

Study of Root Canal Morphology of Permanent Mandibular Incisors in an Indian Subpopulation

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Abstract

Aim: The aim was to examine root canal morphology of permanent mandibular incisors in an Indian subpopulation using cone-beam computed tomography (CBCT). **Materials and Methods:** CBCT images of 150 patients with 100 healthy permanent mandibular incisors were evaluated. According to Vertucci's classification, teeth were examined to determine the number of roots, number of canals, and canal configurations. The effects of gender and age on the incidence of root canal morphology were investigated. **Results:** Of permanent mandibular incisors, 71.64% had a single root with single canal. Mandibular lateral incisors (10.45%) had a higher incidence of the second canal compared with mandibular central incisors (8.34%). A slightly higher percentage of incidence of a second canal was found in males (10%) than in females (5%). Vertucci type I (68.5%) was most common followed by type IV (0.62%) which was the least common. **Conclusion:** The prevalence of the second canal in mandibular incisors was high but within the range of previous studies performed on different populations. CBCT imaging is an excellent method for detection of different canal configurations of mandibular incisors.

Keywords: Canal morphology, cone-beam computed tomography, permanent mandibular incisors

INTRODUCTION

The morphology of mandibular incisors is very analogous. As seen on a periapical radiograph, the morphology of the mandibular incisors is not as simple, it may be complicated by the presence of second (bifurcated) canals, lateral canals, and apical deltas, when viewed under other conventional methods.^[1]

Conventional methods such as cross-sectioning, scanning electron microscopy root canal staining, and stereomicroscopy root clearing were techniques used to identify the configuration of canals.^[2] Radiography is one of the most essential clinical tools in endodontic therapy. However, old-style radiographic images are two-dimensional image; hence, the tooth and its surrounding tissues are visualized only in the mesiodistal plane resulting in some significant information about the canals and foramina's being overlapped.^[3]

Cone-beam computed tomography (CBCT) is a noninvasive technique that facilitates a comprehensive investigation of both the external and the internal anatomy of the tooth from different angles by reconstructing the three-dimensional (3D) images. The major advantages of CBCT include the substantial

reduction in radiation exposure and the higher quality image rendering for the assessment of dental hard tissues.^[4]

The purpose of this study is to analyze the root canal morphology of permanent mandibular incisors using CBCT in the sub-Indian population.

MATERIALS AND METHODS

This study was conducted at the Oral and Maxillofacial Radiology Department, Saveetha University, Tamil Nadu, India. The CBCT images of 150 patients taken between March 2015 and April 2016 were examined and studied. The present study investigated the root canal morphology of mandibular incisors using CBCT images taken for general dental diagnosis and treatment planning. The age and gender of the patients were also recorded. The CBCT images of 100 permanent mandibular incisors were included in this study according to the eligibility criteria: no obvious dental caries, untreated permanent

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mandibular central or lateral incisors, fully developed root and canal without resorption or calcification, and CBCT images of good quality within the interested region.

The roots and canals of the permanent incisors were observed in horizontal and sagittal sections by one investigator using image analysis software. The following observations were recorded the number of roots, number of canals and canal configuration, gender comparison with type of canal configuration.

The canal configuration classification was made according to the Vertucci^[5] method.

RESULTS

The CBCT views of patients (82 male and 68 female) were studied in this study. The patients' ages were from 16 to 70 years (36 years on average). The study results revealed all of the imaged teeth were single rooted. The plurality of permanent mandibular incisors had a single root and a single canal (71.24%). Mandibular lateral incisors (10.45%) had a higher incidence of a second canal compared with mandibular central incisors (8.34%). The prevalence of the two canals system was as follows: left central incisor, 8.45%; right central incisor, 8.88%; left lateral incisor, 11.34%; and right lateral incisor, 9.56%. Type 1 Vertucci configuration (68.5%) was the most prevalent configuration, followed by type 3 (26.2%), type 2 (3.12%), and type 4 (0.62%) [Table 1]. According to gender, 10% of teeth in males and 5% of females had a second canal and there was no relationship between age and number of canals and canal configurations.

DISCUSSION

In clinical practice, the inability to locate a second canal is the primary reason for failure in endodontic treatment of permanent mandibular incisors. The presence of a second canal in mandibular incisors reported was between 45% and 11.5%.^[2,5-10] In this study, 28.7% of the mandibular incisors had a second canal, which is lower than the findings of most earlier studies but higher than the study conducted by Al-Qudah and Awawdeh,^[11] Zhengyan *et al.*^[4] These differences can be accredited to the ethnic background of the participants.

According to gender, the incidence of a second canal in permanent mandibular incisors was relatively high in males in this study, which is in accordance with the Liu *et al.*^[3] study and in contrast to the study conducted by Zhengyan *et al.*,^[4] which showed higher incidence of second canals in females.

Geduk *et al.*^[12] reported that mandibular central incisors had a higher incidence of a second canal compared with mandibular lateral incisors; the result of this study demonstrates that mandibular lateral incisors have a much higher incidence of two root canals compared with mandibular central incisors. The differences between the results of the studies may be due to variations in examination methods, sample size, and ethnic origin.

In the present study, all types of Vertucci canal configuration^[7] were seen in mandibular incisors. Type 1 Vertucci configuration was the most prevalent configuration, which was in accordance with previous studies by Liu *et al.*^[3] and Zhengyan *et al.* [Table 1].^[4] However, although they reported that the Type 5 canal configuration was the least prevalent type, Type 4 was the least prevalent type in our study.

CBCT is very useful technology for diagnosis in all areas of dentistry. The main advantage of CBCT images is nondestructive and 3D reconstruction and visualization of the external and internal anatomy of the teeth and surrounding bony structures.^[12-15] The most notable advantages of CBCT are a significantly lower effective radiation dose, its lower expense compared with conventional CT, a short exposure time (2–5 s), and its high accuracy. In addition, CBCT measurements are geometrically accurate because the CBCT voxels (3D pixels containing data) are isotropic.^[14,15] The use of CBCT imaging in endodontic treatments should be limited to assessment and treatment of complex endodontic treatments, such as identifying potential accessory canals in teeth with suspected complex morphology, determination of root resorptions, root canal system anomalies, fractures, and root curvature.^[2]

CONCLUSION

- Under the conditions of this study, a second root canal consisted more frequently (28.7%) in the mandibular incisors in the Indian subpopulation studied
- Mandibular lateral incisors had a much higher incidence of two root canals compared with mandibular central incisors
- The incidence of a second canal was relatively high in males. In addition, there was no relationship between age and number of canals and canal configurations
- Type 1 Vertucci configuration was the most prevalent, and Type 4 was the least prevalent
- CBCT imaging is an excellent method for detection of different canal configurations of mandibular incisors.

Table 1: Distribution and percentages of the four categories of variants in tooth number

Tooth number	Type 1 1 canal (%)	Type 2 2-1 canals (%)	Type 3 1-2-1 canals (%)	Type 4 2 canals (%)	Total
31	19 (71.67)	1 (2.67)	3 (20)	2 (3.33)	25
32	19 (71.33)	2 (4)	4 (24)	0	25
41	16 (65.34)	2 (2.67)	4 (18.67)	3 (3.33)	25
42	13 (60.6)	4 (4)	7 (29.34)	1 (0.67)	25
Total	70	12	10	8	100

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Conflicts of interest

There are no conflicts of interest.

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