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Original Article

Cone-beam computed tomography evaluation of bifid mandibular canal in a Turkish population

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Abstract

Aim: The aim of the study was to examine the prevalence of bifid mandibular canals (BMC) in a Turkish population, using cone-beam computed tomography (CBCT).
Methodology: The CBCT images of 350 untreated patients (178 male, 172 female ranging in age between 18 and 65,) were included in this study. The presence or absence of BMC was determined in axial, sagittal, and coronal planes by considering gender and side. For statistical evaluation, a chi-square test was used to determine any differences in the prevalence of BMC with significance set at 5%.
Results: BMCs were observed in 129 out of 700 sides (18.42%) and 97 out of 350 patients (27.71%), of which, 55 were in males and 42 in females. Regardless of gender, the right side was more frequently affected (73%). Male patients showed higher prevalence (15.71%) than the female patients (12%).
Conclusions: BMC was observed in 27.71% of examined Turkish subjects and detected more frequently in males and on the right side.

Keywords: Bifid mandibular canal, cone-beam computed tomography, mandibular canal, anatomic variation

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Introduction

The mandibular canal (MC), a bilateral anatomic structure which originates in the mandibular foramen and runs longitudinally towards mental foramen, is a conduit for the inferior alveolar artery, the inferior alveolar vein and the inferior alveolar nerve (IAN), and relates with the roots of the inferior molars and premolars in its course (1, 2).

The location and the configuration of the MC are of particular interest to the clinicians in surgical procedures involving mandible, such as the extraction of the impacted third molar, dental implant treatment, and sagittal split ramus osteotomy (3). The three-dimensional (3D) relationship of the mandibular third molar root with the MC is important to avoid any pressure on the IAN (4). Also, the intrusion of the implant into the canal or penetration by the drill before implant placement may traumatize IAN (5). Moreover, IAN may be damaged during bilateral sagittal split osteotomy (6).

Identifying an anatomical variation has important clinical implications to avoid complications during surgical procedures such as paraesthesia and unanticipated bleeding (7—9). A bifid mandibular canal (BMC) is an anatomical variation implying that the mandibular canal is divided into two branches (10). The exact etiology of BMC is unknown. However, the most likely cause is the incomplete fusion of the three distinct inferior alveolar nerves innervating three groups of mandibular teeth during embryonic development around the seventh week of gestation to form a single nerve (1, 11).

BMC is usually diagnosed as an incidental finding during routine radiographic examination. Dental panoramic radiography, computed tomography (CT) and cone-beam computed tomography (CBCT) have all been used to identify the prevalence of bifid mandibular canals (1). Orhan et al. investigated the incidence and location of BMCs in a Turkish adult population and concluded higher prevalence of BMCs than what has been reported in previous studies using conventional radiography techniques (1).

Villaça-Carvalho et al. (12) investigated the prevalence of BMC by cone beam computed tomography (CBCT) and concluded that the prevalence of BMC is significant and should not be overlooked. Kuribayashi et al. (13) evaluated the incidence and configuration of the BMC using CBCT and reported that a BMC was found in a markedly higher proportion than found in previous reports using panoramic images. The bifid mandibular canals were found in 0.08%-0.95% of the cases when evaluating panoramic radiographs,2,8 and 10.2%-65% of the cases when using CBCT images (3, 13).

Due to lack of epidemiological data, there is not enough information to determine the true frequency of this morphological variation. Therefore, the purpose of this study was to evaluate the prevalence of BMC in a Turkish population by using CBCT.

Materials and Methods

In this retrospective study, CBCT scans of 350 patients who visited İzmir Katip Çelebi University, Faculty of Dentistry between January 2012 and December 2017 were evaluated.

Patients consisted of 178 (50.8%) male and 172 (49.14%) female patients, with a mean age of 32 years (range: 18-65 years). The CBCT scans had been taken for diagnostic purposes as a part of comprehensive evaluation for implant surgery, orthognathic surgery, impacted tooth surgery or orthodontic treatment. As a routine protocol, informed consents were obtained from all patients before exposure. All scans were obtained in supine position, using a NewTom 5G CBCT machine (QR srl, Verona, Italy), operating at 110 kVp, 1-20 mA with a 15×12 field of view (FOV) and standard resolution mode (0.2mm voxel size). Lack of demographic information, images of the maxilla only, radiographic evidence of intraosseous lesions, images of low quality, images without 15x12 FOV were considered as the exclusion criteria.

The presence of BMCs were detected on NNT station (QR srl, Verona, Italy) using the "zoom" tool and manipulation of brightness and contrast on a computer monitor (The RadiForce MX270W features a 27-inch large screen size and a 2560 x 1440 high-resolution) under dim lighting conditions by an experienced oral and maxillofacial radiologist. CBCT images were evaluated in axial, sagittal, and coronal planes (Figure 1-3) and BMCs were detected if 2 radiolucent lines and at least 3 radiopaque borders were clearly seen on the monitor. The BMCs were analyzed by considering gender and side.

25% of the CBCT scans were randomly selected and reevaluated by the same investigator 2 weeks after the first evaluation to determine intraexaminer reliability using the intraclass correlation coefficient (ICC).

Statistical Analysis

All data analyses were carried out using SigmaStat (version 3.5; Systat Software, San Jose, Calif). The recorded data was statistically analyzed using chi-square test (x^2) to compare the prevalence of BMC between genders and sides. A probability value of 0.05 or less was set as the significance level.

Results

Intraexaminer reliability was found excellent (ICC: 0.998).

BMCs were observed in 129 out of 700 sides (18.42%) and in 97 out of 350 patients (27.71%) (Table 1). These canals were observed in 74 males and 55 females. Male patients showed higher prevalence (21.14%) than the female patients (15.71%). There were significant differences in the prevalence between gender and sides (p=0.000).

BMCs were also observed in a higher prevalence on the right side (11.71%). 32 patients were found to have BMCs on both sides (9.14%). There was also significant difference between right and left sides regardless of gender with respect to the incidence of the BMC (Table 2).

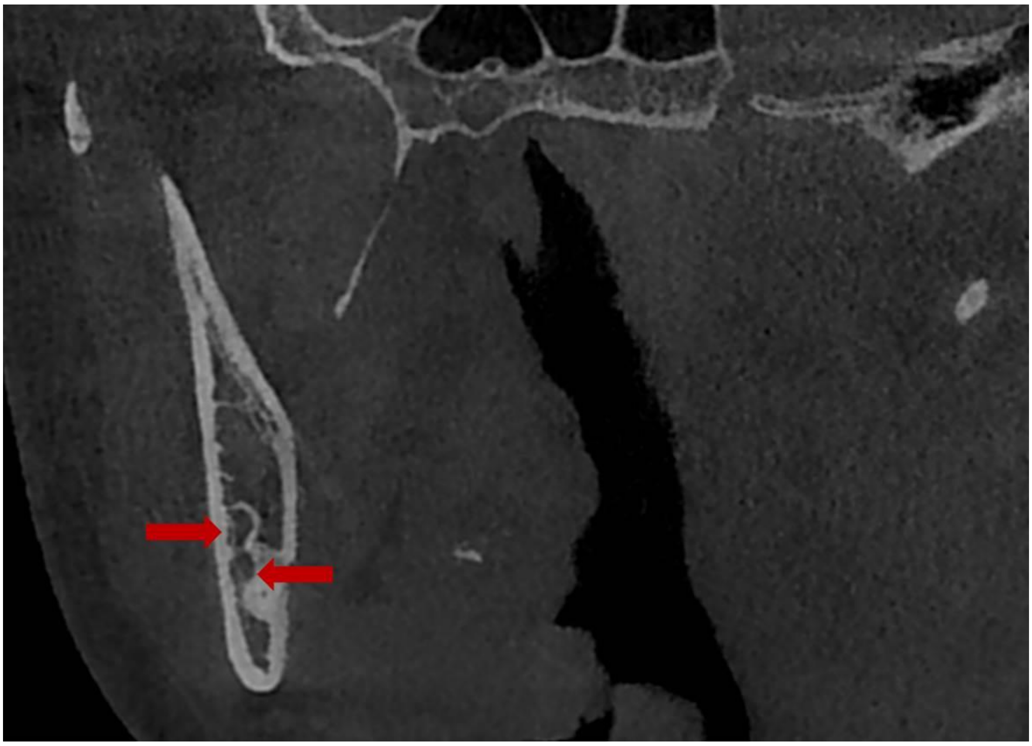

Figure 1. Axial view of bifid mandibular canal

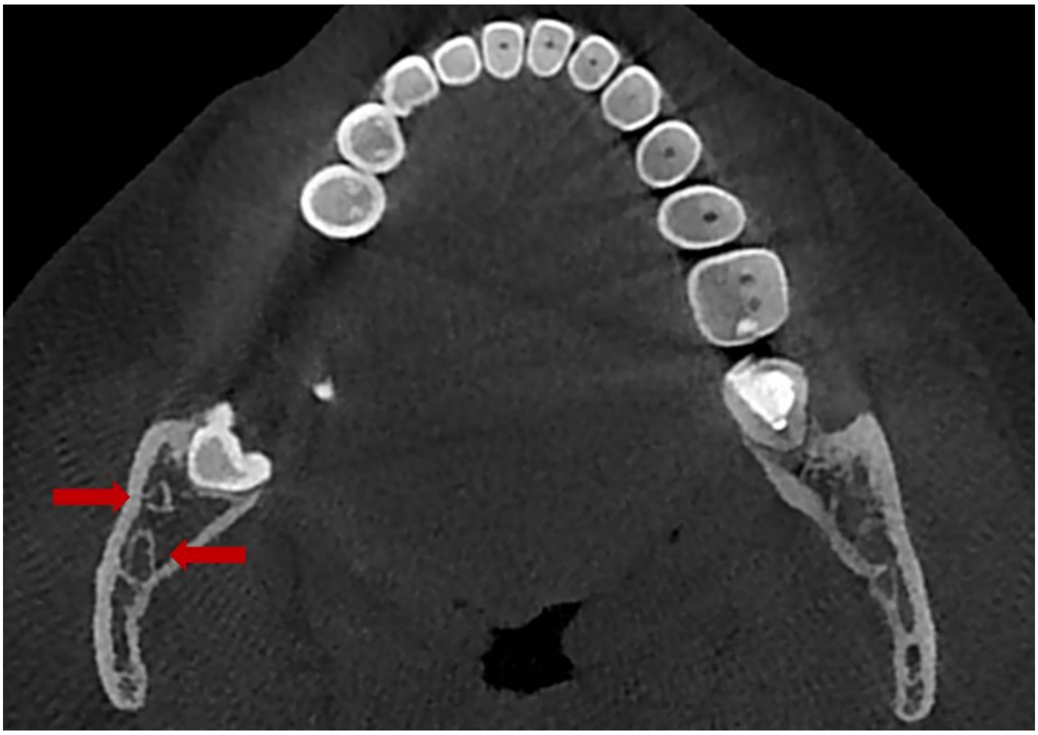

Figure 2. Coronal view of bifid mandibular canal

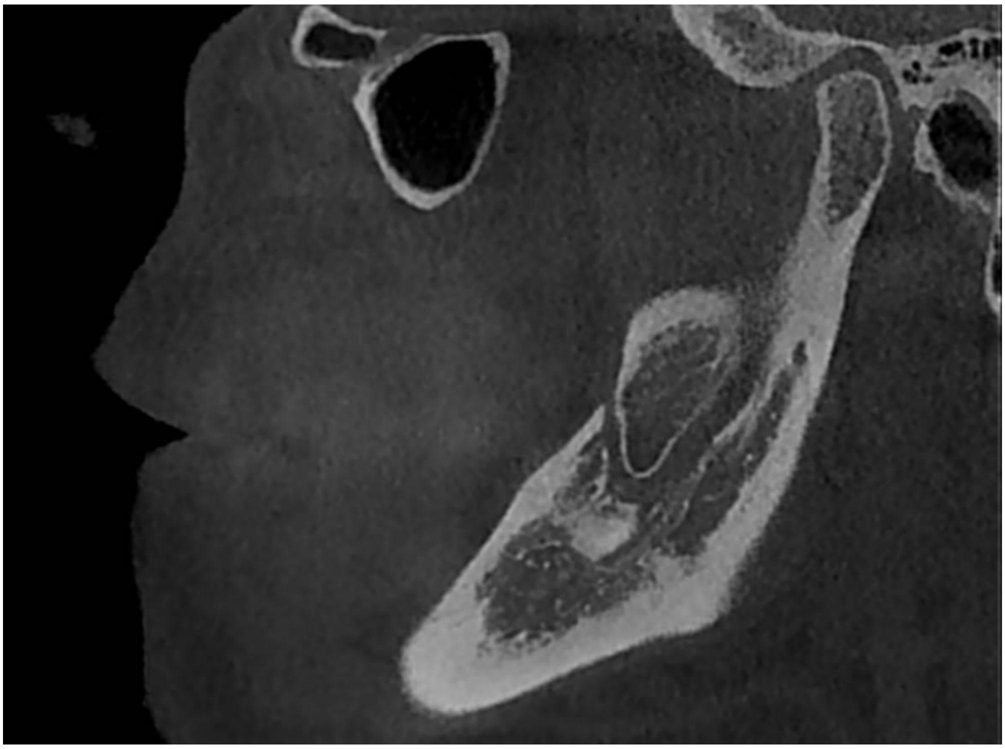

Figure 3. Sagittal view of bifid mandibular canal

Table 1. Prevalence of bifid mandibular canal according to gender and side.

GENDER			LEFT				
			Absent	Present	Total	x^2	p
Male	RIGHT	Absent	123 (69,1%)	15 (8,4%)	138 (77,5%)	26,928	0,0000
		Present	21 (11,8%)	19 (10,7%)	40 (22,5%)		
		Total	144 (80,9%)	34 (19,1%)	178 (100%)		
Female	RIGHT	Absent	130 (75,6%)	9 (5,2%)	139 (80,8%)	25,908	0,0000
		Present	20 (11,6%)	13 (7,6%)	33 (19,2%)		
		Total	150 (87,2%)	22 (12,8%)	172 (100%)		

x^2: Chi-square

Table 2. Prevalence of BMC in total sample regardless of gender

LEFT	RIGHT				
	Absent	Present	Total	x2	p
Absent	253 (72.28%)	41 (11.71%)	294 (84.0%)	50,591	0,0000
Present	24 (6.85)	32 (9.14)	56 (16.0%)		
Total	277 (79.1%)	73 (20.9%)	350 (100%)		

x^2: Chi-square

Discussion

The presence of BMCs has great clinical implication during surgical procedures and the incidence of BMCs has been reported to be in the range of 0.08-64.8% with no agreement in literature (2, 3, 13—15). This study aimed to investigate the BMCs using CBCT since there are few epidemiologic studies that investigated the incidence.

Comparing anatomical and radiographic investigations, some authors believe that panoramic radiographs underestimate the incidence of BMCs and anatomical variations (16—19). Identification of BMCs using panoramic radiography is complicated by ghost shadows created by the opposing semi-mandible and overlapping with pharyngeal airway, soft palate, and uvula (3, 17). Moreover, the false image could be observed due to sclerotic lines caused by the insertion of the mylohyoid muscle into the lingual surface of the mandible (20). Another factor that could mislead the diagnosis of a bifid mandibular canal is the presence of a dense trabecular structure around it (21). Kim et al. performed a study to verify BMCs by using panoramic radiographs from dental patients and CBCT and micro-CT from dry mandibles (22). They confirmed their results by a stereoscopic and histological examination and concluded that the presence of BMCs determined by panoramic radiography should be judged with great caution in relation to dental surgery.

Unlike panoramic radiography, CBCT can provide a multiplanar image suitable for identifying the BMC, without a ghost image and the false appearance of the bifid canal (10). Kuribayashi et al. reported that CBCT is considered a suitable modality for detailed evaluation of BMCs (13). Rouas et al. also recommended CBCT as an excellent, low-cost tool for the evaluation of these anatomical structures with only slightly more radiation than panoramic radiography and far less than a CT-scan (23). Due to its high resolution allowing a detailed identification of the structure of interest, CBCT was used in this study. Also, in an endeavor to avoid misdiagnosing, CBCT images were evaluated in axial, sagittal, and coronal planes and BMCs were evaluated by an experienced oral and maxillofacial radiologist.

In the present study, the prevalence of BMC was 27.71%, which is lower than the number reported by Orhan et al. investigated the incidence of BMCs in mandible of 242 adult Turkish patients by using CBCT and they reported higher prevalence of BMCs (46.5%) than the previous studies using conventional radiography techniques (1). This finding can be attributed to the larger subject size used for this study and the fact that the patients are from different regions. Bilecenoglu and Tuncer conducted a study with dry mandibles and reported similar prevalence rates for BMC (25% of patients and 15% of sides) (7).

In the current study, higher occurrences of BMC were observed in both male and female patients on the right than the left side. Also, Fu et al. reported a higher prevalence of BMC on the right side; however, an exact explanation remains uncertain (24). They suggested masticatory functional force or the physiological drive for the length of MC. Meanwhile, Motamedi et al. assessed the prevalence of BMCs on panoramic images and found the prevalence as 1.2% with no statistically significant correlations regarding age or gender (25).

The proportion of genders were almost 1:1,03 (178 males and 172 females) and in this way, changes resulted from the distribution of the genders were eliminated. When considering the total sample, males presented more cases of BMC. This result is in accordance with the findings of Fu et al. (24), which found a statistical association with males although the majority of studies found no differences with respect to gender (2, 3, 10, 26). On the other hand, some authors reported a slightly higher incidence of BMCs among women (27, 28). Orhan et al. found no significant difference between men and women in the incidence of BMCs in a Turkish population (1). However, the gender differences could be related to the population observed, type of exam and the sample size.

Regarding the affected sides, most of the BMCs were found unilateral. Comparing unilateral and bilateral findings, the high prevalence of unilateral BMC is not in accordance with Nortjé et al. who observed a higher prevalence of bilateral BMCs in their 2D radiographs (27).

This study was limited to the determination of BMC prevalence. However, it is also noteworthy to investigate BMC classification, length, and angle. Further studies are needed regarding the characteristics of BMC.

Conclusions

BMC was more common than the bilateral BMC, with the overall incidence of 27.71% in the studied population. In cases of was unilateral bifidity, the right side of the condyle was more commonly affected than the left side. Also, BMCs were detected more frequently in males.

Ethical Approval: As a retrospective study based on radiological records, this study was exempt from the need for ethical approval. The study was performed in compliance with the principles stated in the Declaration of Helsinki.

Informed Consent: Consent was given by all patients for the use of their photographs in this publication.

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