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PREVALENCE AND CHARACTERISTICS OF BIFID MANDIBULAR CANAL BY USING CONE-BEAM COMPUTED TOMOGRAPHY

Abbas Shokri[1], SepidehFallah[2], Arman Yousefi[3*], SetarehSoheili[4], PayamAmini[5]

[1]Assistant Professor, Department of Oral and Maxillofacial Radiology, Dental School, Hamadan University of Medical Sciences, Hamadan, Iran.

[2]Assistant Professor, Department of Oral and Maxillofacial Radiology, Dental School, Kermanshah University of Medical Sciences, Kermanshah, Iran.

[3]Post Graduate student, Department of Oral and Maxillofacial Radiology, Dental School, Hamadan University of Medical Sciences, Hamadan, Iran.

[4]Post Graduate student, Department of Pediatric Dentistry, Dental School, Hamadan University of Medical Sciences, Hamadan, Iran.

[5]Ph.D student, Department of Epidemiology and Reproductive Health, Reproductive Epidemiology Research Center, Royan Institute for Reproductive Biomedicine, ACECR, Tehran, Iran.

Email: arman.yousefi.den@googlemail.com

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Abstract

Aim: A bifid mandibular canal is an anatomical variation of the mandibular canal. Purpose of this study is to evaluate the incidence and configuration of the bifid mandibular canal in an Iranian population.

Methods: A total of 681 patients which had undergone pre-operative imaging from August 2012 to July 2014, were evaluated. The bifid mandibular canal was identified and classified into the following four types, forward, buccolingual, dental and retromolar canal types. The CBCT images were evaluated by two oral and maxillofacial radiologists. Independent samples t-test and chi square test was applied in order to assess the relationship between categorical variables. Statistical analysis was performed by using the software SPSS.

Results:

Bifid mandibular canals were observed in 23(3.4%) of the 681 patients with a mean (1.5%) of the bifid canals were observed in left side, 6(0.9%) in right side and 7(1%) age of 32.21 years. These canals were observed in 8 males (34.8%) and 15 females(65.2%), however, There was no significant difference between the males and the females with respect to the incidence of the bifid mandibular canal ($p>0.05$). 10 in both sides. However, there was no significant difference between the sides. It was observed that the forward canal type was the most common type 8(1.2%), followed by the buccolingual canal type 5(0.73%), the dental canal type 2(0.3%), and the retromolar type 1(0.14%).

Conclusion: This study shows that the bifid mandibular canals in the Iranian population have a relatively high prevalence rate and must be meticulously considered in surgeries.

Keywords: Cone Beam Computed Tomography, Bifid Mandibular Canal, Anatomic Variation, neurovascular bundle.

Introduction

A bifid mandibular canal is an anatomical variation of the mandibular canal, implying that the mandibular canal is divided into two branches. Each separated canal might contain a neurovascular bundle that can be observed in different forms.(1) The location and the configuration of the mandibular canal are important in surgical procedures involving the mandible, such as the extraction of the impacted third molar, dental implant treatment, and sagittal split ramus osteotomy.

Failure to identify anatomical variations of the mandibular canal can complicate surgery and result in adverse consequences such as traumatic neuroma, paraesthesia, and bleeding. Localization of the mandibular canal might be difficult on the panoramic radiograph, because the mandibular ramus region would superimpose with the opposite side of the mandible, soft palate, and pharynx on the images. CT and CBCT are superior to panoramic radiography in displaying the mandibular canal and their variations because these imaging modalities provide high-resolution, three-dimensional images. (1,2) Various types of bifid mandibular canals have been described and classified in the literature according to anatomical location and configuration, by using panoramic radiographs. However, few studies have used computerized tomography for this purpose.(3) According to Rouas et al,(4)panoramic radiographs can only suggest the presence of bifid mandibular canals, but cannot confirm them. According to the authors, only a tridimensional image exam, such as the cone beam computed tomography (CBCT), can show the presence and morphology of the bifurcation path of the mandibular canal precisely.

Thus, the aim of this study is determining of the prevalence and classifying the morphology of bifid mandibular canals by using CBCT scans of patients. (3,4)

Materials and Methods

A total of 681 patients which had undergone pre-operative imaging for the extraction of impacted mandibular third molars, implant surgery, and Orthognathic surgery by using a CBCT scanner at Dental Hospital of Hamedan University from August 2012 to July 2014, were evaluated. The study group consisted of 305 male and 376 female patients. Each CBCT dataset of the patients included the right or the left side of the mandibular posterior region.

A NewTom 3G Dental CBCT system (Quantitative Radiology, Verona, Italy) had been used to acquire the CBCT images. The dental mode had been used in the CBCT scanners. The exposure parameters had been set as follows: tube voltage of 80 kVp, tube current of 10 mA, and exposure time of 13.3 s with a 360° X-ray source. The field of view had been with a diameter of 30.48cm(12 Inch), and the voxel size was 0.3 mm.

For the reconstruction of images the NNT viewer software was applied. The slice thickness was set to 1mm, the cross sectional view and reconstructed panoramic were reconstructed. The images were viewed on a 20-inch Samsung monitor (200P, Samsung, Seoul, Korea) with a pixel resolution of 1024×1200 and color depth of 32 bits. For the visualization of the mandibular canal of objects, the center of rotation of the reference line for multiplanar reconstruction was initially set at the mandibular foramen in the axial images. Then, the reference lines for the sectional image were rotated horizontally according to the course of the mandibular canal. The reference lines were moved buccolingually and posteroanteriorly to show the clearest and best image of the course of the mandibular canal in the cross sectional and reconstructed panoramic view. The window width and level of the CBCT images were adequately adjusted to clarify the mandibular canal and the bifid mandibular canals. Then, the bifid mandibular canal was identified and classified according to the criteria of Naitoh et al.(4) The canal was classified into the following four types according to the origin site and the direction of the bifurcated canal from the mandibular canal:

1) Forward canal: the branch arising from the superior wall of the main canal. (F)

2) Buccolingual canal: the branch arising from the buccal or the lingual wall of the main canal. (B)

3) Dental canal: in this case, the end of the bifurcated canal reached the root apex of the molars.(D)

4) Retromolar canal: the branch arising from the main canal, opening at the retromolar foramen.(R)

The CBCT images were evaluated by two oral and maxillofacial radiologists. To check any difference in age distribution between the two groups of bifid canal and non-bifid canal, independent samples t-test was performed. Independent chi square test was applied in order to assess the relationship between categorical variables. In case of sparse cross tables, fishers' exact test was utilized. Test were considered significant when the p value was less than 0.05. A statistical analysis was performed using the software SPSS 12.1 for Windows (SPSS Inc., Chicago, USA).

Results

Bifid mandibular canals were observed in 23 (3.4%) of the 681 patients with a mean age of 32.21 years (range: 7-73 years). These canals were observed in 8 males (34.8%) and 15 females (65.2%). There was no significant difference between the males and the females with respect to the incidence of the bifid mandibular canal (p=0.396) (Table 1).

The mean of age is shown in table 2 with 31.04 (11.11) and 32.25 (15.02) for Bifid and non-bifid canal groups respectively. The independent t-test shows no significant difference in mean age of non-bifid canal and bifid canal groups (p=0.703). 10(1.5%) of the bifid canals were observed in left side, 6(0.9%) in right side and 7(1%) in both sides. However, there was no significant difference between the sides (Table 3). It was observed that the forward canal type was the most common type 8 (1.2%)(Figure 1), followed by the buccolingual canal type (0.73%)(Figure 2), the dental canal type 2(0.3%)(Figure 3), and the retromolar type (0.14%)(Figure 4).(Table 4)

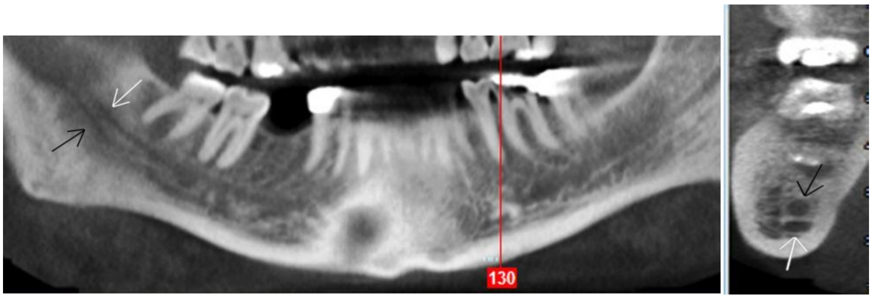

Fig 1: (A and B) Cone-beam CT images of the right mandible (female, 54 years). The cone-beam CT images clearly reveal a narrow upper canal (Forward Type, arrows).

Fig 2: CBCT of mandible, cross sectional view, clearly reveals an accessory canal that arose in buccolingual direction (Buccolingual Type, arrows)

Fig 3: CBCT of right mandible, a panoramic view, arrows show the accessory canal (Dental type, arrows).

Fig 4: Cone beam CT images of the right mandible, panoramic view which clearly reveals a short bifid mandibular canal extending to the third molar area (Retromolar Type, arrow).

Discussion

The bifid mandibular canal is an anatomical variation of the mandibular canal, and each separated canal might contain a neurovascular bundle. The presence and the configuration of the bifid mandibular canal are important in surgical procedures to avoid adverse consequences such as traumatic neuroma, paraesthesia, and bleeding.(1,5)The incidence of bifid mandibular canals has been reported to be in the range of 0.08-0.95% in studies using panoramic radiographs. It has been reported to be 0.9% by Nortje et al, (6) 0.95% by Langlais et al,(7) 0.4% by Zografos et al,(8)and 0.35% by Sanchis et al.(9)

However, more recent studies pointed to a broad variation of the incidence, ranging from 0.09%to 36%. This variation in incidence is due to differences in the sample size of each study, as well as to the type of examination performed. Studies carried out using panoramic images show a lower incidence than studies with CBCT images or dry mandibles. Cone beam CT was able to detect canals with diameters of only 0.88 mm. Furthermore, it was able to easily detect canals that bifurcated in the buccal or lingual directions, which might not have been possible using two-dimensional images as in panoramic radiography. It is clear that with the advances in technology and the improvement of images as diagnostic tools, the number of anatomical variations of the mandibular canal is likely to increase considerably(3). Incidence of bifid mandibular canal using CBCT was higher than that obtained using panoramic radiography,It has been reported to be 64.8% by Naitoh et al,(5) 50% by Naitoh et al,(10) 46.5% by Orhan et al,(11) 15.6% by Kuribashi et al,(12) and 19% by de Oliveira-Santos et al(13). Wide variations of the prevalence rate were reported in different countries - 46.5% in Turkey,(11) 19% in Belgium,(13)30.6% in Taiwan,(15) 15.6%-65% in Japan(5,12) and 10.2% in the Korean population as reported by Kang et al.(1) In our study prevalence rate was lower, 3.4%.because we did not consider the nutritional canals which separated from the main canal and did not have a considerable diameter as a bifurcated canal.

Several classifications of the mandibular canal according to the anatomical location and configuration have been used in previous studies. Carter and Keen (14) classified the intramandibular course of the inferior alveolar nerve into three types on the basis of their anatomical study: Type I, the inferior alveolar nerve is a single large structure lying in a bony canal; Type II, the nerve is situated substantially lower down the mandible; and Type III, the inferior alveolar nerve separates posteriorly into two large branches. Type III is considered to correspond to the bifid mandibular canal.Langlais et al(7) classified the mandibular canals into four types according to the anatomical location and configuration using panoramic radiography, and Naitoh et al(5)classified them into four types using CBCT images: retromolar, dental, forward, and buccolingual canal. They observed the forward canal type (59.6%), retromolar canal type (29.8%), dental canal type (8.8%), and buccolingual canal type (1.8%). Orhan et al (11) used the classification of Naitoh et al for a Turkish population and reported that the most frequently encountered type was the forward canal type, followed by the retromolar canal type. In contrast, Kuribayashi et al(12) following the classification of Nortje et al demonstrated that Type II (dental canal type) was the most common. Fu et al observed the bifid canal in 30.6% of the Taiwanese subjects, and more than half were the dental or retromolar type. In the present study, we also used the classification of Naitoh et al(5). It was observed that the forward canal type was the most common (9), followed by thebuccolingual canal type (6), the dental canal type (3), and the retromolar type (1).

However, these canals were observed in 8 males (34.8%) and 15 females (65.2%), There was no significant difference between the males and the females with respect to the incidence of the bifid mandibular canal. It was similar to the results of the survey of Capote et al. (16)

There was no correlation, in our study, between the presence of the bifid mandibular canal on the right and left sides and between the age of the patients. Other authors also observed that age did not affect, statistically, the presence of the bifid mandibular canal.(17)

In addition, the detection of bifid canals may have some other important clinical implications such as inadequate anesthesia, complications after mandibular osteotomy or implant placement, pain, and discomfort due to the additional pressure of the mandibular prosthesis.(1)

In summary, this study shows that the bifid mandibular canals in the Iranian population have a relatively high prevalence rate through a CBCT evaluation and that the forward canal is the most common type of mandibular canal in this population.Cone beam CT can provide high-resolution three-dimensional images, It can detect accesssory canals with a narrow diameter and those that bifurcate in any directions. CBCT is suggested for a detailed evaluation of the bifid mandibular canals before mandibular surgery.

Conclusion: This study shows that the bifid mandibular canals in the Iranian population have a relatively high prevalence rate and must be meticulously considered in dental and maxillofacial surgeries.

Clinical Significance:

Recognizing the location and the configuration of the mandibular canal are essential in surgical procedures and failure to identify anatomical variations of the mandibular canal can complicate surgery and result in adverse consequences.

References:

1. Ju-Han Kang, Kook-Sun Lee. The incidence and configuration of the bifid mandibular canal in Koreans by using cone-beam computed tomography. Imaging Sci Dent. 2014 Mar; 44(1): 53–60.
2. Oyuntugs Rashsuren, Jin-Woo Choi. Assessment of bifid and trifid mandibular canals using cone-beam computed tomography. Imaging Sci Dent. 2014 Sep; 44(3): 229–236.
3. CorrerGM ,Iwanko D. Classification of bifid mandibular canals using cone beam computed tomography.Brazilian Oral Research;2013, 27 (6): 510
4. Rouas P1, Nancy J, Bar D. Identification of double mandibular canals: literature review and three case reports with CT scans and cone beam CT. DentomaxillofacRadiol. 2007;36(1):34-8.
5. Naitoh M, Hiraiva 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.
6. Nortje CJ, Farmen 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):55-6.
7. Langlais RP, Broadus R, Glass BJ. Bifid mandibular canals in panoramic radiographs. JAm Dent Assoc. 1985 Jun;110(6):923-6.
8. Zografos J, Kolokoudias M, Papadakis E. The types of the mandibular canal. Hell Period StomatGnathopathoprosopikeCheir. 1990 Mar;5(1):17-20.
9. Sanchis JM, Peñarrocha M, Soler F. Bifid mandibular canal. J Oral Maxillofac Surg. 2003 Apr;61(4):422-4.

10. 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 RadiolEndod. 2010;109:e25–e31.
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. SurgRadiol Anat. 2011;33:501–507.
12. Kuribayashi A, Watanabe H, Imaizumi A, Tantanapornkul W, Katakami K, Kurabayashi T. Bifid mandibular canals: cone beam computed tomography evaluation. DentomaxillofacRadiol. 2010;39:235–239.
13. Carter RB, Keen EN. The intra mandibular course of the inferior alveolar nerve. J Anat. 1971;108:433–440.
14. De Oliveira-Santos C, Souza PH, de AzambujaBerti-Couto S, Stinkens L, Moyaert K, Rubira-Bullen IR, et al. Assessment of variations of the mandibular canal through cone beam computed tomography. Clin Oral Investig. 2012;16:387–393.
15. Fu E, Peng M, Chiang CY, Tu HP, Lin YS, Shen EC. Bifid mandibular canals and the factors associated with their presence: a medical computed tomography evaluation in a Taiwanese population. Clin Oral Implants Res. 2014;25:e64–e67.
16. Capote TS, GonçalvesMde A, Campos JÁ.Retromolar Canal Associated with Age, Side, Sex, Bifid Mandibular Canal, and Accessory Mental Foramen in Panoramic Radiographs of Brazilians. Anat Res Int. 2015;2015:434083.
17. von Arx T, Hänni A, Sendi P, Buser D, Bornstein MM. Radiographic study of the mandibular retromolar canal: an anatomic structure with clinical importance. J Endod. 2011 Dec;37(12):1630-5.

Corresponding author:

Arman Yousefi*,

Department of Oral and Maxillofacial Radiology, Dental School,

Hamadan University of Medical Sciences, Shahid Fahmideh Street, Hamadan, Iran.

Email: arman.yousefi.den@gmail.com