

Root canal morphology of maxillary first molar using cone-beam computed tomography in south Indian population

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ABSTRACT

Aim and objective: The purpose of this study was to determine the prevalence of a number of canals and its morphological variations in maxillary first molars using cone-beam computed tomography (CBCT) of patients reported to Saveetha Dental College and Hospitals. **Methods:** A total of 500 CBCTs were collected and the CBCTs were evaluated in all three planes to assess the number of canals and its variations. **Result:** The result of this study showed that around 80% of the maxillary first molars had MB2 canal and around 5% of the maxillary first molar had two palatal and distal canals, respectively. **Conclusion:** CBCT is a clinically useful tool in understanding the variations in root canal morphology, which guides in the assessment of the root canal morphology aiding in successful root canal treatment.

KEY WORDS: Cone-beam computed tomography, Maxillary first molar, Root canal morphology

INTRODUCTION

Maxillary first molars have always been an area of interest among dentists, since 1925, as they are known for their dissimilar and complex morphologies and variations in the number of canals.^[1] Endodontically, this particular tooth with a large volume is one of the most puzzling teeth with a variety of considerations for the treating practitioner. The most common form of the permanent maxillary first molar has three roots and four canals. A search through the literature focuses much on the maxillary first molar, especially the mesiobuccal root and the second mesiobuccal canal (MB2 or mesiolingual canal). The mesiobuccal root of the maxillary first molar is often said to contain a double root canal system than a single canal.^[2] A review of literature has concluded that about 56.8% of the mesiobuccal root had MB2 canal.^[2] These root canal systems communicate frequently along their lengths and terminate either as separate or as one portal exit. The first clinical classification of more than one canal system in a single root was given by Weine in the year 1969,^[3] which used the mesiobuccal

root of the maxillary first molar as the type specimen. Later, Pineda and Kuttler in the year 1972^[4] followed by Vertucci in the year 1982^[5] further developed a system for canal anatomy classification for any tooth that has a broad buccolingual diameter. A successful root canal therapy requires a thorough knowledge about the root and the root canal morphology.^[6] Failure to detect and treat the MB2 canal system will result in pain and a decreased in the prognosis of the root canal treatment.^[5] Cone-beam computed tomographic (CBCT) studies have examined the prevalence of the MB2 canal in maxillary first molars.^[7-10] This article aims at studying the canal anatomy of maxillary first molar from the CBCT of 124 patients.

MATERIALS AND METHODS

Study Selection

The study included 500 CBCTs of patients reported to Saveetha Dental College and Hospitals. CBCT was taken for reasons such as implant planning, impaction removal, orthodontic treatment planning, and diagnosing other pathological conditions. Selection specification included bilaterally intact maxillary first molar with normal crown anatomy, three separate roots with fully formed root apices and intact pulpal floor. Patients with age <15 years and >60 years were

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excluded from the study. Unilateral molars, molars with resorbed roots, grossly destructed teeth, or tooth with any developmental anomaly were also excluded.

CBCT Specifications

The CBCT scanner was set at a constant slice thickness of 125 μm /slice for all the 124 patients. The patients were then exposed followed by which volume rendering and multiplanar volume reconstruction were performed.

Methodology

Based on the inclusion and the exclusion criteria, 500 CBCTs (250 male and 250 female) were selected for the study. The CBCTs were studied by three faculties to eliminate examiner bias. Then, the roots of first maxillary molars were thoroughly examined in all three planes for the number of canals in mesiobuccal, distobuccal, and palatal roots along with their canal configuration (based on Vertucci's classification).

RESULTS

The results of this study are depicted below in the form of tables and chart. Both the distal and the palatal roots showed less percentage of the second canal which is very rarely reported. The mesiobuccal root reported the presence of a second canal in about 80% of the individuals.

DISCUSSION

Some of the common methods used earlier in studying the root canal anatomy include conventional radiographs, canal staining and tooth clearing, digital

radiographic techniques, and radiographic assessment enhanced with contrast media.^[11-13] Recent methods include CT techniques and modified canal staining and clearing.^[14,15] CBCT has been considered to be more accurate than digital radiographs in determining root canal systems, which has also been used *in vivo* studies for diagnosis and pre-operative assessment.^[16] CBCT systems have been designed for imaging hard tissues of the oral and maxillofacial region.^[17] CBCT of the maxillofacial region provides opportunities for dental practitioners to obtain a multiplanar image, thus preventing misdiagnosis. The advantages of using a CBCT imaging system includes its non-destructive nature, three-dimensional (3D) reconstruction of the root canal system, the ability to restrict the imaging area, increased accuracy and resolution of images, and decreased image artifacts.^[15,18,19] CT also plays a pivotal role in understanding the root canal system, as it obtains 3D visualization in both transverse and longitudinal sections.

A tooth, when viewed from the anatomical aspect, is a very complex system which consists of a number of foramina which opens at different locations. Proper and sufficient knowledge about the morphology of the root canal system plays an important role in the success of the root canal treatment. The mesiobuccal root is still associated to a considerable number of failures due to the difficulty in locating and filling the MB2 canal.^[5] The main concern for endodontists remains to be the number of canals inside each root. This study has reported that distobuccal roots contain a single canal in most of the cases (94% and 92.8% among males and females, respectively) and rarely contain type II configuration [Table 1]. Similar

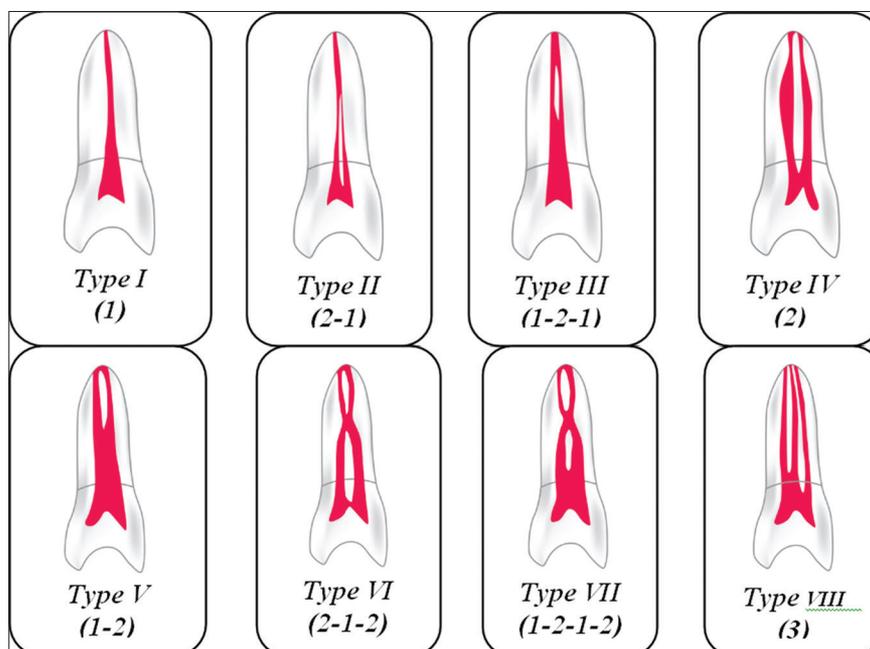


Figure 1: Classification of canal configurations according to Vertucci (6)

findings have been reported in the literature for the distal root with few studies reporting one canal in 100% of cases^[20,21] and a very rare and low incidence (0.1–4%) of two or more canals.^[22,23] The incidence of two palatal canals is very rare too.^[24] In the present study, the presence of a second palatal canal, P2, has been reported in 4% of males and 2.4% of females [Table 2] while the majority of the cases had only a single canal. The present study also reports that about 80% of the mesiobuccal root had MB2 canal in both men and women [Table 3], while the other common canal configuration includes type I, type IV, type V, and type VIII [Figure 2]. Several other studies have also reported the presence of two mesiobuccal canals and its significance in endodontics.^[22,25,26] A study has reported wide variations in MB roots of Indian maxillary second molars.^[27] The mesiobuccal roots of both first and second molars are said to exhibit a wide variation of root canal anatomy. Such a variation has been reported in another study.^[28]

Studies have also attempted to compare the root canal configuration of the first molar based on the ethnicity.

Table 1: Canal configuration of palatal root according to Vertucci classification

Vertucci classification	Male (%)	Female (%)
Type I	240 (96)	244 (97.6)
Type II	10 (4)	6 (2.4)

Table 2: Canal configuration of distobuccal root according to Vertucci classification

Vertucci classification	Male (%)	Female (%)
Type I	235 (94)	232 (92.8)
Type II	15 (6)	18 (7.2)

Table 3: Canal configuration of mesiobuccal root according to Vertucci classification

Vertucci classification	Male (%)	Female (%)
Type I	34 (13.6)	32 (12.8)
Type II	180 (72)	176 (70.4)
Type IV	20 (8)	24 (9.6)
Type V	11 (4.4)	15 (6)
Type VIII	5 (2)	3 (1.2)

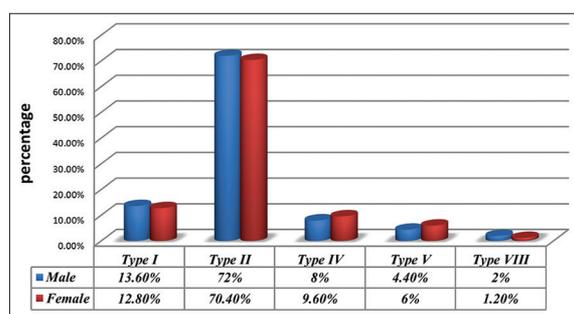


Figure 2: Chart depicting the percentage of canal configuration of mesiobuccal root among male and female

In a study on Iranian population,^[26] the prevalence of MB2 root canals in maxillary first molars was reported to be 55.1% and the most common canal configuration based on the Vertucci classification [Figure 1] was type I (43.6%) followed by type II (44.2%), which is different from those study reported in India, in which the prevalence rates of root canal morphologies of MB2 root canals in maxillary first molars were as follows: Type I, 39.7%; type II, 12.8%; and type III, 47.4%.^[29] In a study on the first molars among the Korean population, 34.4% of the root canals were of type I, 40.65% and 20.45% of it were type IV and type II, respectively.^[10] The predominant canal systems were type IV, followed by type II in a study conducted in the Thai and Japanese populations.^[17,28] In another study on maxillary first molars among the Chinese population, out of 612 molars that were evaluated, 423 teeth had type I configuration followed by 45, 22, 61, and 60 teeth having type II, type III, type IV, and type V configuration, respectively.^[30] Thus, based on the ethnicity, the root canal morphologies of maxillary first molars are different among different populations.

This is clear from the above discussion that the anatomy of maxillary the first molar, particularly the mesiobuccal root has never been straightforward. This study has also reported the rare cases of the presence of the second distal and palatal canals which is unique. The configuration of root canals makes it further complicated in treating the tooth, as six different types of configuration have been classified by Vertucci (6) so far. Thus, the study extends the importance of locating all the canals and its configuration for a successful root canal therapy and the role of CBCT in the same.

CONCLUSION

Based on the results of the present study, the number of roots, number of root canal, and its configuration varies greatly among individuals. Thus, for a successful root canal treatment, all the root canals must be identified and treated. The use of CBCT helps the dentist to evaluate of the morphology of the tooth clearly, thus guiding the dentist for an effective treatment which in turn improves the longevity of the treated teeth.

CLINICALLY TIPS TO FIND EXTRA CANALS

Magnification Aids, DG 16, Slob Rule, Champagne Bubble test, Ultrasonic files, thin taper burs, Dyes, Tracing Developmental Groove, and CBCT are few techniques that guide the dental surgeon in tracing and locating the extra canals.

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