Prevalence and Anatomical Characteristics of the Accessory Mental Foramen in a selected Jordanian population, Using Cone-Beam Computed Tomography

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ABSTRACT

Objectives: The present study seeks to evaluate the prevalence and the anatomical characteristics of the accessory mental foramen (AMF), which is occasionally traced to the main mental foramen, using cone-beam computed tomography (CBCT).

Methods: All 324 CBCT images, which were taken of patients from 2019 to 2021 in Queen Alia Military Hospital, were examined. The frequency of the accessory mental foramen was calculated, and the anatomical characteristics were described for 304 images that met the inclusion criteria.

Results: Accessory mental foramen (AMFs) were observed in 8.89% of patients and in 4.61% of all hemimandibles examined. They are significantly more common in males ($p = 0.016$), but there was no statistically significant difference between the appearance of AMFs and the side of the hemimandible. Most AMFs were located either anterosuperior (25%) or posteroinferior (25%) to the main mental foramen.

Conclusion: This study presents a considerable frequency of AMFs in the Jordanian population. The alertness of clinicians about AMFs is important for avoiding mental nerve damage during mandibular surgeries. CBCT can be used to detect AMFs by producing 3D images that allow a comprehensive evaluation of the anatomy of the chosen region.

Keywords: Accessory mental foramen; cone-beam computed tomography; periapical surgery; mandible.

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Introduction

The mental foramen (MF) is located on the anterolateral aspect of the mandible, 13–15 mm superior to the inferior border of the mandibular body. The direction of the opening of the MF is outward and upward in a posterior orientation (3). The mental nerve branches while it exits from the MF, and innervates the skin of the mental and lower lip region. The buccal mucous membranes and the buccal gingiva from the lower midline to the second premolar region are also innervated by the mental nerve (5).

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The position of the mental foramen is used as a reference point in anesthetic techniques, such as the incisive/mental nerve block. In dental practice, the importance of this structure is mainly related to the positioning of dental implants and to other surgical procedures in this region (7).

Accessory foramina occasionally occurring in the mandible include the lingual, retromolar, and accessory mental foramina (AMFs), and blood vessels and nerve bundles emerge through them (1). An accessory foramen displaying a connection with the mandibular canal is defined as an AMF, and an accessory foramen revealing no connection with the mandibular canal is defined as a nutrient foramen (6). Balcioğlu and Kocaelli asserted that splitting of the mental nerve from the inferior alveolar nerve before the exit to the MF may be a reason for the formation of AMFs (3).

Although AMFs are reportedly rare, with a prevalence ranging from 1.4% to 13.8% (8), they have been widely studied because many dentists encounter them during routine clinical procedures, such as implant, periodontal, and periapical surgery (2). AMFs are generally smaller than the MFs and can be found in the apical region of the first molar or in the posterior or superior region of the mental foramen (4). Utmost care to the AMF and accessory mental nerve is essential during dental-implant surgery or any surgical procedure involving the mandibular molar and premolar region, which may reduce the rate of paralysis and hemorrhage in the mental region, lower lip, and gingiva (3).

Orthopantomography (OPG) is routinely used to visualize the maxillofacial region at dental clinics. OPG shows the upper and lower jaw and teeth and superficially reveals some pathologies or anatomic variations. It sometimes misses anatomic landmarks, such as the AMF (4). The crucial benefit of cone-beam computed tomography (CBCT) is overcoming the limitations of conventional radiography by producing 3D images that allow comprehensive evaluation of the anatomy of the chosen region. CBCT is a useful tool that provides detailed information regarding the structures of the maxillofacial complex, permitting the identification and evaluation of anatomical variations (7).

Since the AMF has not been studied among the Jordanian population, it is important to conduct a study to report the prevalence and describe the anatomical characteristics of AMFs among a selected Jordanian population using CBCT.

Methods

After approval was obtained from the institutional ethical committee of the Royal Medical Services, this retrospective study was conducted at Dental and Maxillofacial Department, at Queen Alia Military Hospital, Amman. Images of patients who had previously undergone CBCT imaging for different clinical reasons from January 2019 to December 2021 were retrieved from the department records.

CBCT scans were acquired via the Kodak Carestream CS900 computed tomography machine, (made in France, manufactured in New York USA), by a well-trained technician. The machine settings were as follows: a tube voltage between 85–95 kVp and a current of 4.0 or 5.0 mA according to the patient's size. The voxel size was 300 micrometers. Exposure times ranged from 8 to 11 seconds according to the selected field and the patient's size. The Carestream 3D imaging-reconstruction program was used to reconstruct and visualize the images, and reconstructed images were then evaluated by the examiners in the axial, sagittal, and coronal views (figure 1). AMF in this study was defined as a buccal foramen smaller than the MF and followed by the accessory branch of the mental canal before it exits from the MF, regardless of its location. The CBCT scans were evaluated in terms of the presence of the AMF. When the

AMF was present, the location and side (right or left side of the mandible) were recorded. The location of the AMF was described in relation to the main MF.

Insert figure 1 here

The CBCT scans were selected according to the following inclusion criteria: adequate fields, adequate quality, visibility of the MF, no lesions observed in the apical area of premolars and MF, no bone resorption occurrence, and availability of precise information about the patient's age and sex.

Out of the 324 CBCT images retrieved, 304 fulfilled ~~our~~ inclusion criteria. All participants were Jordanian, and 147 (48.4%) were male and 157 (51.6%) female. Patients were excluded for the following reasons: 3 patients had localized maxillofacial pathologies, 11 images had inadequate fields, and 6 images had inadequate quality.

Statistical analysis

Data were analyzed using IBM SPSS software version 26.0. We used mean (± standard deviation) to describe continuous variables and frequencies and percentages to summarize other categorical data. A chi-square test was performed to detect relationships between the presence of AMF, side of AMF and gender. A p-value of <0.05 was considered statistically significant.

Results

304 patients met the inclusion criteria and were included in this study. Of these patients, 147 (48.4%) were male and 157 (51.6%) females.

A total of 32 AMFs were observed in 27 (8.89%) out of the 304 participants. And out of the 608 hemimandibles studied, 28 (4.61%) hemimandibles had at least one AMF. AMFs were found in 12.9% of males and in 5.1% of females, as shown in Table I. We found that males were significantly more likely to have AMFs than females, X^2 (1, N =304) =5.571, p = 0.016.

Table I: the presence and absence of AMFs among males and females. Abbreviations: AMF: accessory mental foramen

		presence of AMF				
		absent		present		
		Count	Row N %	Count	Row N %	P value
gender	male	128	87.1%	19	12.9%	0.016
	female	149	94.9%	8	5.1%	

Of the 32 AMFs observed among the participants, 23 (71.9%) were found in males and 9 (28.1%) in females. Among males, 12 were on the right side and 11 were on the left, and among females 6 were on the right and 3 were on the left, as shown in Table I. A Pearson chi-square test found no association between gender and the side on which AMFs were observed, X^2 (1, N =32) =0.552, p = .0.46.

All patients with AMFs had only 1 AMF, except for 4 males and 1 female who had 2. Both the AMFs of these participants were found on the right side, except for 1 who had 1 on each side. However, we found no statistically significant association between gender and the number of AMFs observed (p = 0.601).

Most AMFs were located either anterosuperior (25%) or posteroinferior (25%) to the main MF, and the rest were either posterosuperior (15.6%), anteroinferior (12.5%), anterior (9.4%), superior (6.3%), or posterior (6.3%).

Table II: the side of AMFs among males and females. abbreviations: AMF: accessory mental foramina.

		gender				
		male		female		P value
		Count	Row N %	Count	Row N %	
side	**right**	12	66.7%	6	33.3%	0.46
	left	11	78.6%	3	21.4%	

It is important to note here that 9 patients who had AMFs detected through CBCT also had panoramic radiographs done, but none of these showed AMFs, which means that we cannot depend solely on panoramic radiographs to detect them.

Discussion

To the best of our knowledge, this is the first anatomical study to investigate the prevalence and distribution of AMFs using CBCT on a Jordanian population. CBCT was used because it can provide detailed anatomical descriptions of the MF and any AMFs, if present.

The literature shows wide variations in the prevalence of AMFs among various populations. In our study, 8.9% of the study population had AMFs, compared to 1.4% of White Americans (5) and 13% of Spaniards (9). Our numbers were comparable to numbers reported by other Middle Eastern countries, such as Saudi Arabia (9.9%) (8), and other countries, such as India (8.9%) (12). This difference may be explained by variations in imaging techniques, race, and the definition of AMF used. Depending on panoramic radiography alone may have caused researchers to miss some present AMFs, as it is not as sensitive as CBCT.

In the present study, AMFs were found in 12.9% of males and in 5.1% of females, and males were found to be significantly more likely to have AMFs than females (p = 0.016). A similar relationship was found in a neighboring country, Saudi Arabia (8), and in other countries, such as China and Iran (10, 11). The exact reason for such variation is unclear, but genetic predisposition might play a role.

Of the 32 AMFs detected in our study, 18 (56.2%) were on the right side. But we found that 14 right and 14 left hemimandibles had AMFs (4 right hemimandibles had 2 AMFs), which is consistent with previous research. A systematic review of the literature found that out of 10 studies, only 3 found more AMFs on the left side than the right, and 2 studies found the same number of AMFs on the right and left sides (13).

In our study, the maximum number of AMFs detected in the same patients was 2. However, 5 AMFs in the same patient have been described in a previous study (14). Among the patients with 2 AMFs, all had both presenting on the right side except for 1 patient who had bilateral AMFs. Bilateral AMFs were only seen in 1 patient in the present study (0.32%), which is consistent with previous numbers reported by Lam et al. (0.3%) (14), although a higher percentage was reported in Turkey (1.3%) (15).

As for the location of the AMFs, previous studies had different approaches to describing their locations. In our study, we describe the location of AMFs in relation to the main MF, and we found that most AMFs were located either anterosuperior (25%) or posteroinferior (25%) to the main MF. According to the systematic review by Pele et al., the most commonly reported AMF position was posteroinferior to the MF. Indeed, most AMFs were found at this position in 8 studies out of 17 (13).

Table III the location of AMFs in relation to the MF. abbreviations: AMF: accessory mental foramina, MF: mental foramina.

		Count	percentage
location of AMF in relation to MF	**anterior**	3	9.4%
	anterosuperior	8	25.0%
	anteroinferior	4	12.5%
	posterior	2	6.3%
	posterosuperior	5	15.6%
	posteroinferior	8	25.0%
	superior	2	6.3%

In our study, we used CBCT images to detect and describe AMFs, as these images can provide detailed information on the structures of the maxillofacial complex, permitting the identification and evaluation of anatomical variations (7). Of the patients who had AMFs detected via CBCT, 9 also had panoramic radiographs, but none of these showed the AMFs. Lorenzo et al. advised against depending on panoramic radiographs alone to detect AMFs, as they found that only 45.83% of the AMFs identified on CBCT were visible on such radiographs (16).

The present study described the prevalence and anatomical characteristics of AMFs among a selected Jordanian population. It also highlighted the importance of proper preoperative assessment of each individual due to the presence of wide anatomical variations among the population. Proper assessment starts by selecting the most specific and sensitive tools available. In this study we confirmed previous studies that recommend using CBCT for anatomical surgical assessment. However, greater efforts are needed to determine factors influencing the visibility of vital mandibular anatomical landmarks on panoramic radiographs.

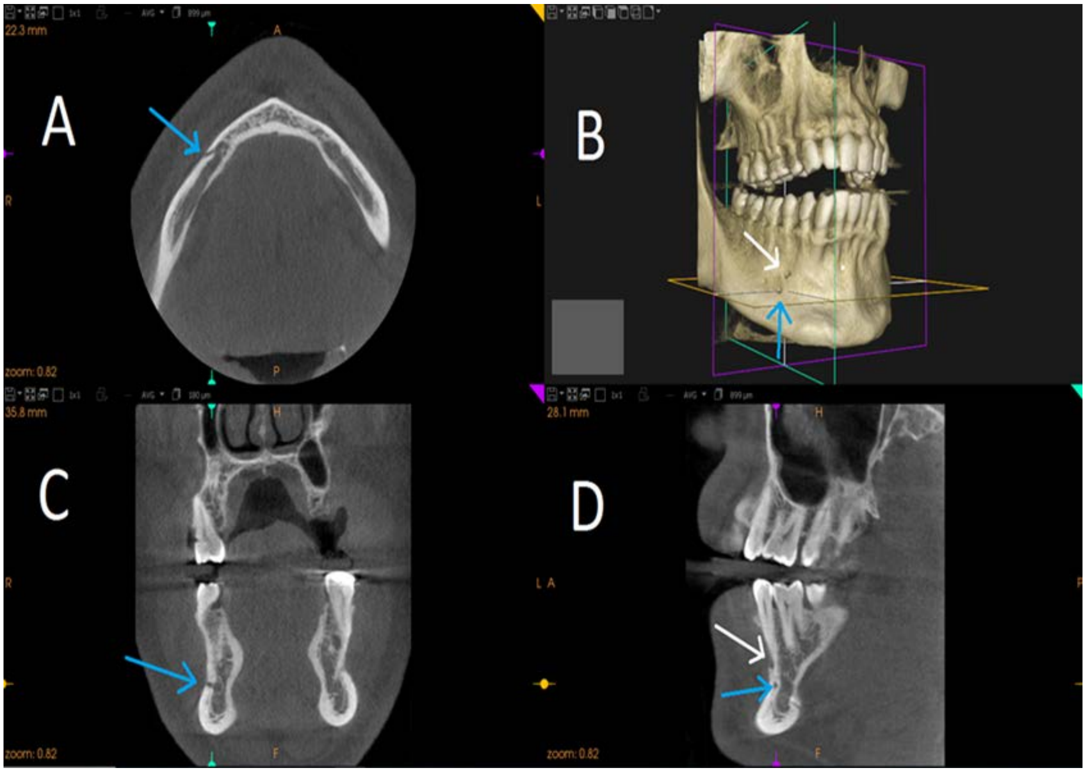

Figure 1: cone beam computed tomography images of the mental and accessory mental foramen. **A**- Axial section image. B- three-dimensional image. **C-** coronal section image **D**- sagittal section image. blue arrowhead - mental foramen, white arrowhead - accessory mental foramen

Conclusion

This study presents a considerable frequency of AMFs in a Jordanian population. Alertness of clinicians about AMFs is important for avoiding mental nerve damage during mandibular surgeries. CBCT can be used to detect AMFs by producing 3D images that allow ~~for~~ a comprehensive evaluation of the anatomy of the chosen region.

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