Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2013) 43: 479-483
© TÜBİTAK
doi:10.3906/sag-1206-105

The assessment of accessory mental foramina using cone-beam computed tomography

Mustafa GÖREGEN[1], Özkan MİLOĞLU[2,*], İbrahim ERSOY[3], İbrahim Şevki BAYRAKDAR[2], Hayati Murat AKGÜL[2]

[1]Department of Oral Diagnosis and Radiology, Faculty of Dentistry, Şifa University, İzmir, Turkey
[2]Department of Oral Diagnosis and Radiology, Faculty of Dentistry, Atatürk University, Erzurum, Turkey
[3]Department of Endodontics, Faculty of Dentistry, Atatürk University, Erzurum, Turkey

Received: 29.06.2012 • **Accepted:** 27.08.2012 • **Published Online:** 29.05.2013 • **Printed:** 21.06.2013

Aim: The aim of the present study is to assess accessory mental foramina (AMFs) in a Turkish population using cone-beam computed tomography (CBCT).

Materials and methods: The CBCT records of 315 patients (196 males and 119 females) were retrospectively analyzed. The differences in AMF incidence by sex, age, side, and location were evaluated using chi-square tests. The distances between the AMF and the mental foramen (MF) and between the AMF and the mandibular canal were measured. Additionally, the relationship between MF size and the presence and absence of the AMF was investigated.

Results: AMFs were observed in 6.3% of the patients. We found no significant difference between the appearance of AMF and sex ($\chi 2=1.45$, $P > 0.05$). There was no significant difference in the vertical size of MF between individuals with and without AMFs ($P > 0.05$).

Conclusion: Our results show a frequency similar to that found in a previous study of AMFs using CBCT in a Turkish population.

Key words: Accessory mental foramen, mental foramen, cone-beam computed tomography

1. Introduction

The mental foramen (MF) is an important landmark when considering placing implants in the foraminal region of the mandibular arch (1). The mental nerve emerges at the MF and divides into 4 branches: the angular branch (the innervation of the angle of the mouth), the medial and lateral inferior labial branches (the skin of the lower lip, oral mucosa, and gingiva as far posterior as the second premolar), and the mental branch (the skin of the mental region) (2). The presence of small foramina identified as accessory mental foramina (AMFs) in the surrounding area of the mental foramen has been discovered (3,4). The AMFs are defined as smaller buccal foramina with continuity to the mandibular canal (MC). Buccal foramina showing continuity without the MC are considered to be the so-called nutrient foramina (5). AMFs normally occur singly, but the number can range from 1 to 3 foramina per side (6–8).

The objective of this study is to clarify the occurrence and location of the AMF in a Turkish population using cone-beam computed tomography (CBCT). There is only one known study on AMFs in a Turkish population (9).

2. Materials and methods

Data from the CBCT examinations of 630 sites in 315 consecutive patients (186 males and 129 females) who had been referred to the oral diagnosis and radiology service at the Atatürk University Dentistry Faculty during a 3-year period were analyzed retrospectively. The overall mean age was 40.90 years (range: 4 to 85 years, standard deviation [SD]: 15.94). Subjects with trauma, skeletal asymmetries, or any destructive bone disease were excluded from this study.

Patients were scanned with CBCT (New Tom FP QR-DVT 9000, 110 kVp, 15 mA, 36 s scan time, 5.4 s typical X-ray emission time, 17 cm diameter and 13 cm height scan volume; Verona, Italy). Depending on the body mass of the patient and the extent of beam attenuation, exposure varied up to 40%. The images were examined by an oral and maxillofacial radiologist. Both the thickness of the image slices and the distance between slices were 1 mm, and voxels were isotropic for both lateral and frontal reconstructions. The CBCT images were reconstructed and observed on a computer (Asus Intel Core I7) using 3D visualization and measurement software (QR-NNT version 2.21).

* Correspondence: omiloglu@hotmail.com

As in previous studies (5,8,9), an AMF was defined strictly as a buccal foramen smaller than the MF and followed by the accessory branch of the MC before its exit from the MF regardless of its location. Buccal foramina showing discontinuity with the mandibular canal were excluded. Age and sex were recorded for all patients and, for the cases of AMF, location, sides, the distances between the AMF and the MF and between the AMF and the MC were measured. With regard to location, AMFs were classified into 2 groups as by Naitoh et al. (10): anterior to the MF and posterior to the MF. The mean vertical size of the MF was also calculated.

The variables were analyzed using the SPSS 15.0 (SPSS Inc., Chicago, IL, USA). The chi-square test was used to determine potential differences in the distribution of lesions as stratified by sex, and the Mann–Whitney U test was used to evaluate the relationship between the vertical size of the MF and the presence of AMFs. $P < 0.05$ was considered statistically significant for both tests.

3. Results

There were 196 males (62.2%) and 119 females (37.8%) in the study population. The average age of the 315 patients who were included in this study was 40.9 years (range: 20 to 85 years, SD: 15.9 years). The mean age of the males was 39.9 years (range: 7 to 82 years, SD: 15.4 years), while the mean age of the females was 42.5 years (range: 4 to 85 years, SD: 16.7 years). Twenty-two AMFs (6.3%) were observed on 630 sides of 315 patients. One AMF was observed on each side in all patients. AMFs were observed on both sides only in 2 patients. Twelve AMFs (54.6%) were located anteriorly, and 10 (45.5%) posteriorly. Fourteen AMFs (63.6%) were on the right sides, and 8 (36.4%) were on the left (Table 1).

The distance between the AMF and the MF ranged from 1.6 to 4.9 mm, with a mean of 2.54 mm (SD: 1.1 mm). The distance between the AMF and the MC ranged from 1.1 to 5.8 mm, with a mean of 2.84 mm (SD: 1.1 mm) (Table 2). Eleven sides of AMFs were observed in both male and female patients. We found no significant difference between the appearance of AMF and sex ($\chi^2 = 1.45$, $P > 0.05$) (Table 3). The mean vertical size of MFs on the same side as the AMF was 4.2 mm (range: 3.0 to 5.5 mm, Sd: 1.2 mm), and that of MF on sides without AMF was 4.5 mm (range: 3.2 to 5.8 mm, SD: 1.3 mm). The relationship between the mean vertical size of MF and the presence of AMF was not statistically significant ($P > 0.05$) (Table 4). Figures 1 and 2 show several MF and AMF examples in different images.

Table 1. Details of AMF detected in the present study.

	Age			Location		Side	
	Mean age	Range	SD	Anterior	Posterior	Right	Left
Male	39.91	7–82	15.40	6	5	8	3
Female	42.54	4–85	16.73	6	5	6	5
Total	40.90	4–85	15.94	12	10	14	8

Table 2. The mean distances between the AMF and MF, AMF, and MC.

	Distance (mm)		
	Range	Mean	SD
AMF–MF	1.6–4.9 mm	2.54 mm	1.09 mm
AMF–MC	1.1–5.8 mm	2.84 mm	1.09 mm

Table 3. Evaluation of AMF with respect to sex.

	Number of AMFs	Prevalence	Sides	χ^2	P-value
Male	11	2.81	392	1.45	P > 0.05
Female	11	4.62	238		

Table 4. Vertical sizes of MF and the presence of AMFs.

	Vertical size of MF (mm)			P-value
	Mean	Range	SD	
MF on side with AMFs	4.2	3.0–5.5	1.2	P > 0.05
MF on side without AMFs	4.5	3.2–5.8	1.3	

Table 5. Prevalence of AMFs in the literature.

Author and year	Number of patients	Number of sides	Sex (M/F)	Age	AMF	AMF %	Review source
Katakami et al., 2008 (8)	150	300	–	–	17	5.7	CBCT
Naitoh et al., 2009 (5)	84	168	27/57	52.1	7	8.3	CBCT
Naitoh et al., 2009 (10)	157	314	48/109	51.5	11	7.0	CBCT
Naitoh et al., 2010 (12)	365	730	130/235	51.7	37	7.7	CBCT+RPR*
Kalender et al., 2011 (9)	193	386	92/101	38.6	32	6.5	CBCT
Present study	315	630	196/119	40.9	22	6.3	CBCT

*RPR: rotational panoramic radiography.

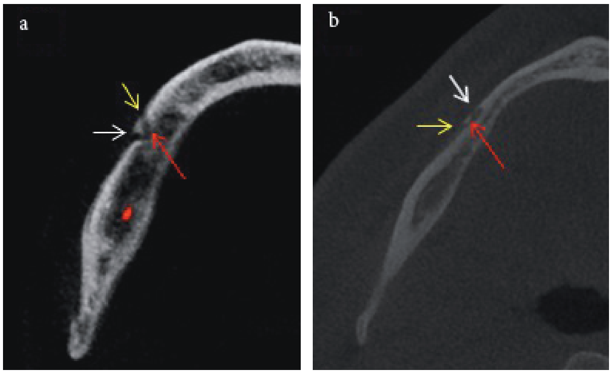

Figure 1. Mental foramen and accessory mental foramen on axial images (a and b). White arrow: mental foramen. Yellow arrow: accessory mental foramen. Red arrow: anterior loop.

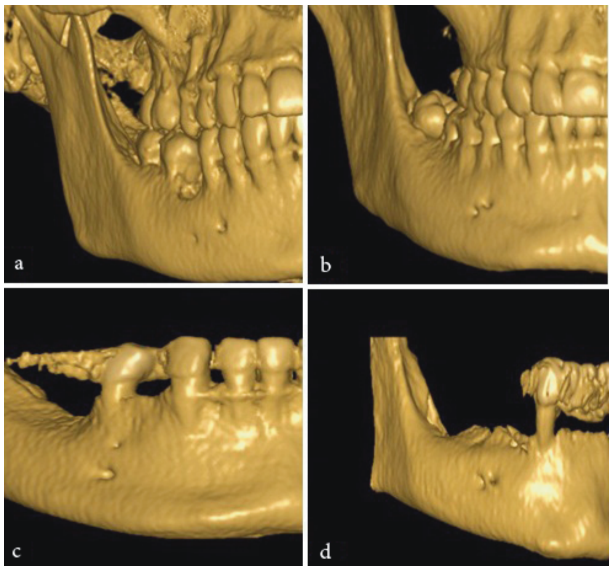

Figure 2. Three-dimensional images (a-d).

4. Discussion

The location and the course of the various neurovascular bony canals, such as the bifid mandibular canal, lateral lingual bony canals, and AMFs in the mandible, which are important factors in implant insertion and implant-related bone grafting, have been observed using multislice CT (MSCT) and CBCT images. Multiple MFs have only been reported and evaluated using CBCT images in some studies (5,8–12). The foramina located in the surrounding region of the MF have been reported as AMFs although there is no clear definition for AMFs. It is also known that there are usually some fine foramina on the bone surface, called nutrient foramina (NF), which are entry sites for arteries distributed to the bone marrow and matrix (13). Naitoh et al. (5) considered an AMF showing no connection to the MC in 3D image findings to be an NF in their investigation of AMFs using CBCT. It is significant that AMFs contain mental nerve fibers (14). Any NFs observed were excluded from this study.

The reported frequency of occurrence ranges from 5.7% to 8.3% in previous CBCT studies (5,8–11). In the present study, the rate of AMF presence was 6.3%, similar to rates found in previous studies (Table 5).

In the present study, the distance between the MF and the AMF ranged from 1.6 to 4.9 mm, with a mean of 2.54 mm (SD: 1.1 mm). Naitoh et al. (5) reported that the distance ranged from 4.5 to 9.6 mm, with a mean of 6.3 mm (SD: 1.5 mm), and Kalender et al. (9) reported a range of 1.3 to 15.4 mm, with a mean of 5.2 mm (SD: 4.4 mm). The present result is less than those of the previous studies.

The distances between the AMF and the MC ranged from 1.1 to 5.8 mm, with a mean of 2.84 mm (SD: 1.1 mm). Naitoh et al. (11) found that the distance between the AMF and the MC ranged from 1.1 to 13.6 mm, with a mean of 6.4 mm (SD: 3.3 mm). Our result is lower than this previous finding.

The mean vertical size of the MF on the same side as the AMF was 4.2 mm (range: 3.0 to 5.5 mm, SD: 1.2 mm), and that on sides without AMF was 4.5 mm (range: 3.2 to 5.8 mm, SD: 1.3 mm). The relationship between the mean vertical size of the MF and the presence of AMF was not statistically significant ($P > 0.05$). Naitoh et al. (5) reported that there was no significant difference in the vertical size and area of the MF in the presence and absence of AMF. Our findings concur with this study regarding the vertical size of AMF.

In conclusion, in humans, the MF and AMF are usually single. However, AMFs are infrequently observed (3,15). Multiple AMFs are considered rare (16). Our findings support this. The presence of AMFs in the mandible is frequently overlooked in clinical procedures (17). It is important to stress that detecting these anatomical variations using CBCT with 3D reconstructions may have a direct influence on therapeutic success. The detection of AMFs using CBCT images might reduce rates of paralysis and hemorrhage in the mental and cheek regions (5). The recognition of AMF may contribute to more adequate anesthetic techniques and help to avoid incorrect diagnosis of bone lesions and eventual damages to the nerves and vessels during periapical surgical procedures. Additionally, the possibility of AMF-related sensory disturbance is low during root canal treatment unless the MF and the MC are injured.

Acknowledgment

This study was submitted as a poster presentation at the 5th biennial meeting of the European Federation of Conservative Dentistry, held in association with the 6th international congress of the Society of Restorative Dentistry, Turkey, 13–15 October 2011, İstanbul, Turkey.

References

1. Greenstein G, Tarnow D. The mental foramen and nerve: clinical and anatomical factors related to dental implant placement: a literature review. J Periodontol 2006; 77: 1933–43.
2. Hu KS, Yun HS, Hur MS, Kwon HJ, Abe S, Kim HJ. Branching patterns and intraosseous course of the mental nerve. J Oral Maxillofac Surg 2007; 65: 2288–94.
3. Riesenfeld A. Multiple infraorbital, ethmoidal and mental foramina in the races of man. Am J Phys Anthrop 1956; 14: 85–100.
4. Sutton RN. The practical significance of mandibular accessory foramina. Aust Dent J 1974; 19: 167–73.
5. Naitoh M, Hiraiwa Y, Aimiya H, Gotoh K, Ariji E. Accessory mental foramen assessment using cone-beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009; 107: 289–94.
6. Simonton FV. Mental foramen in the anthropoids and in man. Am J Phys Anthropol 1923; 6: 413–21.
7. Toh H, Kodama J, Yanagisako M, Ohmori T. Anatomical study of the mental foramen and the distribution of its nerve. Okajimas Folia Anat Jpn 1992; 69: 85–8.
8. 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. J Endod 2008; 34: 1441–5.
9. 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. Clin Anat 2012; 25: 584–92.
10. Naitoh M, Nakahara K, Yuichiro H, Aimiya H, Kenichi G, Eiichiro A. Observation of buccal foramen in mandibular body using cone-beam computed tomography. Okajimas Folia Anat 2009; 86: 25–9.
11. Naitoh M, Yoshida K, Nkahara K, Gotoh K, Ariji E. Demonstration of the accessory mental foramen using rotational panoramic radiography compared with cone-beam computed tomography. Clin Oral Implant Res 2011; 22: 1415–9.
12. Naitoh M, Nakahara K, Suenaga Y, Gotoh K, Kondo S, Ariji E. Comparison between cone-beam and multislice computed tomography depicting mandibular neurovascular canal structures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010; 109: 25–31.

13. Fuakami K, Shiozaki K, Mishima A, Shimoda S, Hamada Y, Kobayashi K. Detection of buccal perimandibular neurovascularisation associated with accessory foramina using limited cone-beam computed tomography and gross anatomy. Surg Radiol Anat 2011; 33: 141–6.

14. López AB, Diago MP. Failure of locoregional anesthesia in dental practice. Review of the literature. Med Oral Patol Oral Cir Bucal 2006; 11: e510–3.

15. Montagu AMF. The direction and position of the mental foramen in the great apes and man. Am J Phys Anthropol 1954; 12: 503–18.

16. Kieser J, Kuzmanovic D, Payne A, Dennison J, Herbison P. Patterns of emergence of the human mental nerve. Archiv Oral Biol 2002; 47: 743–7.

17. Neves FS, Torres MGG, Oliveira C, Campos PSF, Rebello CI. Lingual accessory mental foramen: a report of an extremely rare anatomical variation. J Oral Sci 2010; 52: 501–3.