J. Maxillofac. Oral Surg. (July–Sept 2018) 17(3):379–382
https://doi.org/10.1007/s12663-017-1059-y

ORIGINAL ARTICLE

Prevalence of Bifid Mandibular Canal Amongst Indian Population: A Radiographic Study

Tushar Manohar Rothe[1,2] · Prachur Kumar[1,3] · Navin Shah[1,4] · Rashmi Venkatesh[5,6] · Vaishnavee Vassandacoumara[5,7] · Amit Mahajan[1,8]

Received: 6 September 2017 / Accepted: 20 November 2017 / Published online: 27 November 2017

Abstract
Background Bifid mandibular canal (BMC) is a normal anatomical variation and has been less studied in the Indian population. This study was aimed at estimating the prevalence of BMC amongst Indian population.
Materials and Methods The study sample comprised of 5800 digital orthopantomograms (OPGs) which were from four zones of India, i.e. North India, South India, East India, and West India (1700 OPGs from each zone). Any pathological or normal digital OPGs having age between 15 and 80 years in the format of jepg or jpg image were included, while OPGs of operated case of hemi-mandibulectomy and blurred in which mandibular canal was not traceable were excluded from this study. Each radiograph was assessed for BMC based on the classification given by RP Langlais. Four examiners (two Oral and Maxillofacial surgeons and two Oral and Maxillofacial Radiologists) individually assessed every OPG for the presence of BMC. BMC was considered present, if all the examiners detected it independently.
Results There were 5800 OPGs examined, out of which 2576 were of women and 3224 were of men. Bifid mandibular canals were observed in 135 (2.3%) out of 5800 digital panoramic images. There was no statistically significant correlation found with regard to age. Bifid mandibular canals were found with a female-to-male ratio of 1:1.2. The most frequently encountered type of BMC was type II (1.34%) followed by type I (0.72%), type IV (0.15%), and type III (0.1%).

Keywords Bifid mandibular canal · Orthopantomogram · Mandible · Neuroanatomy

✉ Tushar Manohar Rothe
rothetushar15@gmail.com

1 Oral and Maxillofacial Surgery, K M Shah Dental College, Piparia, Vadodara, Gujarat, India

2 Shivaji Nagar Old City, Akola, Maharashtra 4434001, India

3 401, Sankalp Residence, Behind Reliance Fresh, Near Navrachna School, Sama, Vadodara, Gujarat 390008, India

4 B-101, Prakruti Annex, Opp. Haveli Flats, Near Parimal Railway Underbridge, Jain Nagar, Paldi, Ahemdabad 380007, India

5 Oral Medicine and Radiology, K M Shah Dental College, Piparia, Vadodara, Gujarat, India

6 House No A-1, Staff Quarters, Sumandeep Campus, Piparia, Wagodia Taluka, Vadodara 391760, India

7 A2, Tirth Bungalows, Kubereswar Marg, Dabhoi Ring Road, Vadodara 390019, India

8 201, Aalap, Avdhoot Complex, Nizampura, Vadodara 390002, India

Introduction

One of the normal interesting anatomical variations that we may encounter in the mandible is bifid mandibular canals (BMCs) which can lead to difficulties during performing mandibular anaesthesia or extraction of mandibular third molar, placement of implants, and surgery in the mandible [1]. The incomplete fusion of three inferior dental nerves during embryogenesis is a suggested cause for the formation of BMC [2]. This variation in neuroanatomy may be a reason behind the local anaesthesia failure during inferior alveolar nerve block. By identifying BMCs, it is easy to locate mandibular foramen and path of mandibular canal from mandibular foramen to mental foramen and mainly identification of this possible variation with mandibular canal will permit the clinician for modification of surgical

procedure [3]. The purpose of this study is to evaluate the prevalence of BMCs amongst the Indian population.

Materials and Methods

The study sample comprised of 5800 digital orthopantomograms (OPGs) which were equally gathered from four zones of India, i.e. North India, South India, East India, and West India (1700 OPGs from each zone) from dental clinics and hospitals. Any pathological or normal digital OPGs having age between 15 and 80 years in the format of jepg or jpg image were included, while OPGs of operated case of hemimandibulectomy and blurred in which mandibular canal was not traceable were excluded from this study. Each radiograph was assessed for BMCs based on the classification given by RP Langlais et al. They divided BMCs into four categories, i.e. type I—which consists of bilateral or unilateral BMCs extending to third molar or immediate surrounding area, type II—includes of bilateral or unilateral BMCs which extend along the course of main canal and rejoin it within the ramus or body of the mandible, type III—consists of the first two categories combination, and type IV—includes two separate mandibular foramen which joins to form single larger canal. The criteria for BMC were two radiolucent lines and at least three radio opaque borders clearly seen on the image. Four examiners (two Oral and Maxillofacial surgeons and two Oral and Maxillofacial Radiologists) individually assessed every OPG for the presence of BMC. BMC was considered present, if all the examiners detected it independently.

Results

There were 5800 OPGs examined out of which 2576 belonged to women and 3224 of men. Bifid mandibular canals were observed in 135 (2.3%) out of the 5800 digital panoramic images. Bifid mandibular canals were found with a female-to-male ratio of 1:1.2 (Table 1). The most frequently encountered type of bifid canal was type II with 1.34%. Type I (0.72%), type III (0.1%), and type IV (0.15%) were also found. Bifid mandibular canals were found 0.4% on right side, 0.5% on left side, and bilaterally 1.4% seen in all cases. Amongst BMC-positive cases, 78 were of type II (57.77%), 42 of type I (31.12%), 6 of type III (4.44%), and 9 of type IV (6.66%). A total of 59% cases were bilateral, while 41% were unilateral. Amongst unilateral cases, 19.3% were of left side and 21.5% of right side (Table 2).

Table 1 Bifid mandibular canal percentage within the gender

	Bilateral	Unilateral	Total
Male			
No. of cases	44	39	83
Percentage	53.0%	47.0%	100.0%
Female			
No. of cases	36	16	52
Percentage	69.2%	30.8%	100.0%
Total			
No. of cases	80	55	135
Percentage	59.3%	40.7%	100.0%

Table 2 Left side, right side, and bilateral frequency of BMC

	Frequency	Percentage (%)
Left	26	19.3
Right	29	21.5
Bilateral	80	59.3
Total	135	100

Discussion

Mandibular canal contains the inferior alveolar nerve, inferior alveolar artery, and inferior alveolar vein and runs obliquely downward and forward in the ramus and then horizontally forward in the body. It starts from mandibular foramen and ends with mental foramen [1]. According to Chavez Lomeli, there are three different components of the inferior mandibular nerve bundle indicating the existence of three different developmental fields in the mandibular dentition. These fields are innervated by different nerve branches with different origins and different timing in outgrowth from the central nervous system [2].

Bifid mandibular canal is a neuroanatomical normal variation present occasionally within the mandible. In 1973, Patterson and Funke described a case of unilateral BMC with two mental foramina. Similarly, Kiersch and Jordan published a case of a radiologically manifested BMC [3]. In 1985, Langlais et al. observed 57 (0.95%) cases in 6000 panoramic radiographs and he devised a classification [4]. We followed the classification given by Langlais et al. in our study. Quattrone an Italian article discussed definitive diagnostic confirmation (by computed tomography) of the existence of such a BMC (Fig. 1). The possible causes for a false BMC radiograph may include the imprint of the mylohyoid groove on the medial mandibular surface [5]. The groove lies inferior to mandibular foramen and gives way to mylohyoid nerve

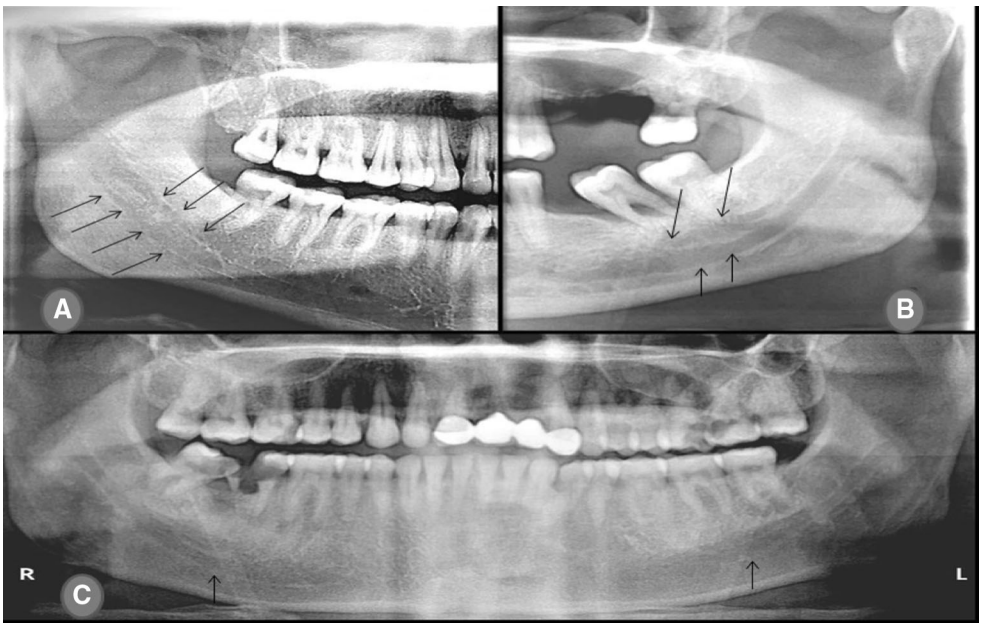

Fig. 1 **a** Type I BMC, **b** Type II BMC, **c** Type III BMC

which separates from the inferior alveolar nerve and travels to the floor of the mouth and gives motor supply to mylohyoid muscle and anterior belly of digastric muscle [6] (Fig. 2).

Bifid mandibular canal could be the radiologic osteocondensation image produced by the origin of the mylohyoid muscle, i.e. mylohyoid ridge into the medial surface of mandible, with a distribution parallel to the mandibular canal [7]. Another explanation for false BMC might be the appearance of internal oblique ridge and external oblique ridge in the OPG, but these ridges appear superior to the mandibular canal [6].

In 1988, Goodday reported a duplicate mental foramen during orthognathic surgery and directly confirmed the existence of two mental foramina and two mental nerves in a patient with a series of congenital malformations related to rubella syndrome [8]. Another study on mandibular canal by Chavez Lomeli suggested that during embryonic development, there could be three inferior dental nerves innervating three groups of mandibular teeth that later fuse to form a single nerve. Partial fusion of these nerves can explain the presence of bifid or trifid mandibular canals [2]. M. S. Kim studied 1000 OPGs from dental patients, and the panorama, cone beam CT (CBCT), and micro-CT from 40

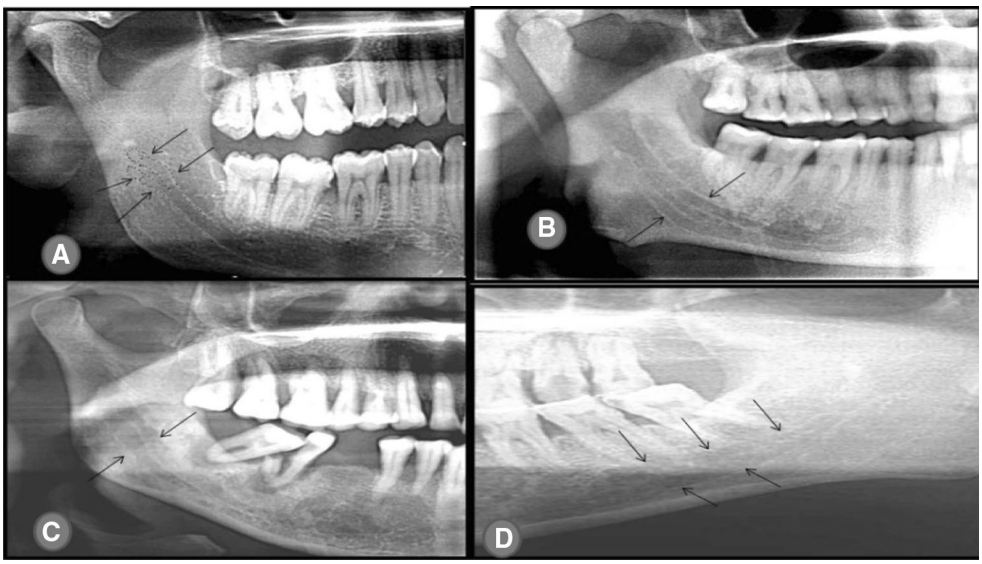

Fig. 2 **a** Type IV BMC, **b–d** Type II BMC

dry mandibles were examined for BMCs. The results were confirmed by a stereoscopic and histological examination of the cross-sectioned mandibles. The author found four cases of BMC in panoramic radiographs suggesting prevalence 0.038%. However, a histological and stereoscopic examination of a cross section of the dry mandible showed that only one canal contains neurovascular bundles, while the others contained marrow fatty tissue. The authors concluded that the presence of BMCs determined by OPGs should be predicted with great caution in relation to surgery associated with mandible [9].

Grover and Lorton studied 5000 panoramic radiographs in US Army recruits and reported four cases of BMC 0.08% [10]. In our study, we got 2.3% of prevalence of BMCs from 5800 OPGs. A clinical implication of a BMC has been defined in the literature as a problem in performing inferior alveolar nerve anaesthesia, especially in patients with type IV BMCs. This problem is usually resolved by performing inferior alveolar nerve block at a somewhat higher level by using Gow–Gates technique or vazirani–akinosi nerve block technique. The presence of BMCs also has other clinical implications that are of particular importance in surgical procedures involving the mandible, such as impacted third molar extraction, dental implant, fracture osteosynthesis, and sagittal split ramus osteotomy. Failure to localize a BMC may result injury to the inferior alveolar nerve, resulting in complications such as paraesthesia, anaesthesia, traumatic neuroma, and bleeding during surgery. Patients with a mandibular prosthesis and resorption of alveolar bone in the proximity of the retromolar pad may have pain because of the pressure on the neurovascular bundle in cases of BMCs with branches extending to the retromolar pad (type I). Therefore, identification of this possible anomaly will permit the clinician to modify their prosthetic design [1, 7, 10].

The limitations of this study are that OPGs are a 2D image of a 3D object leading to the superimposition of anatomical structures and bifurcation of the canal medially or laterally cannot be detected by an OPG. It is beneficial to perform 3D imaging in case a surgical procedure is required.

Conclusion

The findings of this study reveal the prevalence of BMC amongst Indian population to be 2.32%. Therefore, the clinicians should carefully assess for the presence of BMCs prior to any surgical intervention in mandible to decrease the risk of complications.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest to declare.

Ethical Approval This article does not contain any studies with human participants performed by any of the authors.

References

1. Hosein M, Motamedi K, Navi F (2015) Bifid mandibular canals prevalence and implications. J Oral Maxillofac Surg 73:387–390
2. Chavez-Lomeli ME, Mansilla Lory J, Pompa JA, Kjaer I (1996) The human mandibular canal arises from three separate canals innervating different tooth groups. J Dent Res 75:1540
3. Sanchis JM, Penarrocha M, Soler F (2003) Bifid mandibular canal. J Oral Maxillofac Surg 61:422–424
4. Langlais RP, Broadus R, Glass BJ (1985) Bifid mandibular canals in panoramic radiographs. J Am Dent Assoc 110:923
5. Quattrone G, Furlini E, Bianciotto M (1989) Bilateral bifid mandibular canal presentation of a case. Minerva Stomatol 38:1183
6. Richard L (2015) The anatomical basis of clinical practice, 41st edn. Elseiver, Amsterdam
7. Wilson S (1984) The inferior alveolar and mylohyoid nerves: an anatomic study and relationship to local anesthesia of the anterior mandibular teeth. J Am Dent Assoc 108:350
8. Goodday RHB, Com B, Precious DS (1988) Duplication of mental nerve in a patient with cleft lip-palate and rubella syndrome. Oral Surg Oral Med Oral Pathol 65:157
9. Kim MS, Yoon SJ (2011) A false presence of bifid mandibular canals in panoramic radiographs. Dentomaxillofac Radiol 40:434–438
10. Grover PS, Lorton L (1983) Bifid mandibular nerve as a possible cause of inadequate anesthesia in the mandible. J Oral Maxillofac Surg 41:177