**ORIGINAL ARTICLE**

# Cone-beam Computed Tomography Evaluation of Accessory Mental Foramen in a Selected Iranian Population

FATEMEH MOHAMMADIAN [1], EHSAN MAHMOUDI[2], EHSAN MOUDI[3], MOHAMMAD JAVAD KHARAZIFARD[4], FATEMEH DIBAJI [1*]

[1]*Department of Endodontics, School of Dentistry, Tehran University of Medical Sciences, International Campus, Tehran, Iran*
[2]*School of Dentistry, Tehran University of Medical Sciences, International Campus, Tehran, Iran*
[3]*Oral Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.*
[4]*Statistical Advisor, Dental Research Center, Tehran University of Medical Sciences, Tehran, Iran.*
[*]*Corresponding author :Fatemeh Dibaji. Assistant Professor, Department of Endodontics, School of Dentistry, Tehran University of Medical Sciences, International Campus, Tehran, Iran.*
*E-mail: fmdibaji@gmail.com Tel: +98-21 55851149*

## ABSTRACT

**Introduction:** The division of mental nerve to smaller branches can be the cause of accessory mental foramen (AMF) formation. Patients may encounter post-operative complications if this anatomical variation is neglected during invasive treatment procedures. The present research aimed to determine the prevalence of AMF in a selected Iranian population using Cone Beam Computed Tomography (CBCT).

**Materials and methods:** In this retrospective cross-sectional study, CBCT images of 159 patients were evaluated to assessment of presence or absence of AMF and its size and location in relation to main mental foramen (MF). The SPSS v. 24 software and logistic regression model were used for data analysis.

**Results:** AMF was present in 3.77% cases, 83.33 % of which were reported to be unilateral. In 28.57% of patients, the AMF was located mesial to the main foramen, while in 57.14% percent it was located distal to the main foramen and only in one case (14.28%), the main and AMF were located aligned. The mean diameter of AMF were 1.57 mm.

**Conclusion:** The results showed that, AMF is not uncommon, hence to prevent the inadvertent injuries during surgeries in premolar teeth region, pre-treatment assessment using CBT images is recommended.

**Keywords:** AMF, Anatomic landmarks, Cone Beam Computed Tomography, Mental foramen

## INTRODUCTION

Mental foramen (MF) is a round or oval foramen located on the buccal surface of the lower jaw [1]. The main role of this foramen is to transmit the terminal branch of the inferior alveolar nerve and vessels in this area. The inferior alveolar nerve and vessels, exit the MF as supplying vessels and nerves of the inferior teeth, lip, gingiva, and soft tissues of chin after passing through the mandibular foramen and inferior alveolar canal [2].

It seems that mental nerve can divides into some small branches before the 12$^{th}$ week of gestation and can lead to the formation of the AMF [3]. AMF can be located superior, inferior, or posterior to the MF. It can appear either as a single foramen or multiple foramina, unilateral or bilateral and it is generally smaller than 1 mm [4].

The anatomical location of the main and AMF is of great importance for local anesthesia, oral surgeries such as endodontic surgeries, treatment of parasymphysis fractures and etc. [5]. Patients may encounter post-operative complications if this anatomical variation is neglected during invasive treatment procedures. The most important and severe complication of AMF injury is sensory disturbance of the lower lip [6, 7].

CBCT has been commonly used for diagnosis and treatment planning, because of its examination accuracy [8]. Using CBCT a precise anatomic structures analysis is possible, due to the better quality and lower distortion in comparison with conventional radiographs [9].

The great variety of surgical interventions in the chin region including oral implants placement, , endodontic surgery, bone grafting etc. require an exact evaluation of structures of this region like mandibular canal, MF and AMF. CBCT is reliable diagnostic tools for this purpose [6].

Due to the importance of awareness about the prevalence and location of the AMF in different treatment plans, this study aimed to determine the prevalence of AMF in a selected Iranian population using CBCT.

## MATERIALS AND METHODS

This is a retrospective cross-sectional study in which archived CBCT images prepared for various purposes in radiology centers in the north of Iran were used. The images were taken by NewTom VGi (QR SRL Co., Verona, Italy) with 110 kVp, 20 mA and voxel size of 0.3×0.3×0.3 and were taken with different fields of view (8×8, 12×8 ,15×12 and 15×15). The study protocol was approved in the ethics committee of medical studies of Dentistry Faculty of Tehran University of Medical Sciences.

The inclusion criteria for this study were the presence of first and second premolars in both sides of the mandible, absence of any pathology (radiolucencies that might represent cyst and tumor or periapical lesion), fracture, supernumerary or impacted teeth in this region, images with high geometric resolution and availability of precise information about patient's age and gender. Ultimately, 159 CBCT images fulfilling the inclusion criteria were evaluated.

Demographic information of patients such as age and gender were recorded. CBCT images were evaluated in sagittal, coronal, axial, cross-sectional planes to find accessory mental foramina. First, the pathway of the inferior alveolar nerve canal was tracked in axial sections on both sides until it reached the main MF. Then, any small branches of main canal pathway were tracked to the

opening orifice on the labial surface of the bone. If the orifice of AMF was observed, all cross-sectional sections, multiplanar reconstruction, and 3D views were also evaluated to approve the finding. In images that approved the presence of the AMF, those being unilateral or bilateral were also recorded.

To measure the diameter of the AMF, images of different sections were reviewed to determine the greatest diameter present using the measurement tool of NNT Viewer software and its size was recorded. The location of the AMF relative to the main MF (i.e. being medial, distal, coronal, and apical) was evaluated.

SPSS v. 24 and logistic regression statistical tests were used for data analysis and the level of significance was set at 0.05.

## RESULTS

Among all 159 CBCT images fulfilling inclusion criteria, 95 images belonged to women while 64 images belonged to men ranging from 18-77 years.

Prevalence of the AMF was 3.77% (6 cases: 4 males and 2 females) one of which was bilateral (16.67%) and others were unilateral (83.33%). 3 cases of unilateral accessory foramina were located on the right side of the jaw (60%) and two cases were located on the left side of the jaw (40%). The mean diameter of the AMF was 1.57 mm. Relative to the main MF, 2 AMFs were mesial (28.57%), 4 were distal (57.14%), and one case was aligned but coronal to it (14.28%).

Logistic Regression test suggested that age (P=0.957) and gender (P=0.22) do not significantly affect the prevalence of the AMF.

## DISCUSSION

AMF is an important anatomical structure in the premolar and molar areas of the mandible [7]. Awareness of the anatomical variations of the MF is necessary when planning any surgery in this region. Failure to identify and account for the presence of AMF has been suggested as a reason for post-operative complications such as paralysis or hemorrhage following dentoalveolar surgical procedures including periapical endodontic surgery or implant insertion in this region [10]. It has also been associated to labio mandibular paresthesia following endodontic overfilling [11]. Due to the importance of this anatomical variation and the dearth of research in this regard in the north of Iran, this study was conducted.

The use of cone beam computed tomography in the diagnosis and/or management of dentoalveolar problems, is increasing rapidly worldwide. Because three dimensional images provide more highly accurate information with lower distortion than conventional radiographs [9]. After examining of 365 patients, Naitoh et al [12] showed that only 18 AMF were detectable in panoramic radiographs, while they identified 37 AMF with the aid of CBCT. So AMF is more likely to be seen if CBCT is used.

Results of our study suggested that the prevalence of the AMF was 3.77%. These results are in agreement with some researches, such as Yovchev et al. [13] and Imada et al. [14], which showed that AMF was present in 3.68% and 3% patients respectively. However Noruzi et al. [5] found that the prevalence of AMF was 10.55% in another population of Iran. This contrast could be attributed to the differences in sample size and populations of two studies. Incidence of AMF was also more frequent in some populations like Indian (up to 13%) [15].

Like results of Khojastepour et al. [16] and Lam et al. [17], we found that there was no statistically significant difference between frequency of AMF in different sex and age groups. Zmysłowska-Polakowska et al. [6] showed that AMF was more incident in males. It should be stated that some researchers like Paraskevas et al. [18] and Katikireddi et al. [19] used CBCT images to evaluate human dry mandible, so the gender and age were unknown. This limitation was solved in this study by recording demographic information. Thus, this study could be considered more valid due to providing more comprehensive information and it even provided the background for conduction of meta-analyses which are highly-valued studies.

Double AMF occurrence in our results (16.66%) is in accordance with Lam et al. (0.3%) [17] and Katakami et al. (0.7%) [11], but slightly more than study of Yovchev et al. (0.36%) [13]. in current study, AMF is unilateral in 83.33% of cases. In most of other studies, unilateral AMF was more prevalent compared to bilateral location [11, 13, 18].

About the location of the AMF relative to the main MF, it should be stated that in current study, 28.57% of AMFs were mesial, 57.14% of cases were distal, and one case (14.29%) was aligned but vertically coronal. It should be noted that cases in which AMF is located above the level of MF, are more prone to undesirable injuries during periapical surgeries or implantation. Our results showed that approximately 42.8% cases had AMF above the MF. It is in accordance with several studies founding that the position of AMF was usually inferiorly or distal-inferiorly to the MF-location sufficient for most surgical procedures [5, 11, 20, 21]. However Imada et al. [14] found that Most AMFs were located between premolar teeth, superior or mesial to the MF. The differences between studies are probably related with study design, sample size, different imaging techniques, ethnic and racial peculiarities. Interestingly no AMFs were detected in panoramic images of Imada et al. [14]. They concluded that CBCT is an effective tool to 3-dimensionally evaluation of neuromuscular structures such as MF and its alterations

It has stated that larger accessory mental canals with a diameter of more than 1 mm are more prone to a major hematoma [13]. Our data showed that approximately 85% cases had AMF canal bigger than 1 mm, so this anatomic variant should be noticed by surgeons. Our results are in accordance with Noruzi et al. [5], Paraskevas et al. [18] and Yovchev et al. [13] which showed that most of AMF were greater than 1 mm.

In the one of largest study which ever conducted in this regard, lam et al [17] stated that nearly one in 15 individuals have AMF. They suggested that Clinicians must be acutely aware of this anatomical variation and treatment plan of each case accordingly.

## CONCLUSION

The results showed that, AMF is not uncommon, hence to prevent the inadvertent injuries during surgeries in

premolar teeth region, pre-treatment assessment using CBT images is recommended.

## REFERENCES


1. Jasim HH. Evaluation of Mental Foramen Location–A Review Article. *Journal of Medical Care Research and Review*. 2020;3(7):379-85.
2. Shalash M, Khallaf ME, Ali A. Position and dimensions of the mental foramen and presence of the anterior loop in the Egyptian population: a retrospective CBCT study. *Bulletin of the National Research Centre*. 2020;44(1):1-6.
3. Kastamoni Y, Sanli OC, Dursun A, Albay S. A case with multiple accessory foramina of mandible in a fetus. *Anatomical science international*. 2020;95(4):548-52. doi.10.1007/s12565-020-00537-z.
4. Yoon TY, Ahmadi AG, Saed NA, Estrin NE, Miller DE, Dinh TN. Prevalence and anatomical characteristics of the accessory mental foramen: a study using cone beam computed tomography. *General dentistry*. 2019;67(5):62-7.
5. Noruzi M, Mostafavi M, Ghaznavi A, Abdollahi AA. Prevalence and Anatomic Characteristics of Accessory Mental Foramen Using Cone-Beam Computed Tomography Views in an Iranian Population. *Avicenna Journal of Dental Research*. 2020;12(4):136-41.
6. Zmysłowska-Polakowska E, Radwański M, Łęski M, Ledzion S, Łukomska-Szymańska M, Polguj M. The assessment of accessory mental foramen in a selected polish population: a CBCT study. *BMC medical imaging*. 2017;17(1):17. doi.10.1186/s12880-017-0188-6.
7. Muinelo-Lorenzo J, Suárez-Quintanilla JA, Fernández-Alonso A, Varela-Mallou J, Suárez-Cunqueiro MM. Anatomical characteristics and visibility of mental foramen and accessory mental foramen: Panoramic radiography vs. cone beam CT. *Medicina oral, patologia oral y cirugia bucal*. 2015;20(6):e707-14. doi.10.4317/medoral.20585.
8. Cantekin K, Şekerci A. Evaluation of the accessory mental foramen in a pediatric population using cone-beam computed tomography. *The Journal of clinical pediatric dentistry*. 2014;39(1):85-9. doi.10.17796/jcpd.39.1.rxtrn82463716907.
9. Torres MG, Valverde Lde F, Vidal MT, Crusoé-Rebello IM. Accessory mental foramen: A rare anatomical variation detected by cone-beam computed tomography. *Imaging science in dentistry*. 2015;45(1):61-5. doi.10.5624/isd.2015.45.1.61.
10. Iwanaga J, Kikuta S, Tanaka T, Kamura Y, Tubbs RS. Review of Risk Assessment of Major Anatomical Variations in Clinical Dentistry: Accessory Foramina of the Mandible. *Clinical anatomy (New York, NY)*. 2019;32(5):672-7. doi.10.1002/ca.23366.
11. Katakami K, Mishima A, Shiozaki K, Shimoda S, Hamada Y, Kobayashi K. Characteristics of accessory mental foramina observed on limited cone-beam computed tomography images. *Journal of endodontics*. 2008;34(12):1441-5. doi.10.1016/j.joen.2008.08.033.
12. Naitoh M, Hiraiwa Y, Aimiya H, Gotoh K, Ariji E. Accessory mental foramen assessment using cone-beam computed tomography. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*. 2009;107(2):289-94. doi.10.1016/j.tripleo.2008.09.010.
13. Yovchev D, Mihaylova H, Stanimirov P, Gusiyska A, Dimova M. Incidence, location and sizes of the accessory mental foramina in Bulgarian population assessed by cone-beam computed tomography. 2017.
14. Imada TS, Fernandes LM, Centurion BS, de Oliveira-Santos C, Honório HM, Rubira-Bullen IR. Accessory mental foramina: prevalence, position and diameter assessed by cone-beam computed tomography and digital panoramic radiographs. *Clinical oral implants research*. 2014;25(2):e94-9. doi.10.1111/clr.12066.
15. Singh R, Srivastav AK. Study of position, shape, size and incidence of mental foramen and accessory mental foramen in Indian adult human skulls. *Int J Morphol*. 2010;28(4):1141-6.
16. Khojastepour L, Mirbeigi S, Mirhadi S, Safaee A. Location of Mental Foramen in a Selected Iranian Population: A CBCT Assessment. *Iranian endodontic journal*. 2015;10(2):117-21.
17. Lam M, Koong C, Kruger E, Tennant M. Prevalence of Accessory Mental Foramina: A Study of 4,000 CBCT Scans. *Clinical anatomy (New York, NY)*. 2019;32(8):1048-52. doi.10.1002/ca.23434.
18. Paraskevas G, Mavrodi A, Natsis K. Accessory mental foramen: an anatomical study on dry mandibles and review of the literature. *Oral and maxillofacial surgery*. 2015;19(2):177-81. doi.10.1007/s10006-014-0474-1.
19. Katikireddy R, Setty S. Incidence of accessory mental foramen in South Indian adult dired mandibles. *Int J Anat Res*. 2016;4(1):1916-18.
20. Kalender A, Orhan K, Aksoy U. Evaluation of the mental foramen and accessory mental foramen in Turkish patients using cone-beam computed tomography images reconstructed from a volumetric rendering program. *Clinical anatomy (New York, NY)*. 2012;25(5):584-92. doi.10.1002/ca.21277.
21. Neves FS, Nascimento MC, Oliveira ML, Almeida SM, Bóscolo FN. Comparative analysis of mandibular anatomical variations between panoramic radiography and cone beam computed tomography. *Oral and maxillofacial surgery*. 2014;18(4):419-24. doi.10.1007/s10006-013-0428-z.