DETERMINATION OF THE FREQUENCY OF ACCESSORY MENTAL FORAMEN USING CBCT IN PATIENTS PRESENTING TO A LOCAL TERTIARY CARE HOSPITAL

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ABSTRACT

OBJECTIVES

This study aimed to determine the frequency of accessory mental foramen using CBCT in the local population.

METHODOLOGY

The cross-sectional descriptive study; Periodontology Department, Institute of Dentistry, CMH Medical and Dental College, Lahore. Patients reporting to the outpatient department for routine dental treatment that required a CBCT assessment were sought. Adult dentate subjects with at least mandibular canine to first molar teeth present bilaterally were selected. Volumetric data from CBCT scans was used to reconstruct mandibular images. Mental foramen was identified as the largest opening on the mandibular buccal surface. Any additional buccal opening in the proximity of the mental foramen was recognized as an accessory foramen. The location of the accessory foramen concerning the mental foramen and its diameter was noted. Data was analysed using the Statistical Package for the Social Sciences (SPSS), version 24. Descriptive statistics were evaluated. Effect modifiers were controlled through stratification, and a post-stratification chi-square test was used. An Independent sample t-test was used to compare the mean foramen diameter between males and females. A p-value of ≤0.05 was considered significant.

RESULTS

Accessory mental foramen was observed in only 5.5% of subjects. The most frequent location of accessory mental foramen to mental foramen was "postero-inferior", seen in 3% of cases. No significant difference in the incidence of accessory mental foramen was seen between males and females (p=0.733).

CONCLUSION

Results of this study suggest it is quite possible to encounter an accessory mental foramen during dental procedures in the Pakistan population. It is a rare but significant anatomical variation. Care must be taken to identify such structures during the treatment planning phase of dental surgical procedures.

KEYWORDS: *Mental Foramen; Cone Beam Computed Tomography; Mandible*

INTRODUCTION

Mental foramen (MeF) marks the point of exit of the mental nerve from the mandibular canal, from where it travels to provide sensory innervation to the mandible and lower half of the face.[1] MeF is usually circular or slightly elliptical, occurring either amid the root apices of the two mandibular premolars or right below the second premolar.[2] It is a solitary opening on the anterolateral mandibular surface and is present bilaterally.[3] Openings besides the primary MeF have been reported and are termed "accessory mental foramina" (AMeF). It is theorised that AMeF may arise as a result of the division of the mental nerve during the first trimester of intrauterine development.[4,5] AMeF can be single or multiple, located unilaterally or bilaterally and are usually smaller than the main MeF.[6] For a foramen to be termed AMeF, it must be in continuation with the mandibular canal; otherwise, the term "nutrient foramen" is used.[2] MeF serves as an important anatomical landmark. It is essential to evaluate the exact position and presence of any accessory foramina before conducting invasive surgical procedures in the region, such as the placement of dental implants or harvesting bone graft material, to ensure optimal outcomes.[7] However, failure to identify AMeF can also lead to serious post-operative complications such as hemorrhage due to the damage to the associated neurovascular bundle and/or nerve damage leading to altered sensations or paralysis in the chin, lower lip and surrounding areas.[8,9] Conventionally, panoramic radiographs have been used for such an evaluation.

However, due to poor resolution, two-dimensional images, and the superimposition of structures, accurate identification of anatomical landmarks becomes difficult. With the use of CBCT, the identification of these landmarks, including AMeF, can be more accurate and reliable, with high image resolution, minimal distortion, and three dimensional visualisation.[10] Studies have reported a varying prevalence of AMeF in different populations ranging from 1% to 14%.[2,8,11] Data reporting on "how frequently one can encounter AMeF in the Pakistani population" is rather scarce. A retrospective study done on the local population in the Federal region reported a 4.5% prevalence of AMeF.[12] Suggesting considerable frequency of AMeF in our population. The present study, therefore, aimed to determine the frequency of accessory mental foramen using CBCT in patients presenting to a local tertiary care hospital in Lahore. The knowledge thus gained will aid in more effective pre-operative planning of dental surgical procedures and enhanced provision of care to patients.

METHODOLOGY

A cross-sectional descriptive research study was designed and conducted at the Periodontology Department, Institute of Dentistry, CMH Medical and Dental College, Lahore, from October 2023 to March 2024. Approval for the research was sought from the Institute's ethical review committee (letter no. 646/ERC/CMH/LMC). The sample size was calculated using the WHO calculator. With confidence level (1-α) at 95%, the margin of error (d) at 0.05, and anticipated population proportion (P) at 0.1223.[2] a total sample size of 165 was calculated. The target population consisted of subjects reporting to the dental outpatient department of CMH Lahore Institute of Dentistry for routine dental treatment that required a CBCT assessment (e.g., dental implant placement). Adult dentate subjects >18 years of age, with at least mandibular canine to first molar teeth present bilaterally and those with high-resolution CBCT images were included in the study. Subjects who were under-aged <18 years, or pregnant, or those with any bone pathology, impacted mandibular premolars, periapical lesions associated with mandibular posterior teeth, a history of mandibular fracture and/or mandibular surgery for any reason, signs of bone loss in the posterior mandible, presence of any artifacts in CBCT images were excluded from the study. All selected individuals were asked to sign a consent form, and their demographic details were recorded on a proforma. A CBCT scan of each subject was performed at the radiology department by trained personnel using a Carestream CS9600 (Carestream Dental LLC, Atlanta, GA) with 120 kVp, 20 mA, and a voxel size of 0.3 × 0.3 × 0.3 mm, with up to 14 different fields of view. Volumetric data from CBCT scans was used to reconstruct mandibular images in coronal, sagittal and axial planes using the CS MAR imaging software. Mental foramen was identified as the largest opening on the mandibular buccal surface and in continuity with the mandibular canal. Any additional buccal opening in the proximity of MeF was identified as AMeF. The location of the AMeF for MeF was noted and classified using Ayutgar et al.'s[2] method as follows: "(i) posterior, (ii) posterior-superior, (iii) posterior-inferior, (iv) inferior, (v)antero-inferior, (vi) antero-superior, and (vii) anterior". As a secondary objective, the diameter of AMeF was also calculated. Three readings were taken for each subject and foramen to calculate the mean. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 24. Descriptive statistics were evaluated. Mean ± standard deviation values of quantitative variables, such as age and foramen diameter, were calculated, while frequencies and percentages for categorical variables, like the presence or absence of an accessory mental foramen, were determined. Stratification was performed to control for effect-modifying variables, such as age and gender. A post-stratification chi-squared test of independence was used to determine any differences attributable to age and gender. An independent sample t-test was used to compare the mean accessory foramen diameter between males and females. A p-value of ≤0.05 was considered significant.

RESULTS

Of the 165 study subjects, 43% (n = 71) were male and 57% (n = 94) were female. The mean age of the study subjects was 39.5 ± 8.8 years (range, 24-62 years). Accessory mental foramen (AMeF) was observed in only 5.5% (n=9) of subjects. Only a single accessory opening was observed in all cases. The most frequent location of AMeF to MeF was "postero-inferior" seen in 3% (n=5) cases, followed by anterior location seen in 1.2% (n=2) cases (Table 1). No significant difference in the frequency of AMeF was observed between males/females (p=0.733) and between different age groups (<35 years vs. ≥35 years) (p=0.726) (Table 2).

Table 1: Distribution of accessory mental foramina according to their location

Accessory Mental Foramen Location	%Age (n)
Posterior	-
Posteroinferior	3(5)
Postero-superior	-
Inferior	0.6 (1)
Antero-inferior	0.6 (1)
Antero-superior	1.2 (2)
Superior	-

Table 2: Association of frequency of accessory mental foramen with age and gender

Parameter		Accessory Mental Foramen (n)		P-value
		Present	Absent	
Gender	Male	03	68	0.73
	Female	06	88	
Age Group	<35 years	03	46	0.72
	≥35 years	06	110	

The mean distance of AMeF from MeF was 3.12±0.11 mm. The mean diameter of the accessory foramen was 1.68±0.37 mm. No significant difference in mean accessory foramen diameter was seen between males and females (p=0.454) (Table 3).

Table 3: Comparison of mean diameter of accessory mental foramina between males and females

Gender	N	Accessory Mental Foramen Diameter Mean±SD mm	p-value
Male	03	1.54±0.58	0.454
Female	06	1.75±0.25	

DISCUSSION

Typically, human mandibles have only a single, bilateral opening for the mental nerve on the anterolateral aspect. However, one or more additional openings may be encountered on either side, termed as "accessory mental foramen", which is a "rare anatomical variation".[13] Hence, planning mandibular surgical procedures requires utmost care and attention to detail to accurately identify the MeF and any accessory foramina to avoid neurovascular damage in the mental region. These anatomical variations are often missed when only two-dimensional imaging is used; therefore, they mandate the use of three-dimensional imaging, such as CBCT, for accurate diagnosis.[14,15] The present study found an overall 5.5% prevalence of accessory mental foramen. Comparable results have been reported by Shah et al., who found AMeF in 4.5% of the studied Pakistani population.[12,11] Similarly, Khojastepour et al. reported a 5.1% prevalence of AMeF in the Iranian population. A slightly higher prevalence of 7.8% AMeF has been reported by Ahmad et al. in the Pakistani population.[16] However, since the authors analysed retrospective data from a very small sample, selection bias may have been introduced into their findings.[17] Varying prevalences of AMeF have been reported in different populations worldwide. Zmysłowska-Polakowska et al. reported a 7% prevalence in the Polish population, while Rajkohila et al. reported an 8.85% prevalence in the Indian population.[18,19] Wei et al. reported a 10.5% prevalence in the Chinese population, while Lam et al. quoted a prevalence of 6.4% in the Australian population.[7,8] Ayutgar et al. reported a 12.23% prevalence in the Turkish population, which is the highest documented prevalence.[2] The present research found only single unilateral AMeFs, i.e., only a single unilateral accessory opening was observed in all subjects. Ahmad et al. have also reported unilateral occurrence of AMeF in a Pakistani study cohort.[16] Literature, however, reports AMeF occurring in varying numbers across different races and ethnicities. A study conducted in the Australian population reported 1% of cases showing three AMeF, and one case in particular exhibiting 05 AMeF, with three on one side of the mandible and two on the other side.[8] Likewise, Ayutgar et al. have also reported several AMeF ranging from 01-03 with both unilateral and bilateral occurrences.[2] In the present study, the most frequently encountered position of AMeF was postero-inferior to MeF. This finding is endorsed by Ayutgar et al., who also reported postero-inferior as the most common location of AMeF concerning MeF.[2] Similar findings have been reported by Rajkohila et al., Noruzi et al. and Li et al.[19,20,21] Likewise, Aljarbou et al. reported "posterior and inferior to MeF" as the most frequent location of AMeF in the Saudi population.[5] Contrary to our findings, Wei et al.[7] and Li et al.[21] reported posterosuperior as the most prevalent location of AMeF. In contrast, Yoon et al.[6] reported that the anterosuperior location is the most prevalent site of AMeF. These differences may be attributed to the differences in ethnicity, age, and gender, as well as the status of dentition of the study sample. No difference was observed in the incidence of AMeF between males and females in this study. Although a majority of the subjects presenting with AMeF were female, association of AMeF frequency and gender was not statistically significant (p=7.33), This finding is endorsed by that of Zmysłowska-Polakowska et al.[18], Ayutgar et al.,[2] Lam et al.[8], Noruzi et al.[20] and Yoon et al.[6] Contrarily, Aljarbou et al.[5], Li et al.[21] and Direk et al.[9] reported a greater frequency of AMeF in men. Like all other AMeF parameters, variation in this finding may also be due to differences in the study population. The present study attempted to determine the frequency of AMeF in the local population. The study did not collect data retrospectively; rather, it targeted prospective patients who reported for routine dental treatment that required a CBCT scan. Hence, unnecessary exposure of patients to radiation (by advising CBCT for the sole purpose of this study) was also eliminated. Additionally, prospective data collection helped eliminate selection bias, a major drawback of retrospective data.[17] The key shortcoming of the study is its relatively small study sample. Further studies on a larger scale involving a diverse sample are suggested.

LIMITATIONS

This study has certain limitations. Firstly, the sample size was relatively small and limited to a single

institution, which may affect the generalizability of the findings to the broader Pakistani population. Secondly, the cross-sectional design does not allow for longitudinal assessment or correlation with clinical symptoms. Thirdly, potential inter-observer variability in CBCT image interpretation may influence the identification of accessory mental foramina. Lastly, the study did not account for ethnic or regional variations within the local population, which may play a role in anatomical differences.

CONCLUSIONS

Results of this study suggest it is quite possible to encounter an accessory mental foramen (AMeF) during dental procedures in the Pakistan population. AMeF is a rare but significant anatomical variation. Care must be taken to identify it during the treatment planning phase of dental surgical procedures to avoid iatrogenic damage to anatomical structures.

CONFLICT OF INTEREST: None

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.