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Prevalence and morphometric analysis of the accessory mental foramina in Arab and Kurdish Iraqi populations using cone beam computed tomography

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ABSTRACT

Purpose: Evaluation of the presence and morphology of the accessory mental foramina (AMF) before performing dental implants or other surgical procedures is crucial to prevent damage to the inferior alveolar neurovascular bundle and the associated complications. The aim of this study was to determine the prevalence and morphology of AMF in Arab and Kurdish Iraqi populations.

Methods: Cone beam computed tomography images of 400 subjects (200 Arabs, 200 Kurds) were collected from radiology archives. RadiAnt DICOM software (Medixant, Poland) was used for image analysis. The prevalence, location, shape, and size of AMF were determined. Chi-square test for differences and descriptive statistics were performed using IBM SPSS version 26.

Results: The prevalence of AMF was found in 6.25% of the subjects of both populations. AMF was observed in 3.5% of the Arab population and in 9% of the Kurdish population, both exhibited no significant difference between males and females. There was a significant difference in the prevalence of AMF between the two groups. Among the Kurds, AMF was most commonly positioned below the mental foramen (MF), while among the Arabs, it was equally distributed between below and at the same level as the MF. The oval shape was most prevalent among the Arabs, whereas oval and irregular shapes were the most common among the Kurds. In the Arab population, the mean width and length of the AMF were 1.38 mm and 1.43 mm, respectively. In the Kurdish population, the mean width and length of the AMF were 1.26 mm and 1.19 mm, respectively.

Conclusion: Awareness of anatomical variations, including the presence of AMF, is important in planning surgical interventions of the mandible, to help prevent complications that could arise from inadequate preoperative assessments. This study represents the most extensive research on AMF within Iraq's two largest ethnic groups of the country, the Arabs and Kurds.

Keywords: accessory mental foramen, cone beam computed tomography, CBCT, Iraq

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INTRODUCTION

The mental foramen (MF) is a single oval-shaped opening usually located at the tip of the second premolar on either side of the jaw. The inferior alveolar nerve exits the MF and becomes the mental nerve, which supplies general sensation to the lower lip, chin, and buccal mucosa and gingiva. Anatomical variations of the MF have been described in the literature, including the existence of additional foramina around the MF. These are often known as the accessory mental foramen (AMF). It is crucial to differentiate between a true AMF (a branch derived from the mandibular canal) and a nutrient canal (which supplies nutrients to the mandible and has no connection with the mandibular canal).^{1–5}

To date, much attention has been paid to the course of the mandibular canal to avoid damage to the essential neurovascular system within it. Therefore, consideration of AMF is crucial for several clinical and dental procedures, including oral surgery and local anesthesia, in order to prevent post-operative sensory disturbances or bleeding. This could lead to an adverse outcome of the intended therapy.^{6–9}

Previous studies have documented the prevalence of AMF, which ranged significantly from 1.4% to 14.3%.^{10–15}

The researchers in this study aimed to understand how common AMF is among Iraqi Arabs and Kurds using cone beam computed tomography (CBCT) images and to study its morphology.

MATERIALS AND METHODS

Ethical approval was obtained from Jawatankuasa Etika Penyelidikan Manusia, Universiti Sains Malaysia for this study. In this study, 400 CBCT images (200 Arabs, 200 Kurds: 100 males and 100 females, aged 20–50 years) were collected for each ethnic group from two CBCT imaging centers: one was located in Baghdad for the Arab group, and the other was in Sulaymaniyah for the Kurdish group.

The software used to view and measure the image was RadiAnt DICOM viewer software, which was found to be reliable in previous studies.^{16–18}

The measurements were conducted by the first author. Two weeks elapsed between the applications of the same measures in 10% of subjects to assess intra-examiner reliability. Similarly, 10% of subjects were selected for inter-examiner reliability between two examiners. The second examiner was an oral and maxillofacial radiologist who had expertise in CBCT readings. The Kappa and intra-class correlation coefficients (ICC) tests were used to evaluate the reliability of measurements. The results showed a favorable level of agreement, both for intra- and inter-examiner reliability.

The measurements performed were as follows:

1. Prevalence and number of the AMF.
2. Position of the AMF according to the main mental foramen (above, below, or at the same level).
3. Shape of the AMF.
4. Size of the AMF (width and length).

The AMF is defined as a tiny foramen located near the main MF, originating from a branch of the mandibular canal.^{1–4} The MF and any AMF were examined in each subject. Since all MFs were detected, no data was excluded. For subjects with AMF, the prevalence, number, location, shape and size were determined (Figures 1–5).

Statistical analysis was performed using IBM SPSS version 26. A frequency analysis was used to determine the prevalence of one or more AMF. To determine any variations in the presence of AMF and the gender, shape, ethnic group, and location of the AMF, the chi-square test was used. Descriptive statistics (mean and standard deviation) were determined for the width and length.

RESULTS

Arab population showed an AMF prevalence of 3.5% (7 out of 200 subjects), found only on the right side of the mandible, with no significant difference between males and females. In contrast, the Kurdish population exhibited a prevalence of 9% (18 out of 200 subjects), with AMFs observed on both sides of the mandible and no significant difference between genders. One subject in the Kurdish population had two AMFs. Collectively, AMFs were found in 25 (6.25%) of the subjects across both populations, with a significant difference between the two groups ($p = 0.037$) (Table 1).

The location of AMF related to MF in Arab population showed significant difference between males and females ($p < 0.001$). The males exhibited AMF in the location above and at the same level as the MF while most females' AMFs were located below the MF (Table 2).



Figure 1. Two AMFs (the two red arrows) and the MF (the green arrow).



Figure 2. AMF located above the main MF.



Figure 3. AMF located below the main MF.



Figure 4. AMF located at the same level (lateral) to the main MF.



Figure 5. Measurements of the width and length of AMF (red arrow).

Table 1. Descriptive statistics and comparison of the presence of the AMF in the Arab and Kurdish populations.

Arabs				Kurdish				Population	Present	Absent	<i>p</i>
Gender	Present	Absent	<i>p</i>	Gender	Present	Absent	<i>p</i>				
Male	2	98	0.248	Male	9	91	0.785	Arabs Kurdish	7	193	0.037*
Female	5	97		Female	9	91					

*Significant at $p < 0.05$. Chi-square for differences.

Table 2. Location of AMF related to MF in the Arab population on the right side.

Gender	Above MF	Same level as MF	Below MF	Total	<i>p</i>
Male	1	1	0	2	< 0.001**
Female	0	1	4	5	

**Significant at $p < 0.001$. Chi-square for differences.

In Kurdish population, the location of AMF related to MF differ significantly between males and females for both right and left sides ($p < 0.001$). On the right side, males have the majority of AMF at the same level as MF while the AMF in females, the majority were located below the MF. Similarly, on the left side, males' AMFs were located at the same level as MF while in females the AMF were located equally above and below the MF (Table 3).

Comparison of the location of AMF related to MF between populations can only be performed on the right side as no AMF were found on the left side in Arab population. Significant differences were found ($p < 0.001$) where the majority of Arabs had AMF situated below the MF while the Kurdish had AMF located at the same level as MF (Table 4). In the case where AMFs were located at the same level as MF, they always situated lateral to MF.

Table 3. Location of AMF related to MF in the Kurdish population on the right and left sides.

Gender	Right					Left				
	Above MF	Same level as MF	Below MF	Total	<i>p</i>	Above MF	Same level as MF	Below MF	Total	<i>p</i>
Male	1	3	1	5	<0.001**	0	3	1	4	<0.001**
Female	1	1	2	4		2	1	2	5	

**Significant at $p < 0.001$. Chi-square for differences.

Table 4. Comparison of the location of AMF related to MF between the Arab and Kurdish populations on the right side.

Population	Above MF	Same level as MF	Below MF	Total	<i>p</i>
Arabs	1	2	4	7	<0.001**
Kurdish	2	4	3	9	

**Significant at $p < 0.001$. Chi-square for differences.

Table 5. Shape of the AMF in the Arab and Kurdish populations.

Population	Round	Oval	Irregular
Arabs	0	5	2
Kurdish	2	8	8

Table 6. Width and length of the AMF and MF in the Arab and Kurdish populations (mm).

Population	AMF		MF	
	Width Mean $\pm$ SD	Length Mean $\pm$ SD	Width Mean $\pm$ SD	Length Mean $\pm$ SD
Arab	1.38 $\pm$ 0.854	1.43 $\pm$ 0.696	3.01 $\pm$ 1.78	3.21 $\pm$ 1.07
Kurd	1.26 $\pm$ 0.743	1.19 $\pm$ 0.596	2.90 $\pm$ 1.85	3.35 $\pm$ 1.21

The shapes of the AMF in the Arab and Kurdish populations are presented in [Table 5](#). The Arabs had predominantly oval shaped AMF while the Kurdish had oval and irregular shaped foramen.

The width and length of the AMF are less than 2 mm for both populations and are considerably smaller than the size of the MF ([Table 6](#)).

DISCUSSION

The population of Iraq is 40,150,000 people consisting mostly of Arabs and Kurds. Arabs mostly dominate the central and southern parts of Iraq, while Kurds predominantly inhabit the northern region. CBCT images of Iraqi Arabs were collected from a clinic in Baghdad in the central area. The CBCT images of the Kurdish population were taken from a facility in Sulaymaniyah in the northern region.

The neurovascular structures of MF have additional pathways due to the existence of the AMF. Therefore, it is essential that surgeons accurately diagnose AMF to prevent surgical complications such as bleeding and damage to the neurovascular systems, as well as to provide effective local anesthesia.^{19,20}

CBCT images were used to assess AMF in this research. CBCT demonstrated a higher incidence of identifying AMF and which may result in a reduction of the likelihood of complications during invasive procedures.²¹

AMF was detected in several previous studies where the prevalence varied between 1.4% and 26%.^{10-15,22,23} The findings of the current study indicated that the AMF was within this range i.e. 3.5% of Arabs and 9% of Kurds with significant difference between the two populations.

Conflicting results were reported regarding the association between gender and AMF prevalence. A few studies^{19,24} found that males had significantly higher rates of AMF than females. Others discovered that AMF was more often found in females.^{2,25} Even though, the prevalence of AMF was higher among females

in the Arab population, this difference was not significant, which is in line with the findings of a previous study.²⁶ Similarly, the Kurds also showed no difference in the prevalence of AMF between genders.

The AMF was evenly distributed between the left and right sides of the mandible in the Kurdish population, which is consistent with previous studies.^{6,22} In another study²⁷, the AMFs were mostly unilateral as was found in the Arabs where they were observed only on the right side. Additionally, researchers generally observe a frequency of one to two AMFs per subject.^{3,6,28,29} However, in the current study, there was only one subject from the Kurdish population presented with two AMFs.

Previous studies have found the AMF positioned below the MF,^{8,30} which is similar to the Arabs findings, as well as at the same level as and above the MF.⁶ One study found AMF located above the MF in 12%, below the MF in 47%, and at the same level as MF in 51% of their population.³ Whereas, another study found similar discovery as the Kurdish population where the AMF was mostly located at the same level as the MF.³¹ None of the previous studies indicated whether the AMF was located medial or lateral to the MF when both are at the same level.

The oval shaped AMF was predominant for the Arabs, whereas both oval and irregular shapes were equally prevalent for the Kurds. Unfortunately, no studies have considered the shape of AMF in their research.

The AMF was observed to be quite small (less than 2 mm) and approximately half the size of MF which is consistent with a few previous studies.^{4,29}

CONCLUSION

In summary, this study examined CBCT images of 400 subjects and found a small prevalence of AMF (6.25%) with significant difference between the Arabs and Kurds. Bilateral presence of AMF was observed in the Kurdish population, while Arabs exhibited unilateral presence. No gender differences were observed. The AMFs were found to be located above, at the same level, and below the MF with the majority located below the MF for the Arabs and at the same level as MF for the Kurds. The oval shape was predominant among the Arabs, while oval and irregular shapes were common among the Kurds. The size of the AMF was small, approximately half that of the MF.

Although AMF is rare, this study revealed its existence, which is a noteworthy discovery. The prevalence may be higher in studies using a larger number of subjects. In such a situation, the need to obtain CBCT images before surgery is emphasized for appropriate diagnosis and to mitigate any difficulties in patient management. Finding and identifying additional foramina in other locations such as at the posterior region of the mandible using CBCT is also important to prevent complications associated with dental and surgical procedures.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHORS' CONTRIBUTIONS

Omar Basheer Taha: Conceptualization (Equal), Formal analysis (Lead), Methodology (Equal), Investigation (Lead), Supervision (Lead), Validation (Lead), Writing – Original draft (Lead). **Mohamad Arif Awang Naw:** Formal analysis (Supporting). **Johari Yap Abdullah:** Validation (Supporting), Writing – Review & editing (Equal). **Asilah Yusof:** Conceptualization (Equal), Methodology (Equal), Supervision (Supporting), Validation (Supporting), Writing – Review & editing (Equal).

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