF to the lower border of mandible (mm)	Location related to inferior premolars	Distance from MF to the lower border of mandible (mm)
N	Valid	50	50	50	50	50	50
	Missing	0	0	0	0	0	0
Mean			23.46	3.46	13.0120	3.56	13.0728
Median			22.50	4.00	12.9650	4.00	12.9950
Std. Deviation			4.446	0.734	0.98467	0.760	0.96029
Minimum			18	1	11.06	1	11.16
Maximum			34	5	15.76	5	15.59

Table 1. Descriptive statistics of the different variables

patients taken for diagnosis purposes (e.g., before oral surgical procedures mainly the extraction of impacted wisdom teeth and sinus diagnosis) in a specialized maxillofacial surgery center in Beirut, Lebanon. Consents of the patients were obtained after being informed that their images might be anonymously used for research purpose at any later stage. The study got the approval of the Center Scientific Board.

The CBCT scans were acquired using the Kodak CS 9300 Cone Beam 3D System (Carestream Health, Inc., Rochester, NY). Technical parameters ranged between 60–90 kVp and 7–15 mA, with an exposure time of 15 s and field of views (FOVs) compatible with the indications for referral. The principle of "As Low As Reasonably Achievable (ALARA)" was all the time respected.

The inclusion criteria included: (a) age 18 years or older; (b) presence of all fully-erupted permanent teeth on both sides of the mandible and visualization on CBCT image; and (c) absence of any pathological conditions or deformities in the mandible.

Fifty CBCT images of 23 males and 27 females with age ranging from 18 to 34 years met the inclusion criteria and were included in the study.

One oral and maxillofacial radiologist having more than 8 years of experience reviewed the selected images in 3 sessions spaced by a ten-day period.

To avoid errors, the initial investigation was repeated one month later without having in hands the initial results and the mean values were taken into consideration in front of any disagreements.

Each image was evaluated from both sides of the mandible to:

- Assess the horizontal position of the MF using the method suggested by Tebo and Telford (5) (Figure 1).
- Measure the distance from the upper border of MF to the inferior border of the body of the mandible (vertical position) (Figure 2).

For data entry and analysis, the Statistical Package for Social Sciences for Windows version 24 (IBM Corp., Armonk, New York, USA) was used. Descriptive statistics were calculated for each numerical variable. Statistical significance was set at $p < 0.05$, and Chi-square test and Fisher's exact test were used to test statistical significance. A two-sided t-test was used to compare means.

3. RESULTS

Out of the 50 inspected CBCT radiographs, 23 (46%) belonged to males and 27 (54%) to females (a total of 100 MF). The mean patients' age was 23.46 years (SD ± 4.446) (Table 1).

The horizontal location of the MF was found to be most frequently along the vertical axis of the second premolar corresponding to position 4 in both left and right sides. The second most frequent position was between the first and second premolars, in position 3 (Tables 2a and 2b).

Concerning the distance between the superior border of the MF and the inferior border of the body of the mandible, the right-side results had a mean of 13.0120 ± 0.98487 mm, while that of the left side was 13.0728 ± 0.96029 mm. More specifically, males, generally, had a longer distance than females in both sides (Table 3).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1*	1	2.0	2.0	2.0
	2*	2	4.0	4.0	6.0
	3*	18	36.0	36.0	42.0
	4*	26	52.0	52.0	94.0
	5*	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

Table 2 a. Horizontal location of the mental foramen (left horizontal location. 1* = position 1 (mesial to the first premolar); 2* = position 2 (in line with the long axe of the first premolar); 3* = position 3 (between the first and second premolars); 4* = position 4 (in line with the long axe of the second premolar); 5* = position 5 (distal to the second premolar))

Valid	1*	1	2.0	2.0	2.0
	2*	3	6.0	6.0	8.0
	3*	19	38.0	38.0	46.0
	4*	26	52.0	52.0	98.0
	5*	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 2 b. Horizontal location of the mental foramen (right horizontal location)

Gender		Right distance from MF to the lower border of mandible (mm)	Left distance from MF to the lower border of mandible (mm)
M	Mean	13.6848	13.7435
	N	23	23
	Std. Deviation	0.89288	0.85908
F	Mean	12.4389	12.5015
	N	27	27
	Std. Deviation	0.64124	0.61364
Total	Mean	13.0120	13.0728
	N	50	50
	Std. Deviation	0.98467	0.96029

Table 3. Vertical distance from the superior edge of the mental foramen (MF) to the lower border of the body of the mandible (mm).

Value	df	Asymptotic Significance (2-sided)
7.221a	4	0.125
8.071	4	0.089
1.914	1	0.167
50		

Table 4a. Chi-Square Tests for the relation of gender with right horizontal location. No gender difference was shown (p>0.05). a. 6 cells (60.0%) have expected count less than 5. The minimum expected count is 0.46

Value	df	Asymptotic Significance (2-sided)
6.095a	4	0.192
8.374	4	0.079
3.318	1	0.069
50		

Table 4b. Chi-Square Tests for the relation of gender with left horizontal location. No gender difference was shown (p>0.05)

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Right Distance from MF to the lower border of mandible	Equal variances assumed	5.725	48	0.000	1.24589	0.21761	0.80837	1.68342
	Equal variances not assumed	5.578	39.179	0.000	1.24589	0.22336	0.79416	1.69762
Left Distance from MF to the lower border of mandible	Equal variances assumed	5.944	48	0.000	1.24200	0.20894	0.82189	1.66211
	Equal variances not assumed	5.789	39.040	0.000	1.24200	0.21456	0.80803	1.67596

Table 5. t-test for equality of means between male and female measures of vertical distance. A significant difference between genders was shown ($p<0.05$) in both left and right sides.

4. DISCUSSION

In clinical practice, knowledge of the MF position is essential to safely perform oral surgeries by avoiding mental nerve injury. Moreover, good assessment of MF location aids in endodontic, diagnostic, and forensic procedures.

In the literature, the position of the MF was investigated in different ways and populations. Budhiraja et al. **(2)**, Udhaya et al. (6), and Ilayperuma et al. **(7)** evaluated it on dry skulls, while others used different radiographic techniques like panoramic (8-10) and CBCT (3, 11, 12).

In this study conducted on a sample of Lebanese population, we considered the CBCT technology to examine the location of MF.

Horizontal location of MF

In our sample, MF was mostly located below the apex of the second mandibular premolar. Our results appear to be similar to those of studies conducted on Iranian (Afkhami et al. (10) and Khojastepour et al. (11), Saudi Arabian (Al-Mahalawy et al. (12), Sri Lankan (Ilayperuma et al. (7), Chinese (Wang et al. (13), Nigerian (Kekere-Ekun (14), Malays (Ngeow and Yuzawati (15).

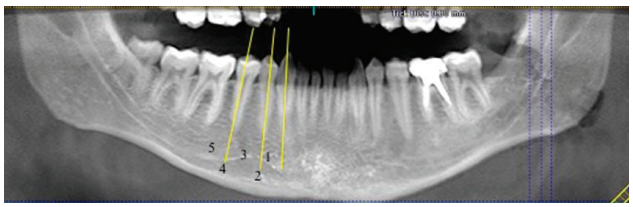

Figure 1. Panoramic reconstruction from a cone-beam computed tomography showing the method used to assess the horizontal position of the mental foramen.

Figure 2. Para-axial cut of a cone-beam computed tomography illustrating the method of measuring the distance between the superior border of the mental foramen and the inferior border of the body of the mandible as considered in our study.

On the other hand, other studies assessing MF location using the same method fall within our second most common position for MF (between the first and second mandibular premolars/ position 3); among others, these were the ones conducted on Caucasian (Fishel et al. (16) and Neiva et al. (17), Jordanian (Al-Khateeb et al. (18), Brazilian (Oliveira Junior et al. (19), and British (Currie et al. (20) and Santini and Land (21).

In our study, when assessing the association gender- horizontal position of MF, it showed a statistically non significant relationship (Tables 4a and 4b). Our findings corroborate many others such as the ones of Sheikhi et al. (3), Al Jasser and Nwoku (22), and Currie et al. (20); this suggests little use of this parameter in clinical implications, notably in forensic gender identification.

Vertical location of MF

Regarding the vertical position of MF, many studies have considered it using the adjacent teeth (16, 23, 24), which are, by our judgment, non stable anatomical landmarks. Nevertheless, some others better assessed the same location in relation to the inferior border of the body of the mandible mostly by using panoramic radiographs (8, 23). According to Apinhasmit et al. (25) a significant difference exists when measuring MF-inferior mandibular border directly on dry skulls (mean=14.33 mm) or using panoramic radiography (mean=16.52 mm). Nowadays, technological improvement of imaging techniques has provided alternatives for detailed and accurate assessments using CBCT.

In our study, we opted for the inferior border of the mandible as a fixed landmark to assess the vertical location of MF and for CBCT technology which provides measurement accuracy superior to panoramic radiography. Our results (13.01 ± 0.98 mm for the right-side and 13.07 ± 0.96 mm for the left) were in accordance with that of Sheikhi et al. (26) who was among the few researchers investigating the vertical position of MF using the same parameters and technique on a sample of Iranian population (13.26 ± 2.34 mm in the right side and 13.37 ± 2.19 mm in the left).

When assessing the association gender - vertical position of MF, it showed a statistically significant relationship (Table 5) corroborating the findings of Sheikhi et al. (26).

Finally, our study aiming to evaluate the position of MF in a Lebanese population is not without limitations. Because of the limited number of CBCT images assessed due to the fully dentate criteria we followed, definite conclusions must be delayed until future research validates our finding.

5. CONCLUSION

Within the limits of this study, we concluded that in our sample of Lebanese population, there was substantial variability in the MF location; consequently, to reduce potential complications during surgical interventions in the region, a CBCT is essential to assess the morphology of the region.

• Competing interests: The authors declare that there is no conflict of interest regarding the publication of this paper.

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