Cumhuriyet Dental Journal, 25(Suppl): 42-46, 2022
DOI: https://doi.org/10.7126/cumudj.1032866

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

A Retrospective Evaluation of Bifid Mandibular Canal Prevalence of Southeastern Anatolia Population by Cone-Beam Computed Tomography#

Nedim Gunes[1,a]*, Rıdvan Guler[1,b], Hatice Demircan Agin[1,c], Serkan Dundar[2,d], Veysel Eratilla[3,e]

[1]*Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Dicle University, Diyarbakir, Turkiye*
[2]*Department of Periodontology, Fculty of Dentistry, Firat University, Elazig, Turkiye*
[3]*Department of Prosthodontics, Faculty of Dentistry, Batman University, Batman, Turkiye*
**Corresponding author*

Research Article

Acknowledgment
#This study was presented as an oral presentation at the "Sivas Cumhuriyet University 1st International Dentistry Congress" held between 23-25 November 2021.

History

Received: 05/12/2021
Accepted: 16/02/2022

ABSTRACT

Introduction: Bifid mandibular canal (BMC) is often detected incidentally on radiological examination and can be observed in unilateral or bilateral forms. The correct localization of the BMC plays an important role in the prevention of complications such as paresthesia, anesthesia, bleeding, traumatic neuroma, which may occur during or after surgical operations on the mandible such as sagittal split ramus osteotomy, impacted third molar tooth extraction, and dental implant surgery.

Objective: This study aims to retrospectively evaluate the prevalence of bifid mandibular canal (BMC) in the Southeastern Anatolian population via Conical Beam Computed Tomography (CBCT).

Material and Method: In this retrospective study, CBCT images of 615 patients, who applied to the Department of Oral and Maxillofacial Surgery in the Faculty of Dentistry at Dicle University, Turkey, for various reasons from 2015 to 2020, is evaluated and cases with bifid mandibular canals are examined. The prevalence evaluation is conducted by statistical analyses in terms of sex and laterality.

Results: According to the analyses, the BMC prevalence did not constitute a significant difference in terms of the age variable. The incidence of unilateral BMC was higher than bilateral BMC. Additionally, the prevalence of BMC was higher in males compared to.

Conclusion: BMC, which can be detected more easily and frequently via CBCT technology, is an anatomical formation that should be taken into account during oral and maxillofacial practices.

Keywords: Bifid Mandibular Canal, Alveolaris Inferior, Cone-Beam Computerized Tomography, Anatomical Variation.

[a] *nedimgunes1905@hotmail.com* *https://orcid.org/0000-0001-7160-1899*
[b] *ridvanguler06@gmail.com* *https://orcid.org/0000-0003-4750-9798*
[c] *dthaticedemircan@hotmail.com* *https://orcid.org/0000-0002-0330-3133*
[d] *dtserkandundar@gmail.com* *https://orcid.org/0000-0003-3944-1957*
[e] *veyseleratilla@gmail.com* *https://orcid.org/0000-0002-3511-5612*

How to Cite: Güneş N, Güler R, Demircan Agin H, Dündar S, Eratilla V.(2021) A Retrospective Evaluation of Bifid Mandibular Canal Prevalence of Southeastern Anatolia Population by Cone-Beam Computed Tomography, Cumhuriyet Dental Journal,25(Suppl): 42-46.

Introduction

The bifid mandibular canal (BMC) is the division of the mandibular canal into two, passing through the ramus or dentoalveolar structure, each canal containing a separate vascular nerve package. Although anatomical variations of the mandibular canal can be observed on panoramic radiographs, these variations can be overlooked in panoramic radiographs due to a lack of experience by many clinicians.[1-5]

Furthermore, due to negative reasons such as the pharynx, soft palate, uvula, and ghost images in panoramic radiography, difficulties may be experienced while determining the anatomical location of the mandibular canal. Because of these negative features of panoramic radiography, Cone-beam Computed Tomography (CBCT), which emits less radiation and has a lower cost compared to Computed Tomography (CT), is considered practical in the evaluation of bifid mandibular canals.[3-5]

Although the mandibular canal is recognized as the only bilateral structure originating from the mandibular foramen, extending along the mandible and ending in the mental foramen, the presence of a second, or even third, accessory branch was reported in the literature. Despite the lack of concrete evidence on the etiology of the bifid mandibular canal (BMC), it was also reported that BMC could occur due to incomplete fusion of the inferior alveolar nerve during embryonic development. Furthermore, BMC cases were often detected incidentally on radiological examinations and observed in unilateral or bilateral forms.[4-6]

In clinical practice, the correct localization of BMC plays an important role in preventing complications such as paresthesia, anesthesia, bleeding, traumatic neuroma, which may occur during or after surgical operations in the mandible, such as sagittal split ramus osteotomy, impacted third molar tooth extraction, and dental implant surgery.[1-7]

To the best of our knowledge, there has been no study in the literature evaluating the bifid mandibular canal with Computed Tomography (CT) or Cone-beam Computed

Tomography (CBCT) examining the Southeastern Anatolian population. Accordingly, we think that our study will contribute to the literature in this regard along with the three-dimensional evaluation of the bifid mandibular canal, which both increases the reliability and emphasizes the authenticity of the current study. Within this scope, this study aims to retrospectively evaluate the prevalence of the bifid mandibular canal in the Southeastern Anatolian population via Cone-beam Computed Tomography (CBCT).

Material and Methods

In this retrospective study, CBCT images of 615 patients, who applied to the Department of Oral and Maxillofacial Surgery in the Faculty of Dentistry at Dicle University for various reasons from 2015 to 2020, are evaluated and cases with bifid mandibular canal were evaluated in terms of age, sex and laterality. Before the study was initiated, the study was approved by the Faculty of Dentistry Clinical Research Ethics Committee at Dicle University (Case no: 2020-48). Then, the images of the patients were analyzed to determine the prevalence ratios.

Within the framework of the study, 305 male (49.59%) and 310 female (50.41%) patients were included in the study. In the analyses, it was determined that the mean age of the patients was 34 (ranging from 18 to 65). CBCT data and assessments were derived from diagnostic images as part of the evaluation during treatment planning for implant surgery, orthognathic surgery, wisdom teeth surgery, or orthodontic treatment practices. Additionally, informed consent was obtained from all the patients before obtaining the radiological data.

During the imaging procedures, all the radiological scans were conducted in the supine position with Icat CBCT device (Imaging Sciences International Hatfield PA, USA) operating at 110 kVp, 1-20 mA, 15×12 field of view (FOV) and standard resolution mode (0.2 mm) (voxel size). Moreover, lack of demographic data, images obtained only from the maxilla, radiographic images of intraosseous lesions, low-quality images, images without 15x12 FOV were determined as the exclusion criteria for the patients.

The presence of BMCs was detected by an experienced oral and maxillofacial radiologist using the "zoom" tool at the NNT station (QR srl, Verona, Italy) in dim light conditions and manipulation of brightness/ contrast ratios on a computer monitor (RadiForce MX270W with 27-inch high-resolution widescreen monitor running on 2560x1440 resolution). Sex and laterality were taken into account while analyzing BMCs. The data were obtained by evaluating the CBCT images in axial directions and orthopantomography images (Figure 1, 2, 3). While evaluating BMC, attention was paid to examining 2 radiolucent lines and at least 3 radiopaque borders on the monitor in the image analysis.

Statistical Analysis

For the statistical analyses, IBM SPSS 21.0 package software was used with the data. The measured variables were presented as mean ± standard deviation (SD) while the categorical variables were presented in numbers and percentages (%). The Kruskal-Wallis test was used to compare the groups with more than two samples. The Chi-square ($\chi 2$) test was used for the intergroup comparison of categorical variables. The hypotheses were two-sided, and the level of statistical significance was regarded as $p \leq 0.05$.

Results

According to the results of our study, the percentage of BMC in the total population (615 patients) was 24.39%. Among those with BMC, 53.33% were males while 46.67% were females. Of the 615 patients, the incidence of unilateral BMC was 22.11% while the rate of bilateral BMC was 1.14%. When the patients with BMC were examined (150 patients), the rate of unilateral incidence was 90.67% in addition to the 9.33% of bilateral incidence.

Figure 1. Bifid mandibular canal on the orthopantomography image with both sides of the mandible.

Figure 2. BMC on the right side of the mandible in the axial tomographic (cone-beam computerized tomography) section.

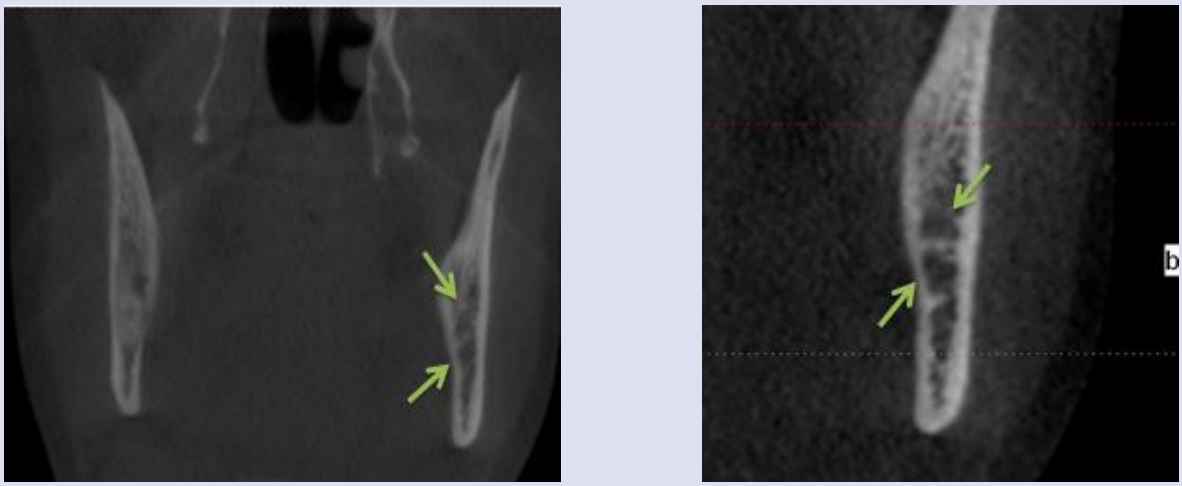

Figure 3. BMC on the left side of the mandible in the axial tomographic (cone-beam computerized tomography) section.

A total of 150 BMCs were detected in 143 patients. While BMC was detected in the bilateral form in 7 patients, it was detected unilaterally in 136 patients. Among the patients with BMC, 73 were males and 70 were females (Table 1). The prevalence of unilateral BMC was statistically significant compared to bilateral BMC ($p<0.05$; $p=0.016$) (Table 2). The prevalence of BMC in males was higher in a statistically significant way compared to females ($p<0.05$; $p=0.008$). When the incidence of BMC was evaluated in terms of the age variable, no statistically significant difference was observed (Table 3).

Discussion

Bifid mandibular canal (BMC) is an anatomical variation formed by the division of the mandibular canal into two branches. The reason why BMC occurs is not exactly known. The most likely cause is incomplete fusion of three different inferior alveolar nerves innervating the three mandibular teeth groups during the embryonic developmental stage of the seventh week of pregnancy.[4,5]

Accurate recognition of the anatomy and variations of the mandibular canal is important during oral and maxillofacial surgical applications involving the lower jaw, such as surgical implant placement, surgical fixation of mandibular fractures, extraction of impacted teeth, and orthognathic surgery. In cases where the bifid mandibular canal cannot be detected, many undesirable conditions such as paresthesia, traumatic neuroma, anesthesia, and bleeding may be encountered during surgical procedures.[9,10]

In the literature, previous studies reported that the prevalence of BMC was evaluated by panoramic radiography. However, the image obtained with panoramic radiographs is 2 dimensional, which may lead to a failure of detecting a possible BMC due to superpositions. Accordingly, a need for studies in further detail arises. Furthermore, few studies examined BMC with Computed Tomography (CT) and Cone-Beam Computed Tomography (CBCT), which reinforces the need for further detail. Evaluation of BMC in 3 dimensions improves the reliability of the data obtained in the analyses.

Table 1. Total prevalence of BMC in sex and laterality

Results	AGE RANGE	BMC
615 Patients - 310 Females -305 males	18-25	19
150 BMC in 143 Patients	26-33	21
Unilateral in 136 patients	34-41	24
Bilateral in 7 patients	42-49	27
73 males - 70 females	50-57	28
310 Females-305 males	58-65	24

Unilateral BMC: 136/615, Bilateral BMC: 7/615

Table 2. Prevalence of BMC in sex

Total	615	143	p
Female	310	70	0.008**
Male	305	73	

	615	143	p
Unilateral	136	136	0.016*
Bilateral	7	7	

*p<0.05 **p<0.01

Table 3: Statistical Analysis in terms of Age

Ranks			
	Group	N	Mean Rank
BMC	18-25	1	1.00
	26-33	1	2.00
	34-41	1	3.50
	42-49	1	5.00
	50-57	1	6.00
	58-65	1	3.50
	Total	6	

Test Statistics[a,b]	
	BMC
Kruskal-Wallis H	5.000
df	5
Asymp. Sig.	0.416[ns]
a. Kruskal Wallis Test	
b. Grouping Variable	

ns: p>0.05

Compared to CT, CBCT is advantageous in the evaluation of bone structures in the maxillofacial region with its features such as less radiation, shorter imaging time, high resolution in bone, and low cost. Therefore, CBCT was chosen to analyze BMC in this study.[11-14]

The mandibular canal is an anatomical formation that extends bilaterally from the mandibular foramen to the mental foramen, which carries the alveolaris inferior neurovascular vascular nerve package. Knowing the location, shape and anatomical structure of the mandibular canal is essential for surgical applications involving the mandible. Although the mandibular canal can be detected as a single formation, its anatomical variations were also detected. Bifid is a term of Latin origin, which means divided into two. In a study conducted by Chavez et al., it was reported that three different lower dental nerves might be combined to form a single nerve during embryonic development. In such cases, bifid and trifid mandibular canals could occur as a result of incomplete fusion of these three nerves.[14,15]

Anatomical structures should be studied carefully during clinical and surgical applications. Knowing the anatomical variations of the mandibular canal can help prevent undesirable conditions such as traumatic neuroma, paresthesia, anesthesia, and bleeding related to BMC during surgical procedures performed on the mandibular canal. Previous studies in the literature reported that the anatomical structures and locations of BMCs were taken into account while detecting BMC. Nortje *et al.*[16] and Langlais *et al.*[17] used panoramic radiography to detect BMCs. Moreover, Naitoh *et al.*[18] used CBCT for the detection of BMCs in their study. In studies where the mandibular canal and its variations were evaluated with panoramic radiography, problems such as ghost images that may occur on the opposite side of the mandible and overlapping of neighboring structures may be encountered. In previous studies, it was thought that BMC was under-detected due to the limitations of panoramic radiography.[18]

CBCT Panoramic radiography is more advantageous compared to CT thanks to its features such as high quality and 3D image acquisition in detecting the mandibular canal and its variations. The application of CT in dentistry is limited. It is possible to detect BMCs with CT, but it is not preferred due to disadvantages such as high cost, low accessibility, and high radiation dose. In this study, BMC was analyzed in three dimensions with CBCT. We think that the evaluation of BMC in 3

dimensions improves the reliability of the study. Accordingly, our study can ensure significant contributions to the literature as well as compensate for the lack of studies investigating the Southeastern Anatolian Region in Turkey.[14-19]

In this study, only the prevalence of BMC was evaluated. However, the BMC length and angle along with the BMC classification can also provide valuable data on the subject. Accordingly, further studies are required on the properties of BMC.[4]

Conclusions

In conclusion, in this study, BMC was evaluated with CBCT in the Southeastern Anatolian population. Although the bifid mandibular canal is a rare phenomenon, it is increasingly reported with advanced imaging methods and is an important anatomical variation that should be taken into account during oral and maxillofacial pratices.

References

1. Okumuş Ö, Dumlu A. Prevalence of bifid mandibular canal according to gender, type, and side. J Dent Sci. 2019 Jun;14(2):126-133. DOI: 10.1016/j.jds.2019.03.009. Epub 2019 Apr 11. PMID: 31210887; PMCID: PMC6562102.
2. Zhang YQ, Zhao YN, Liu DG, Meng Y, Ma XC. Bifid variations of the mandibular canal: cone-beam computed tomography evaluation of 1000 Northern Chinese patients. Oral Surg Oral Med Oral Pathol Oral Radiol. 2018 Nov;126(5):e271-e278. DOI: 10.1016/j.oooo.2018.06.008. Epub 2018 Jun 30. PMID: 30093317.
3. Correr GM, Iwanko D, Leonardi DP, Ulbrich LM, Araújo MR, Deliberador TM. Classification of bifid mandibular canals using cone-beam computed tomography. Braz Oral Res. 2013 Nov-Dec;27(6):510-6. DOI: 10.1590/S1806-83242013000600011. PMID: 24346049.
4. Laçin N, Aytuğar E, Veli İ Cone-beam computed tomography evaluation of bifid mandibular canal in a Turkish population. International Dental Research, 2018; 8 (2), 78-83.
5. Das S, Suri RK. An anatomic-radiological study of an accessory mandibular foramen on the medial mandibular surface. Folia Morphol 2004;63:511-3.
6. Kuribayashi A, Watanabe H, Imaizumi A, Tantanapornkul W, Katakami K, Kurabayashi T. Bifid mandibular canals: cone-beam computed tomography evaluation. Dentomaxillofac Radiol. 2010 May;39(4):235-9. DOI: 10.1259/dmfr/66254780. PMID: 20395465; PMCID: PMC3520225.
7. Elnadoury EA, Gaweesh YSE, Abu El Sadat SM, Anwar SK. Prevalence of bifid and trifid mandibular canals with unusual patterns of nerve branching using cone-beam computed tomography. Odontology. 2021 Jul 15. DOI: 10.1007/s10266-021-00638-9. Epub ahead of print. PMID: 34263380.
8. Zhang YQ, Zhao YN, Liu DG, Meng Y, Ma XC. Bifid variations of the mandibular canal: cone-beam computed tomography evaluation of 1000 Northern Chinese patients. Oral Surg Oral Med Oral Pathol Oral Radiol. 2018 Nov;126(5):e271-e278. DOI: 10.1016/j.oooo.2018.06.008. Epub 2018 Jun 30. PMID: 30093317.
9. Claeys V, Wackens G. Bifid mandibular canal: literature review and case report. Dentomaxillofac Radiol. 2005 Jan;34(1):55-8. DOI: 10.1259/dmfr/23146121. PMID: 15709108.
10. Mizbah K, Gerlach N, Maal TJ, Bergé SJ, Meijer GJ. The clinical relevance of bifid and trifid mandibular canals. Oral Maxillofac Surg. 2012 Mar;16(1):147-51. DOI: 10.1007/s10006-011-0278-5. Epub 2011 Jun 23. PMID: 21698363; PMCID: PMC3294215.
11. Orhan K, Aksoy S, Bilecenoglu B, Sakul BU, Paksoy CS. Evaluation of bifid mandibular canals with cone-beam computed tomography in a Turkish adult population: a retrospective study. Surg Radiol Anat. 2011 Aug;33(6):501-7. DOI: 10.1007/s00276-010-0761-y. Epub 2010 Dec 16. PMID: 21161224.
12. Villaça-Carvalho MF, Manhães LR Jr, de Moraes ME, Lopes SL. Prevalence of bifid mandibular canals by cone-beam computed tomography. Oral Maxillofac Surg. 2016 Sep;20(3):289-94. DOI: 10.1007/s10006-016-0569-y. Epub 2016 Jul 15. PMID: 27417545.
13. De Oliveira-Santos C, Souza PH, de Azambuja Berti-Couto S, Stinkens L, Moyaert K, Rubira-Bullen IR, Jacobs R. Assessment of variations of the mandibular canal through cone-beam computed tomography. Clin Oral Investig. 2012 Apr;16(2):387-93. DOI: 10.1007/s00784-011-0544-9. Epub 2011 Mar 30. PMID: 21448636.
14. Shen EC, Fu E, Fu MM, Peng M. Configuration and corticalization of the mandibular bifid canal in a Taiwanese adult population: a computed tomography study. Int J Oral Maxillofac Implants. 2014 Jul-Aug;29(4):893-7. DOI: 10.11607/jomi.3435. PMID: 25032769.
15. Chávez-Lomeli ME, Mansilla Lory J, Pompa JA, Kjaer I. The human mandibular canal arises from three separate canals innervating different tooth groups. J Dent Res. 1996 Aug;75(8):1540-4. DOI: 10.1177/00220345960750080401. PMID: 8906121.
16. Nortjé CJ, Farman AG, Grotepass FW. Variations in the normal anatomy of the inferior dental (mandibular) canal: a retrospective study of panoramic radiographs from 3612 routine dental patients. Br J Oral Surg. 1977 Jul;15(1):55-63. DOI: 10.1016/0007-117x(77)90008-7. PMID: 268217.
17. Langlais RP, Broadus R, Glass BJ. Bifid mandibular canals in panoramic radiographs. J Am Dent Assoc. 1985 Jun;110(6):923-6. DOI: 10.14219/jada.archive.1985.0033. PMID: 3860553.
18. Naitoh M, Hiraiwa Y, Aimiya H, Ariji E. Observation of bifid mandibular canal using cone-beam computerized tomography. Int J Oral Maxillofac Implants. 2009 Jan-Feb;24(1):155-9. PMID: 19344041.
19. Von Arx T, Bornstein MM. The bifid mandibular canal in three-dimensional radiography: morphologic and quantitative characteristics. Swiss Dent J. 2021 Jan 11;131(1):10-28. Epub 2020 Dec 16. PMID: 33325209