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Descriptive and Morphometrical Analyses of Human Mental Foramen Using CBCT Technique.

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ABSTRACT

The mental foramen (MF) is a bilateral, round or oval hole situated along the buccal cortical plate on the mandibular body's outer surface below the premolars region. A total of 82 patients (164 hemi-mandibular CBCT scans) were randomly selected from different specialized dental centers in Iraq. These cases were obtained during the extended period from September 2023 to March 2024.

The results of this study revealed that for the size of the MF, the mean VD was 3.459 mm in males and 2.995 mm in females. While the mean HD was 3.521 mm in males and 3.126 mm in their female counterparts. The mean MF-AC distance was 15.219 mm in males and 13.202 mm in females. While the mean MF-IBM distance was 12.051 mm in males and 10.757 mm in their female counterparts. For all the parameters, male patients had significantly higher values than female patients. The MF was most frequently round in 105 (64.02%) scans, followed by H-oval in 37 (22.56%) scans. For the H position, H4 (73.17%) was the most common, followed by H3 (15.24%). The most common V position was V3 (90.24%), then V2 (7.32%).

In conclusion, the mean size of the MF and the mean MF-AC and MF-IBM distances were significantly greater in males than females. The MF was most frequently round in 105 (64.02%) scans. The most prevalent H position of the MF was H4. For the V position, V3 was the most frequent

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Declaration of World Medical Association; with its last revision in Edinburgh in 2000.

This study was conducted using CBCT images of 82 patients (164 hemi-mandible) that were randomly selected from different specialized dental centers in Iraq, where the scans were used for various diagnostic objectives with ages ranging from 20 to over 50 years old. These cases were obtained between September 2023 and March 2024. Four age groups were established from the patients (42 males and 40 females), group 1: (20-30) years old, included 23 patients (12 males and 11 females), group 2: (31-40) years old, included 22 patients (10 males and 12 females), group 3: (41-50) years old, included 20 patients (11 males and 9 females), and group 4: over 50 years old, included 17 patients (9 males and 8 females).

The current study included CBCT scans that were performed for different diagnostic reasons, patients with canine and both premolars in the examined hemiarch, high quality scans, and age greater than or equal to 20 years old. The CBCT scans were excluded if there is any pathology, fracture, or impacted teeth near the MF region, and presence of motion artifacts that made images inadequate for thorough evaluation.

On CBCT, the following parameters were evaluated:

1- Diameters and location of the MF: the horizontal diameter (HD) and vertical diameter (VD) of the MF were measured by software's measurement tool in the sagittal view. The distance from the superior margin of the MF to the alveolar crest (AC) and the distance from the inferior margin of the MF to the inferior border of mandible (IBM) were measured in the coronal view (Figure 1).

INTRODUCTION

The mental foramen (MF) is a bilateral, round or oval hole situated along the buccal cortical plate on the mandibular body's outer surface below the premolars region. It is generally a singular entity and represents the anterior limit of the mandibular canal. The terminal branch of the inferior alveolar nerve, which is the mental nerve (MN), and its corresponding vessels are transmitted via the MF [1]. The MN supplies the soft tissues of the lower lip, chin, and gingiva on the same side of the lower jaw with sensory innervation. The MF is a vital anatomical marker during anesthetic nerve blocks, insertion of dental implants, mandibular osteotomy, or repair of the lower lip [2].

The topography of the MF differs across dentate and edentulous individuals; it also shows ethnic differences and even variable on both sides within the same individual. These topographic differences might lead to problems during different surgical operations, which is why an accurate identification of the MF is necessary [3].

Various radiological techniques have been applied to accurately evaluate the MF. The most common imaging technique for diagnosis was the panoramic radiography. However, prior studies have suggested that the magnification effect in this 2-dimensional image could give rise to mistakes in the assessment of true anatomical dimensions. Recently, cone-beam computed tomography (CBCT) has been regarded as the standard imaging modality for the oral and maxillofacial region due to its precision in measuring distance, high resolution, reductions in exposure time, and ability to use in 3-dimensions, which make CBCT a better choice for evaluating fine anatomical features of the jaws [4].

Materials and Methods:

The current study was approved by the Medical Ethics Committee of Tikrit University, College of Medicine (Code IQ.TUCOM.REC.3/7/272). Ethical approval statements were acquired for all participated individuals, depending upon Helsinki

higher than the level of the tips of the FP and SP roots, V2- the position of the MF is at the level of the tips of the FP and SP roots, V3- the position of the MF is lower than the level of the tips of the FP and SP roots.

Data were described, analyzed, and presented using the statistical software for social science (SPSS version -22, Chicago, Illinois, USA). The mean, standard deviation, and statistical parametric tests were determined. Tables and graphs were created, and statistical significance was identified using the independent samples T-test, ANOVA test, and chi square test. A P-value of less than 0.05 was regarded statistically significant.

RESULTS

Diameters and Location of the MF:

In the sagittal view, the MF diameters were evaluated (Table 1). The mean VD was 3.459 mm in males and 2.995 mm in females. While the mean HD was 3.521 mm in males and 3.126 mm in their female counterparts. Male patients had significantly higher values than female patients for both diameters ($P < 0.05$). There was no significant difference between side or age groups.

In the coronal view, the mean MF-AC distance was 15.219 mm in males and 13.202 mm in females. While the mean MF-IBM distance was 12.051 mm in males and 10.757 mm in their female counterparts (Table 1). For both distances, male patients had significantly higher values than female patients. There was no significant difference between side or age groups.

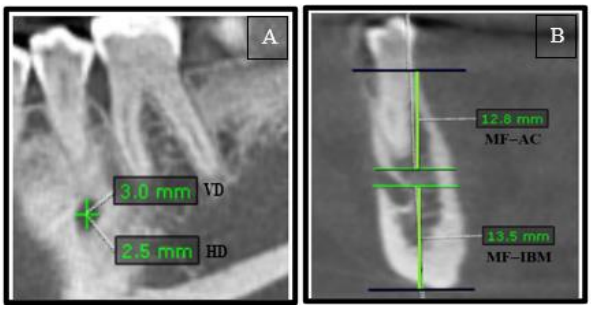

Figure 1: CBCT images. A- The HD and VD of the MF (sagittal view). B- The distance from the superior and inferior margins of the MF to AC and IBM (coronal view).

2- Shape of the MF: after the measurement of each MF's HD and VD was done, the ratio of the two diameters was determined. Then, the shape of the MF was categorized into three forms using the HD:VD ratio [5],[6]: a- oval horizontal or H-oval: when HD:VD was higher than 1.24 mm, b- oval vertical or V-oval: when HD:VD was lower than 0.76 mm, and c- round: when 0.76 mm ≤ HD:VD ≤ 1.24 mm.

3- Horizontal (H) position of the MF: the MF's H relations to the lower teeth in the sagittal view were determined using Tebo and Telford classification [7]: H1- the position of the MF is between two teeth, canine and first premolar (FP), H2- the position of the MF is at the level of FP, H3- the position of the MF is between two teeth, FB and second premolar (SP), H4- the position of the MF is at the level of SP, H5- the position of the MF is between two teeth, SP and first molar, H6- the position of the MF is at the level of the first molar.

4- Vertical (V) position of the MF: three categories of the MF's V positions were identified based on the tips of mandibular FP and SP roots [8]: V1- the position of the MF is

Table 1: Comparison of the HD, VD, AC, and IBM distance to the MF between males and females.

		Male					Female					T	P
		N	Minimum	Maximum	Mean	±SD	N	Minimum	Maximum	Mean	±SD	test	value
Right	HD	42	1.9	4.0	3.476	0.499	40	1.7	3.6	3.135	0.484	3.139	**0.002**
	VD	42	1.5	4.4	3.457	0.664	40	1.7	4.0	2.925	0.459	4.201	**0.000**
	AC	42	12.2	19.2	15.214	1.771	40	10.0	17.2	13.025	1.732	5.656	**0.000**
	IBM	42	8.3	15.9	11.857	1.768	40	9.0	14.8	10.567	1.412	3.638	**0.000**
Left	HD	42	2.0	4.7	3.567	0.533	40	1.6	4.0	3.117	0.573	3.677	**0.000**
	VD	42	1.8	4.3	3.462	0.558	40	1.6	4.0	3.065	0.574	3.173	**0.002**
	AC	42	11.6	20.0	15.224	1.841	40	10.7	18.6	13.380	1.782	4.604	**0.000**
	IBM	42	8.2	15.6	12.246	1.713	40	7.7	16.0	10.948	1.464	3.518	**0.000**

Shape of the MF:

The MF was most frequently rounded on both sides (Table 2). In 105 (64.02%) scans, the MF's shape was round; in 37 (22.56%) scans, it was H-oval; and in 22 (13.41%) scans, it was V-oval. There was no significant difference in the relationship between the MF shape and age, sex, and side ($P > 0.05$).

Horizontal and Vertical Positions of the MF:

In (Table 2) and (Figure 2), the total prevalence of the various H positions is shown. H1 and H6 were not found in the participants in the survey. H4 (73.17%) was the most common H position, followed by H3 (15.24%), H5 (6.71%), and H2 (4.88%), which was the least common. The most common V position was V3 (90.24%), then V2 (7.32%), and V1 (2.44%) (Table 2) and (Figure 3).

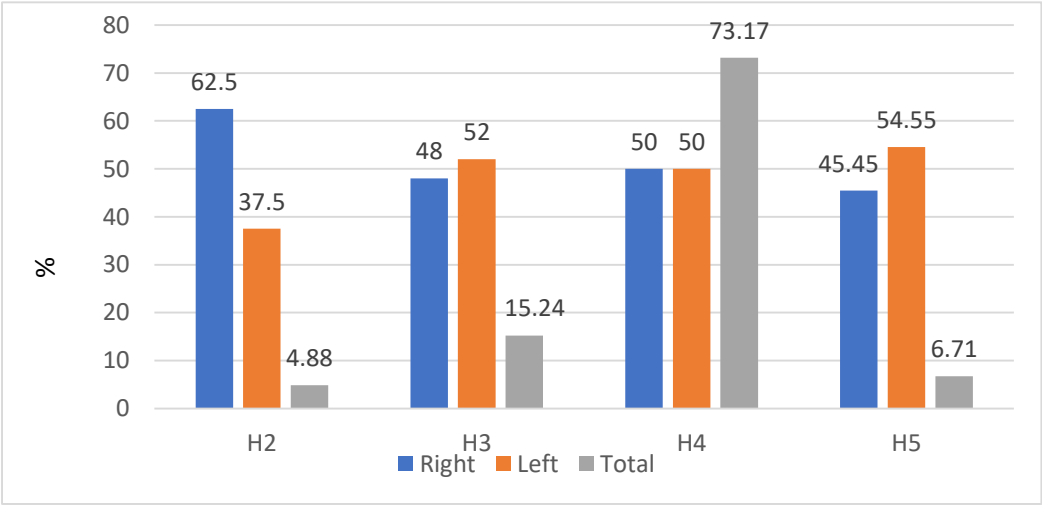

Figure 2: A clustered bar chart shows a comparison of the H position of the MF between right and left sides.

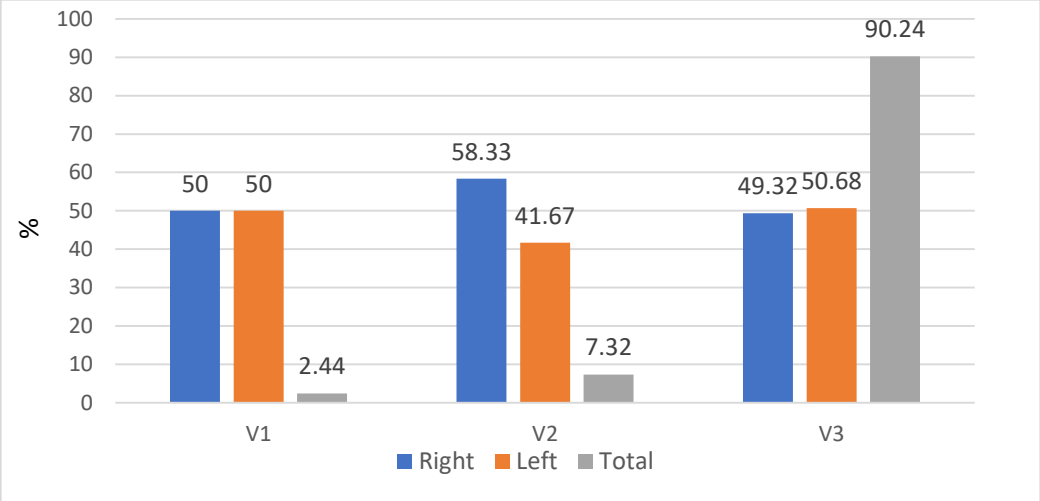

Figure 3: A clustered bar chart shows a comparison of the V position of the MF between right and left sides.

Table 2: Comparison of the shape, H location, and V location of the MF between right and left sides.

		Side				P value	N	%
		Right		Left				
		N.	%	N.	%			
Shape	Round	52	49.52	53	50.48		105	64.02
	H-oval	18	48.65	19	51.35	0.945	37	22.56
	V-oval	12	54.55	10	45.45		22	13.41
H location	H2	5	62.50	3	37.50	0.922	8	4.88
	H3	12	48.00	13	52.00		25	15.24
	H4	60	50.00	60	50.00		120	73.17
	H5	5	45.45	6	54.55		11	6.71
V location	V1	2	50.00	2	50.00	0.910	4	2.44
	V2	7	58.33	5	41.67		12	7.32
	V3	73	49.32	75	50.68		148	90.24

population [12]. This supports the theories about variance in the MF diameters between multiple racial populations.

The mean distance from the MF to AC and IBM was 15.219 mm, 12.051 mm in male patients and 13.202 mm, 10.757 mm in female patients. The present data was lower than the data presented by Abdalla MA [13] and higher than the data presented by Pelé A et al [14]. Since this distance varies greatly, each patient needs to be assessed individually. In this

DISCUSSION

The current study revealed significant gender-based variations in the HD and VD of the MF, with males presented significantly higher values than females. This result agrees with the study conducted with CBCT by Zmyslowska-Polakowska E et al [9]. The current data concerning the MF diameters is in line with Turkish population [10]. The values of the HD and VD seem to be lower than Egyptian population [11], while it was higher than Indian

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Conflict of Interest:
None declared.

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study, both MF to AC and IBM distances were longer in male patients than female patients, a statistically significant finding that agrees with Sheikhi M et al [15] and disagrees with Al-Mahalawy H et al [16] who observed no significant differences in sex. This result can be caused by a limited sample size, as sex differences need to be carefully examined using a large sample size.

In the current study, the MF was most frequently rounded on right and left sides in 105 (64.02%) scans. This data was in line with the data presented by Alam MK et al [17] who investigated into the populations of Jordan and Egypt. However, the Italian population [5] and Indian population [18] had commonly an oval shape.

In present study, H4 (73.17%) was the most frequent H position of the MF, followed by H3. This data is in agreement with Kurdish population [19], Spanish population [20], and Brazilian population [21]. However, H3 was the most frequent, followed by H4 in other studies, as in Indian population [22], and British population [23].

For the V position of the MF, the most frequent position was V3 (90.24%), which is in agreement with Saudi population [24], Nigerian population [25]. The variation in the MF's position may be caused by genetic characteristics in different racial groups or is linked to feeding habits that may influence mandibular development.

Conclusions:

The mean size of the MF and the mean MF-AC and MF-IBM distances were significantly greater in males than their female counterparts. Age and side had no significant influence on the measured parameters. The MF was most frequently round in 105 (64.02%) scans, followed by H-oval in 37 (22.56%) scans. The most prevalent H position of the MF was H4 which is at the level of the SP. For the V position, V3 was the most frequent position which is lower than the level of the tips of the FP and SP roots.

Acknowledgments:

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