Original Article

ANATOLIAN CURRENT MEDICAL

DOI: 10.38053/acmj.1614898

Anatolian Curr Med J. 2025;7(2):132-139

Morphometric and morphologic analysis of the mental foramen using cone beam computed tomography

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Cite this article as: Kotanlı S, Doğan MS, Yavuz Y, Kotanlı MV, Çelik N, Bingül MB. Morphometric and morphologic analysis of the mental foramen using cone beam computed tomography. *Anatolian Curr Med J.* 2025;7(2):132-139.

Received: 07.01.2025 ◆ **Accepted**: 27.01.2025 ◆ **Published**: 21.03.2025

ABSTRACT

Aims: It is critical to know the localization, anatomy and dimensions of mental foramen (MF) to avoid nerve damage during surgical procedures in the mandibular anterior region and to ensure complete local anesthesia for dental procedures. The aim of our study was to retrospectively evaluate the morphological and morphometric features of MF using cone-beam computed tomography (CBCT) and to contribute to the existing data.

Methods: In our study, the location of the MF, its horizontal diameter, its vertical diameter, the distance of the MF to the alveolar crest, the distance to the lower border of the mandible, the distance to the apex of the adjacent tooth and the distance to the midline were evaluated in the CBCT images of 500 patients between the ages of 18-65. In addition, the types of exit of the mental nerve from the MF were examined. Pearson Chi-square test was used to analyze categorical variables. Normally distributed characteristics were compared using the student t test.

Results: In our study, CBCT images of 500 cases, 250 (50%) of which were male and 250 (50%) of which were female were examined (mean age: 37.12±11.91). No significant relationship was found between MF location and gender ($p>0.05$). In the right mandibular region, a statistically significant difference was found between the vertical and horizontal diameters of the MF (higher in males), the distance to the alveolar crest (higher in males), the distance of the MF to the lower border of the mandible (higher in males), the distance to the midline (higher in males) and gender ($p<0.05$). No statistically significant relationship was found between MF exit types and gender in the right and left mandibular regions ($p>0.05$).

Conclusion: It is important to examine the localization, size and distance of MF to neighboring anatomical structures, the presence and dimensions of alveolar loop (AL) with CBCT before procedures with high risk of complications in the interforaminal region.

Keywords: Mental foramen, alveolar loop, CBCT

INTRODUCTION

Anterior mandibular region has been considered a safe area for many years, but with the widespread use of implant surgery in the interforaminal region, which has been considered a safe area for many years, more detailed morphometric analysis of the anatomical formations and variations in this region is needed.[1] The mandibular canal origins from the mandibular foramen on the medial surface of the ramus and courses anteriorly, then ends at the mental foramen (MF) on the vestibule surface of the premolar region.[1,2] Knowing the localization, anatomy and dimensions of MF is critical to avoid nerve damage during surgical procedures in the relevant region and to successfully perform local anesthesia for dental procedures.[1,3] The location of MF on the jaw varies according to race and gender.[4] Horizontal and vertical diameters of MF have been measured in various studies.[1,5-8] In studies conducted with cone beam computed tomography (CBCT), the horizontal diameter of MF was reported to be between 3.2-4.08 mm and the vertical diameter was reported to be between 3-3.45 mm.[5,7]

Mental nerve, which is a branch of the inferior alveolar nerve; at the terminal end of the mandibular canal, it continues its course in different ways as it exits the MF.[9,10] After the mental nerve leaves the MF, it distributes in the chin and lip region in the form of horizontal, vertical, alveolar loop (AL) exit types and provides innervation to the surrounding tissue.[2,9] In the

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AL type, the mental canal leaves the MF by bending upwards and backwards.[11] The incidence of AL has been found to be between 7% and 93.57% in the literature.[9,12,13] Another important issue to consider in patients in whom AL is detected is AL lengths. In literature anterior extension of AL has been reported to be 0.11-11 mm, and its caudal extension to be 2.68-11.27 mm.[9,13,14]

The diagnostic method to be chosen is important for correct diagnosis and treatment. Panoramic radiographs, which are routinely used in dentistry, have disadvantages such as providing evaluation in only two dimensions, creating magnifications in the image, and not being able to prevent superpositions.[1,7] The disadvantages of traditional projections have been eliminated with the use of computerized tomography (CT) devices that provide three-dimensional imaging in dentistry. However, the use of CT devices in dentistry has been limited due to features such as high radiation dose, cost and long time to obtain images. Cone beam computed tomography (CBCT) provides three-dimensional data acquisition in a single rotation and with a very low radiation dose.[15] CBCT, which provides images to be obtained more quickly with lower radiation dose and lower cost compared to CT, is especially useful in evaluating bones because it has high resolution.[14,15]

In our study, the location, dimensions and distance of MF to adjacent anatomical structures were evaluated with CBCT. Additionally, the exit types of the mental artery from MF were examined. The purpose of our study is to retrospectively investigate the morphological and morphometric features of MF with CBCT and to contribute to the existing data.

METHODS

This research was conducted with the approval of the Harran University Faculty of Dentistry Ethics Committee (Date: 07.02.2022, Decision No: 22/03/23). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. In our study, the morphological and morphometric features of MF were retrospectively examined in CBCT images of cases aged 18 and over who applied to the Department of Dentomaxillofacial Radiology of Harran University Faculty of Dentistry in 2023 for various reasons.

G power 3.1 was used for power analysis. When $\alpha=0.05$ and $1-\beta=0.90$ were accepted, the sample size was found to be 375. In our study, CBCT images of 500 cases between the ages of 18-65 were analyzed. Images of patients aged 18 and over who did not have any defects, lesions or pathologies in the anterior mandibular region, did not have a jaw fracture, did not undergo any surgical procedure, and did not have a systemic or genetic disease that would affect the jaw bones were included in the study. Low-resolution images with patient- or device-related artifacts that prevented the examination of anatomical structures in the relevant region were excluded from the study. Images were examined and evaluated in multiplanar (axial, sagittal, coronal) planes and their variations were analyzed morphologically and morphometrically.

In our study, it used blocked randomization to ensure that the groups being compared were of equal size and to increase the power of the statistical procedure to reject the null hypothesis, in resulting randomly selected 250 female and 250 male patients. CBCT images were obtained with the Castellini X-Radius Trio Plus CBCT device (imola, ITALY) using irradiation parameters of 16 mAs and 90 kVp. CBCT images size of 0.3 mm and a field of view (FOV) of 13x16 cm were created reconstruction images with slice thickness of 1 mm using the IRYS viewer 15.1 software program. The reconstruction algorithm used was "filtered back projection" because it is simple and can be quickly implemented on modern computers. In this technique, each projection was processed with filtering to reduce high-frequency noise and to highlight the edges of objects. The filtered projections were projected back into the original image space, thus obtaining a complete cross-sectional image. In this way, cross-sectional images of the object were created using projection data taken from different angles. All images were examined by a single observer and evaluated on a full HD display with a maximum screen resolution of 1920x1080 and a screen size of 15.6 inches. Multiplanar reconstructions ensured to depict the anatomic structures in flattened curved or linear transaxial planes, enable linear measurements in images. In this way, it was possible to ensure consistency and repeatability, especially of millimetric measurements.

MF location, horizontal diameter, vertical diameter, distance of MF to the alveolar crest, distance to the lower border of the mandible, distance to the adjacent tooth apex and distance to the midline were evaluated. MF is divided into six separate groups according to its location:

Location 1: Situated anterior to the 1. premolar

Location 2: In level with the 1. premolar

Location 3: Between the 1. and 2. premolars

Location 4: In level with 2. premolar

Location 5: Between 2. premolar and 1. molar

Location 6: In level with 1. molar (**Figure 1**).

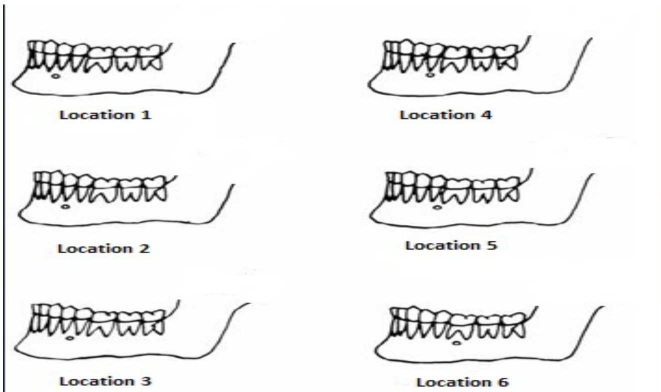

Figure 1. MF location tipes: location 1 (situated anterior to the first premolar), location 2 (in line with the first premolar), location 3 (between the first and second premolars), location 4 (in line with second premolar), location 5 (between second premolar and first molar), location 6 (in line with first molar)

The different exit types of the mental canal as it exits the bone from the MF were examined in sagittal, axial and coronal planes. These output types are divided into three groups: horizontal, vertical and AL (**Figure 2**). In images where AL was detected, anterior alveolar loop (aAL) length and caudal alveolar loop (cAL) length were measured.

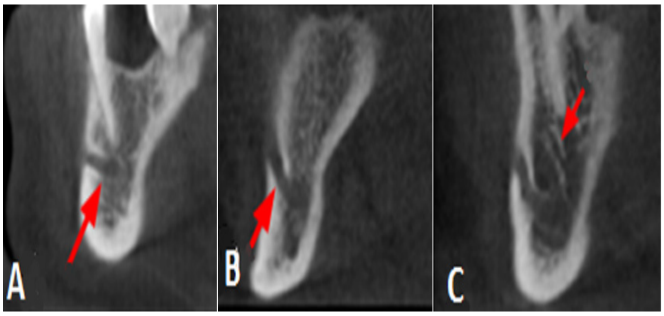

Figure 2. MF output types; horizontal (**A**), vertical (**B**), anterior loop (**C**)

Statistical Analysis

The Kolmogorov-Smirnov test was used to test whether the data were normally distributed. Normally distributed characteristics were compared using the student t test. Pearson Chi-square test was used to analyze categorical variables. To investigate intraobserver agreement, approximately 20% of the total number of patients (n: 100) were remeasured at two-week intervals and an intraclass correlation test was applied. In our study, the statistical confidence level was found to be high (0.87). Statistical analysis was performed using SPSS Windows version 23.0 package program and $p<0.05$ was considered statistically significant.

RESULTS

CBCT images of 500 cases between the ages of 18-65 were examined and it was determined that 250 (50%) of the cases were females, 250 (50%) were male and the average age was 37.12±11.91.

The relationship between MF localization in the right and left mandibular region and gender is shown in Table 1. MF localization in the right region was most frequently observed at the line of the 2. premolar teeth in male, and in the region between the 1. and 2. premolar teeth in females. MF localization in the left region was most frequently detected between the 1. and 2. premolar teeth in males and females. No significant relationship was observed between MF localization in the right and left mandibular regions and gender ($p>0.05$).

Table 2 shows the comparison of the horizontal diameter, vertical diameter of the MF, the distance of the MF to the alveolar crest, the distance to the lower border of the mandible, the distance to the adjacent tooth apex, and the distance to the mandibular midline according to gender.

Table 2. Comparison of the horizontal and vertical diameters of the MF, the distances of the MF to the alveolar crest, the lower border of the mandible, the apex of the adjacent teeth and the mandibular midline according to gender

	Male mean±SD	Female mean±SD	Total mean±SD	p
Right				
Horizontal diameter (mm)	3.12±0.86	2.81±0.87	2.92±0.91	0.046*
Vertical diameter (mm)	2.87±0.82	2.39±0.59	2.61±0.68	0.001*
MF-alveolar crest (mm)	13.45±2.89	12.37±2.43	12.91±2.72	0.035*
MF-lower border of the mandible (mm)	13.91±2.01	12.08±1.53	12.97±1.97	0.001*
MF-adjacent tooth apex (mm)	4.09±2.49	3.48±1.74	3.87±2.62	0.328
MF-mandibular midline (mm)	26.12±2.01	24.93±2.87	25.51±2.72	0.001*
Left				
Horizontal diameter (mm)	3.11±0.80	2.91±0.86	2.99±0.87	0.210
Vertical diameter (mm)	2.80±0.77	2.15±0.72	2.52±0.78	0.001*
MF-alveolar crest (mm)	13.25±3.11	12.78±2.71	12.94±2.67	0.204
MF-lower border of the mandible (mm)	13.71±1.62	11.57±1.53	12.83±1.64	0.001*
MF-adjacent tooth apex (mm)	4.04±2.01	3.69±1.57	3.89±2.11	0.362
MF-mandibular midline (mm)	24.38±2.05	24.01±1.91	24.23±1.95	0.128

MF: Mental foramen, SD: Standart deviation

The horizontal diameter of MF in the right mandibular region was found to be higher in males (3.12±0.86 mm) than in females (2.81±0.87) ($p=0.046$). The horizontal diameter of MF in the left mandibular region was found to be 3.11±0.80 mm in males and 2.91±0.86 mm in females ($p=0.210$). The mean vertical diameter of MF in the right mandibular region was calculated to be higher in males (2.87±0.82 mm) than in females (2.39±0.59 mm) ($p=0.001$). The mean vertical diameter of MF on the left side was found to be higher in males (2.80±0.77 mm) than in females (2.15±0.72 mm) ($p=0.001$).

Table 1. Location of MF on the right and left sides according to gender

	Male n (%)	Female n (%)	Total n (%)	p
Right				
Situated anterior to the first premolar	0 (0%)	0 (0%)	0 (0%)	0.812
In line with the first premolar	8 (44.4%)	10 (55.6%)	18 (100%)	
Between the first and second premolars.	94 (45%)	115 (55%)	209 (100%)	
In line with second premolar	114 (55.1%)	93 (44.9%)	207 (100%)	
Between second premolar and first molar	34 (51.5%)	32 (48.5%)	66 (100%)	
In line with first molar	0 (0%)	0 (0%)	0 (0%)	
Left				
Situated anterior to the first premolar	0 (0%)	0 (0%)	0 (0%)	0.894
In line with the first premolar	10 (62.5%)	6 (37.5%)	16 (100%)	
Between the first and second premolars.	118 (47.4%)	131 (52.6%)	249 (100%)	
In line with second premolar	101 (51.8%)	94 (48.2%)	195 (100%)	
Between second premolar and first molar	21 (56.8%)	16 (43.2%)	37 (100%)	
In line with first molar	0 (0%)	0 (0%)	0 (0%)	

MF: Mental foramen

The average distance of the MF to the alveolar crest was determined to be 13.45±2.89 mm in males and 12.37±2.43 mm in females in the right mandibular region (p=0.035). The average distance of the MF in the left mandibular region to the alveolar crest was reported as 13.25±3.11 mm in males and 12.78±2.71 mm in females (p=0.204).

In the right mandible, the distance of the MF to the lower border of the mandible was measured to be greater in males (13.91±1.01 mm) than in females (12.08±1.53 mm) (p=0.001). The average distance of the MF on the left side to the lower border of the mandible was calculated as 13.71±1.62 mm in males and 11.57±1.53 mm in females (p=0.001).

The average distance of the MF to the adjacent tooth apex was measured as 4.09±2.49 mm in males and 3.48±1.74 mm in females in the right mandibular region (p=0.328). In the left mandibular region, the distance of the MF to the adjacent tooth apex was reported as 4.04±2.01 mm in males and 3.69±1.57 mm in females (p=0.362).

The distance of the MF to the mandibular midline was measured higher on the right side in males (26.12±2.01 mm) than in females (24.93±2.87 mm) (p=0.001). The average distance of the MF in the left mandibular region to the mandibular midline was determined as 24.38±2.05 mm in males and 24.01±1.91 mm in females (p=0.128).

Comparison of MF exit types in the right and left mandibular region according to gender is shown in **Table 3**. AL type was detected in 125 (25.0%) of 500 cases. Of these, 86 (68.8%) were unilateral and 39 (31.2%) were bilateral. No statistically significant relationship was found between MF outlet types and gender in the right and left mandibular regions (p>0.05). Of the ALs observed in the right mandibular region, 51 were detected in males and 42 in females and in the left mandibular region, 34 were observed in males and 37 in females.

Table 3. Comparison of MF exit types in the right and left mandibular regions according to gender

	Male n (%)	Female n (%)	Total n (%)	p
Right				
Horizontal	77 (55.4%)	62 (44.6%)	139 (100.0%)	0.481
Vertical	122 (45.5%)	146 (54.5%)	268 (100.0%)	0.143
Alveolar loop	51 (54.8%)	42 (45.2%)	93 (100.0%)	0.395
Left				
Horizontal	81 (52.9%)	72 (47.1%)	153 (100.0%)	0.798
Vertical	135 (48.9%)	141 (51.1%)	276 (100.0%)	0.833
Alveolar loop	34 (47.9%)	37 (52.1%)	71 (100.0%)	0.912

MF: Mental foramen

Table 4 shows the comparison of the anterior and caudal extensions of the AL in the right and left mandibular regions according to gender. According to the measurements, the average cAL length in the right mandibular region was calculated as 3.82±1.03 mm in males and 3.65±1.40 mm in females (p=0.648). The average cAL length measurements in the left mandibular region were 3.64±0.93mm in males and 3.49±1.03mm in females (p=0.705). The average aAL length measurements on the right side were calculated as 2.75±0.81 mm in males and 3.43±1.29 mm in females (p=0.379). On the left side, the average aAL length was measured as 3.01±0.64 mm in males and 3.28±0.96 mm in females (p=0.559).

Tablo 4. Comparison of anterior and caudal extensions of AL in the right and left mandibular regions according to gender

	Male mean±SD	Female mean±SD	Total mean±SD	p
Right				
cAL (mm)	3.82±1.03	3.65±1.40	3.77±1.21	0.648
aAL (mm)	2.75±0.81	3.43±1.29	3.56±1.19	0.379
Left				
cAL (mm)	3.64±0.93	3.49±1.03	3.55±1.46	0.705
aAL (mm)	3.01±0.64	3.28±0.96	3.31±0.97	0.559

AL: Alveolar loop, SD: Standart deviation, cAL: Caudal extension of anterior loop, aAL: Anterior extension of anterior loop

DISCUSSION

Before surgical procedures involving the MF, it is of great importance to know the structures and variations of this region. Examining the location, size and distance of the MF before interventional applications in the region is important in order to prevent complications such as permanent or temporary loss of sensation, bleeding or severe pain that may arise during the procedure.[2,3,16]

There are various skull, panoramic, CBCT and magnetic resonance imaging (MRI)-based studies in the literature regarding MF localization, dimensions and distance to surrounding tissues.[1,17-23] Studies have reported that CBCT is more successful than panoramic radiography in measuring the localization, dimensions and distance of MF to surrounding anatomical structures and allows more accurate measurements.[1,7] With panoramic radiographs that provide imaging in two dimensions, small-sized MFs can be overlooked or incorrect measurements can be made. Unreliable measurements can be made as a result of artifacts such as magnification and superposition in panoramic radiographs that are not positioned in the optimum position. More accurate measurements can be obtained in CBCT studies due to the elimination of such artifacts and the acquisition of three-dimensional data.[7,22,23]

While there are studies in the literature reporting that MF localization is most common among the premolar teeth,[1,4,6,7] there are also studies that detect MF most frequently at the line of the 2. premolar teeth.[2,18,24,25] In the 500 CBCT images examined in our study, MF was most frequently detected between the 1. and 2. premolar teeth in the right and left mandibular regions, and second most frequently at the level of the 2. premolar tooth. When MF localization was examined by gender, no significant difference was detected. It is thought that ethnic changes may cause differences in MF localization.[2,4,26,27] Santini and Alayan[27] evaluated MF localization in a total of 155 Chinese, European and Indian skulls in their anthropometric study. While MF was most frequently observed between the premolar teeth in European and Indian samples, it was most frequently detected at the 2. premolar tooth level in Chinese samples. In studies evaluating the Arab population, MF was most frequently reported at the 2. premolar tooth level.[2,28,29] Kalender et al.[7] evaluated MF localization using CBCT in the Turkish population and Gungor et al.[1] obtained a result consistent with our study and reported MF most frequently between premolar teeth.

Kalender et al.[7] in their study examining the Turkish population using CBCT, found the average vertical diameter to be 3.7±0.7 mm and the horizontal diameter to be 3.4±0.8 mm. Ertuğrul et al.[21] reported the mean vertical diameter as 2.78 mm and horizontal diameter as 2.95 mm. In their morphometric head analysis, Neiva et al.[17] the horizontal diameter was 3.59 mm and the vertical diameter was 3.47 mm, Apinhasmit et al.[30] calculated the average horizontal diameter as 2.80±0.70 mm, Oğuz and Bozkır[20] calculated the horizontal diameter as 2.98 mm on the right mandibular region, 3.14 mm in the left mandibular region, and the vertical diameter as 2.38 mm on the right side and 2.64 mm on the left side. Elmansori et al.[26] They determined the vertical diameter on the right side as 3.15±0.78 mm and the horizontal diameter as 3.45±1.08 mm, and on the left side the vertical diameter as 3.46±0.86 mm and the horizontal diameter as 3.85±1.27 mm.

Caglayan et al.[31] calculated the right vertical diameter as 3.29±0.6 mm, the vertical diameter as 3.36±0.9 mm, the right horizontal diameter as 3.83±0.99 mm, and the left horizontal diameter as 3.8±1.01 mm. In our study, the horizontal diameter of the MF was measured as 2.92±0.91 mm in the right mandibular region and 2.99±0.87 mm in the left mandibular region. The vertical diameter of the MF was determined as 2.61±0.68 mm on the right side and 2.52±0.78 mm on the left side. The reason for these different results between studies is that anatomical structures may differ from region to region and from person to person. In addition, different results can be obtained because the number of data evaluated in the studies and the device and technique used may also vary.

In our study, when the horizontal and vertical lengths of the MF were compared between genders in the right and left mandibular regions, they were reported to be higher in males than in females, consistent with previous studies.[2,6,7,26,30]

Gungor et al.[1] in their study measured the distance to the alveolar crest as 13.36±2.84 mm on the right side and 13.22±2.76 mm on the left side. Caglayan et al.[31] determined the distance to the alveolar crest as 11.86±2.75 mm on the right side and 12.08±3.12 mm on the left side. Udhaya et al.[18] also stated that the distance measurements to the alveolar crest in the right and left mandibular regions were 12.02±2.48 mm and 12.21±2.61 mm, respectively. Singh et al.[8] calculated this distance as 17.82±1.87 mm and 17.91±1.16 mm on the right and left sides, respectively. Haktanir et al.[32] reported the average distance to the alveolar crest as 14.2 mm in their multidetector CT study. In our study, the average distance of the upper border of the MF to the alveolar crest was found to be 12.91±2.72 mm in the right mandibular region and 12.94±2.67 mm in the left mandibular region. When the results of our study are similar to the some studies in the literature,[18,31] but there are differences between them.[1,8] This may be because the alveolar crest region does not have a stable structure and is heavily affected by bone resorptions.[7,12]

When the average distance of the MF to the alveolar crest is evaluated according to gender; On the right side, it was found to be higher in males (13.45±2.89 mm) than in females (12.37±2.43 mm). On the left side, no significant difference was found between genders in the distance of the MF to the alveolar crest. However, higher measurements were obtained in males than in females on both sides. There are studies in the literature where the distance to the alveolar crest is found to be higher in males.[1,7,31,32] Since the mandible is smaller in females, it is an expected result that the distance to the alveolar crest is also smaller.[7,26] Additionally, metabolic diseases such as osteoporosis are more common in females and can cause increased crest resorption.[33]

In morphometric skull analysis, Neiva et al.[17] the distance to the lower border of the mandible was 12 mm on average, Apihasmit et al.[30] this value; They found the average length to be 15.40±1.73 mm in males and 13.89±1.40 mm in females. In CBCT-based studies conducted in the Turkish population, the distance to the lower border of the mandible; Gungor et al.[1], 12.75±2.19 mm on the right side, 12.65±1.88 mm on the left, Çağlayan et al.[31] reported it as 12.86±1.55 mm on the right and 13.13±1.89 mm on the left. In our study, the distance of the MF to the lower border of the mandible was evaluated according to the lower border of the MF, and the average was calculated as 12.97±1.97 mm on the right side and 12.83±1.64 mm on the left side.

In our study, the distance between the lower border of the MF and the lower border of the mandible was calculated to be higher in males than in females on the right and left sides. In the literature, higher measurements were found in males compared to females in terms of distances.[6,7,30,31]

Al-Mahalawy et al.[34] found the average distance between the MF and the adjacent tooth apex to be 3.1 mm in their study. Von Arx et al.[6] found the distance to the adjacent tooth apex to be higher than 5 mm. Kalender et al.[7] found the average distance to the adjacent tooth apex as 4.2±2.4 mm in their study. In our study, the average distance of the MF to the adjacent tooth apex was measured as 3.87±2.62 mm on the right and 3.89±2.11 mm on the left. Since anatomical structures may vary from region to region and from person to person, it is thought that these in studies differences can be considered normal in various ethnic groups.

In the literature, the distance of MF from the mandibular midline is; Neiva et al.[17] 27.61±2.29 mm, Apinhasmit et al.[30] 28.52±2.52 mm and Udhaya et al.[18] also calculated it as 25.79±1.78 mm in the right mandibular region and 25.29±2.29 mm in the left mandibular region. Haktanır et al.[32] reported this value as an average of 24.9±2.1 mm in their CT-based study. Singh et al.[8] found this distance to be 28.87±1.45 mm on the right side and 28.38±1.44 mm on the left side. In our study conducted with CBCT, this value was found to be 25.51±2.72 mm on the right side and 24.23±1.95 mm on the left side. Our findings regarding the distance of the MF to the midline of the mandible are in line with the results of Udhaya et al.[18] and Haktanır et al.[32], while the study by Singh et al.[8], the study by Neiva et al.[17] and the study by Apinhasmit et al.[30] showed a difference. Anatomical structures may vary depending on different populations, the number of data, and the device and technique used. In addition, one reason for these differences may be that different evaluations were made in different axial sections of CBCT images.

The average distance of the MF from the midline of the mandible was calculated to be higher in males than in females.

It can be said that the reason for this is that the mandible in males is larger than in females. In statistical evaluation, a significant difference between genders was observed for the right side, while no significant difference was found for the left side. It is possible that a significant difference will be shown for the left side as the number of data increases.

More studies have been conducted on the AL exit type, which is clinically more important and is formed by the mental nerve bending upwards and backwards, compared to other types.[9,11,12,14] There are studies aimed at detecting the clinically important AL exit type and knowing its dimensions before implant applications or other surgical procedures such as apical resection.[11,14,35] AL studies in the literature include macroscopic cadaveric examinations, conventional radiography, and advanced imaging techniques such as CT and CBCT.[11-14,36] In these studies, the prevalence of AL has been reported in a wide range, between 7% and 93.57%.[17,37,38] Soman et al.[9] They reported the prevalence of AL in the Saudi population as 4.24%. Rodricks et al.[39] They reported this rate as 57.5% in the Indian population. Shahman et al.[12] found the prevalence of AL to be 28.5% in their study in the Turkish population. AL exit type was found in 125 (25.0%) of 500 CBCT images evaluated in our study. Of the detected ALs, 86 (68.8%) were unilateral and 39 (31.2%) were bilateral. In our study, the prevalence of AL was calculated to be higher in males on the right side and higher in females on the left side. However, this difference was not found to be statistically significant. Studies have generally reported that the prevalence of AL is higher in males than in females, even if it is not statistically significant.[11,14,39,40]

The reason why the prevalence of AL is observed in such wide ranges as a result of studies in the literature may be ethnic differences, the number of data used in studies, and different imaging methods used. When the techniques used in these studies are evaluated, it is accepted that anatomical macroscopic examinations and CT/CBCT studies reflect measurements more accurately than conventional imaging techniques such as panoramic and periapical.[9,41] Uchida et al.[11] compared anatomical measurements with CBCT measurements in their study and found similar values in the results, except for minor differences.

In the literature, the average aAL length has been reported to be between 0.15 and 11 mm, while the average cAL length has been reported to be between 7.8 and 15.1 mm.[9,12,17,39,42] In our study, aAL measurements were calculated as 3.56±1.19 mm on the right side and 3.31±0.97 mm on the left side. In our study, cAL measurements were found to be 3.77±1.21 mm on the right side and 3.55±1.46 mm on the left side. In comparison between genders, cAL length in the right and left mandibular regions was found to be higher in men, and aAL length in females. In other studies in the literature, aAL was generally calculated to be higher in males than in females.[11,12,35,42] The reason why these results do not correlate with the literature may be the variety of devices used, different measurement methods and the number of data, in addition to the fact that studies were conducted in different populations. In addition, the fact that this study was single-centered, there was no ethnic diversity, and the measurements were made by a single observer may be the reasons for the significant difference in cAL length.

In the presence of AL in the interforaminal region, the main issue is that implants placed mesial to the MF may cause various complications if the AL dimensions are not taken into consideration.[9,11,39] To prevent possible complications, different researchers have recommended various distances (between 1 mm and 6 mm) that should be left between the distal surface of the implant and the mesial border of the MF.[43] Considering that TAL may have various sizes, instead of determining a standard distance in order to prevent complications, evaluating the presence and dimensions of AL in multiplanar sections with pre-implant CBCT application will be effective in treatment planning.

Since CBCT is insufficient in diagnosing the contents of the anatomical structures in the anterior mandible region, we think that detecting the neurovascular tissues in this region and evaluating them with MR imaging in cases where they need to be analyzed in more detail will increase the success before interventional procedures.[44] Another limitation of our study is that since it is single-centered, the measurements represent a local region. In future studies, studies involving many centers can be planned.

CONCLUSION

It is important to know the localization, size and distance of the MF before treatments such as regional anesthesia, root canal treatment, implant surgery, periodontal surgery, osteotomy, genioplasty and apical resection applied to the lower jaw. In order to prevent complications that may occur in the presence of AL, the presence and size of AL must be evaluated with CBCT before each operation. Using CBCT images instead of standard panoramic radiographs before procedures with high risk of complications will help to clearly monitor the area and make correct treatment planning.

ETHICAL DECLARATIONS

Ethics Committee Approval

This research was conducted with the approval of the Harran University Faculty of Dentistry Ethics Committee (Date: 07.02.2022, Decision No: 22/03/23).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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