

Variations in the Root canal morphology of Permanent First Mandibular Molars in Central Kerala population: A CBCT Study

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Abstract

Context: Root canal configuration, Mandibular molars, 2 Distal Canal, Cone Beam Computed Tomography

Aims: To analyse the variations in the root canal morphology of permanent first mandibular molars and the frequency of a fourth canal in the distal root of Central Kerala Population by using Cone beam computed tomography.

Methods and Material: For this study 153 intact Permanent first Mandibular first molars were selected. The samples were mounted on a template and CBCT scan was done. Each sample was evaluated, the variables observed were the number of roots and canals, the root canal configuration were tabulated using a combination of Vertucci’s, Weine’s and Gulabivala’s classifications

Results: The results of this study shows that, of the total 153 teeth 73% of teeth had 3 canals, 23.5% had 4 canals

and 2.6% had 5 canals. In the distal canal configuration, about 111 teeth (72.5%) with type I, 27(17.0%) with type II, 1(0.6%) with Type V, 9(5.8%) Type III and 5(3.2%) Type IV configuration.

Conclusions: Preoperative assessment of number of roots & canals and its canal configuration is very important for a successful endodontics. CBCT imaging has opened new vistas as the diagnostic tool due to its accurate and high quality 3 dimensional imaging.

Keywords: Root canal Configuration, Mandibular Molar, Apical foramen, Cone Beam Computed, Tomography

Introduction

Endodontics plays a main role in restoring the form, function and esthetics of the tooth. A successful endodontic treatment includes access preparation, cleaning and shaping followed by 3 dimensional obturation of the root canal system.¹

The most important aetiological factor for pulp and periapical pathology is the presence of microorganism. The main reason for endodontic failures in molars is due to incomplete removal of pulp tissue from the root canal system.²

This persistent infection is caused by unidentified root canals which lead to failure in removing pulpal tissue and microorganism. Therefore it is of at most importance that one should be aware of the root canal morphology so to improve the success of root canal system.³

Mandibular molar is the first permanent teeth to erupt in the oral cavity and the first to undergo tooth loss because of caries and the most commonly extracted teeth. They have mainly two roots (mesial and distal) and three root canals and sometimes four canals is also seen.⁴ The morphology of the dental pulp varies with genetic and environmental influence, and the need for clinicians to be made aware of the frequency of racially determined forms is important.¹² The occurrence of intercanal communications and isthmuses depends on the morphology and bucco-lingual width of the mesial root.

Several studies have been done in different populations on the root canal anatomy of mandibular first molar. Literature search has shown that very few studies have been conducted in the Indian population and no studies have been reported in the central Kerala population.

There are numerous methods employed to study the root canal anatomy of the teeth. The most frequently used method is root canal staining, tooth clearing, digital and conventional radiography. Recently 3-D imaging technology has been introduced and cone-beam computed tomography (CBCT) in particular is starting to prove very valuable in dento-maxillofacial imaging. It has been found to be useful for identifying complex root canal anatomy, extra roots and evaluation of periapical lesions. Thus providing an accurate diagnosis and executing better

endodontic treatment.^{5,6} Only few studies have reported this modern diagnostic technique (CBCT) to analyse root canal configuration.

Hence, the purpose of the study was to analyse the root canal morphology of permanent first mandibular molars in the Central Kerala population by using Cone beam computed tomography.

Materials and Methods

153 Mandibular first molars were collected from the Department of Oral and Maxillofacial Surgery of Amrita School of Dentistry, Kochi, Kerala India. The teeth were collected irrespective of age and gender. All the intact mandibular molars were included in this study and the exclusion criteria were those with fractured root and calcified canals. These tooth were washed under tap water and immediately submerged in stored in 10% formalin immediately after extraction (Nice chemicals, Kochi, Kerala, India). The residual soft tissues, bone fragments, and calculus were cleansed and removed by curettes and ultrasonic scalers.

The samples were mounted on a template and CBCT scan of all the samples were taken. The scanning was carried out by an expert radiologist, who had experience using CBCT. The device used for this survey was the i-CAT (Imaging Sciences International) with a voxel size of 0.2mm and a grey scale of 14 bits.

Owing to the characteristics of the CBCT, sagittal, coronal and axial views of each samples were evaluated. The variables that was observed were the number of roots and canals, the root canal configuration were tabulated using a combination of Vertucci's, Weine's and Gulabivala's classifications and the incidence of the mesial canals that joins into 1 and 2 separate canals were also evaluated.¹³

Results:

The result of this study shows that, Of the total 153 teeth 73% of teeth were seen with Three canals, 23.5% with

Four canals and 2.6% with Five canals (Table No 1) . When the canal configuration was considered, Of the mesial root canals evaluated about 83(54.2%) were seen with Type II, 52(33.9%) with type IV, 4(2.6%) with Type V, 2(1.3%) with Type X, 2(1.3%) with Type III and 5(3.2%) with Type XXII configuration. Of the distal canal configuration about 111(72.5%) with type I, 27(17.0%) with type II, 27(17.0%) with type II, 1(0.6%) with Type V, 9(5.8%) Type III and 5(3.2%) Type IV configuration.

In the mesial canal about 90(58.8%) where joining at the apex and 58(37.7%) had separate apical exit .The distal canals showed about 147(96%) single portal of exit and about 6(3.9%) were seen having a single portal of exit. The results obtained has been tabulated as table 1 showing number of canals present in the teeth ,(Table No 2) showing mesial root canal configuration & table 3 shows the distal root canal configuration.

Discussion

The complex root canal anatomy with its clinical challenges and difficulties often jeopardizes the success of endodontic treatment. It is important to have a knowledge about both normal and abnormal anatomy which can increase the probability of success of a root canal therapy.⁷

In this study the permanent mandibular first molars were considered as it is the tooth mostly undergoing endodontic treatment and also with highest rate of failure. The external simplicity masks its internal complexity.²

Normally the first mandibular molar presents with 2 well-defined roots, a mesial root characterized by a flattened mesiodistal surface and widened buccolingual surface, and a distal root mostly straight with a wide oval canal or 2 round canals⁸. The most relevant variable related to the number of canals is the presence of third canal in the mesial root.⁹

Number of methodologies are available which is used to study the root canal system configuration of the

mandibular first molar. They are a) Plastic resin injection, b)Radiographs c) Staining samples d) Sectioning and macroscopic evaluation e) Computed tomography f) Spiral computed tomography g) Micro- CT h) CBCT

In this study CBCT was used because of its non invasive and non destructive function. CBCT in endodontics have the most important advantage were it demonstrates anatomic features in three dimensions that intraoral and panoramic imaging can't.¹⁰ In this study, out of the 153 samples scanned ,98% had two roots and 1.9% with three root similar to the study of Garg et al.¹⁴ In this study the two rooted configuration showed about 69.9% with 2 mesial and a single distal canal which is in accordance with the studies done by Vertucci et al¹³ and Kuttler at al¹⁵ where it was seen that about 57 – 59% of mesial roots had two canals and a single distal canal. The incidence of MMC in this study was 2.6%. According to studies done by Vertucci et al¹⁶ and Baugh & Wallace et al¹⁷ incidence of three canals in the mesial root is 1% to 15%. In the distal root about 23.5% of teeth where seen with two distal canals which is in contrast with Skidmore and Bjorndal et al¹⁸ where they reported distal root with 88.8% with single canal and 28.9% with 2 canals. According to Barker et al¹⁹ 41% of Mesial canals exit in two foramen and 28% in one foramen and 70% of Distal canals exit in one foramen and 15% in 2 canals. In this study about 58.8% of mesial canals had a common exit foramen and 37.9% with two separate apical foramen. In the distal root canal about 96% had single portal of exit and 3.9% had two apical exit .

Of the mesial root canal configuration mostly seen were the Type II (54.5%) followed by Type IV(33.9%), Type V (2.6%) and Type III(1.3%). Additional configuration Type X (1.3%) (Gulavibala et al. 2001)⁶ and Type 3-2-1(3.2%) (Al-Qudah & Awawdeh 2009)⁶ were also seen.

In the Distal root configuration most prevalent was type 1(1-1) followed by type 2(2-1) ,type 3(1-2-1) and type

5(1-2) (Table No 3). And it is a known fact that the external morphology of distal root is rounded and less likely to accommodate two separate canals. Due to the high incidence of two distal canals, triangular access preparation during root canal treatment should be extended towards the distolingual direction in a rectangular form to improve canal identification. Another thing to keep in mind about the tooth morphology is the curvature. Long, narrow and curved canals can pave path towards transportation Instrument deformation and fracture. Slowey et al had observed that the mesio buccal canal have a distinct curvature at the floor of the chamber and that the mesiolingual canal is straighter in the long axis to the root.¹¹

Table 1: Number Of Canals

No. of Canals	Three Canals	Four Canals	Five Canals
Percentage of incidence of canals	73%	23.5%	2.6%

Table 2: Mesial root canal system configuration

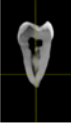





	2-1	2-2	1-2	3-2-1	2-1-2-1	1-2-1
						
Number of teeth	83	52	4	5	2	2
Incidence in %	54.2%	33.9%	2.6%	3.2%	1.3%	1.3%

Table 3: Distal root canal system configuration




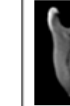

	1-1	2-1	1-2	1-2-1	2
					
Number of teeth	111	27	1	9	5
Incidence in %	72.5%	17.6%	0.6%	5.8%	3.2%

Figure 1



Samples were placed in a template CBCT scan of all the samples were taken

CBCT Images of Sagittal, coronal and axial views of each samples evaluated.

Figure 2



Figure 3

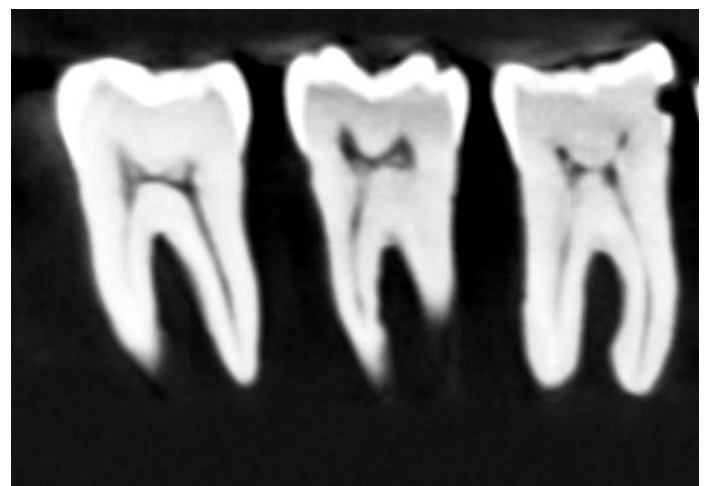
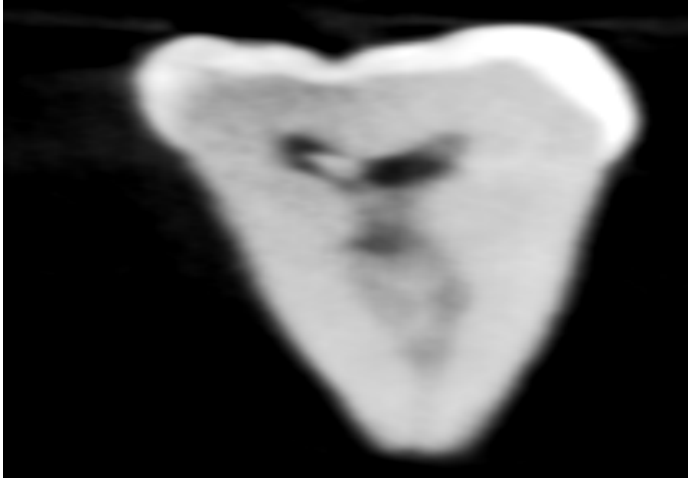


Figure 4



CBCT Image Showing Number of Canals

Figure 5: Three canals

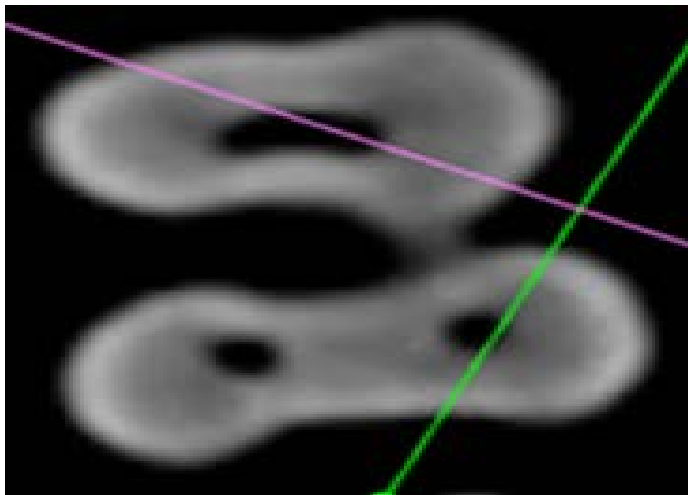


Figure 6: Four canals

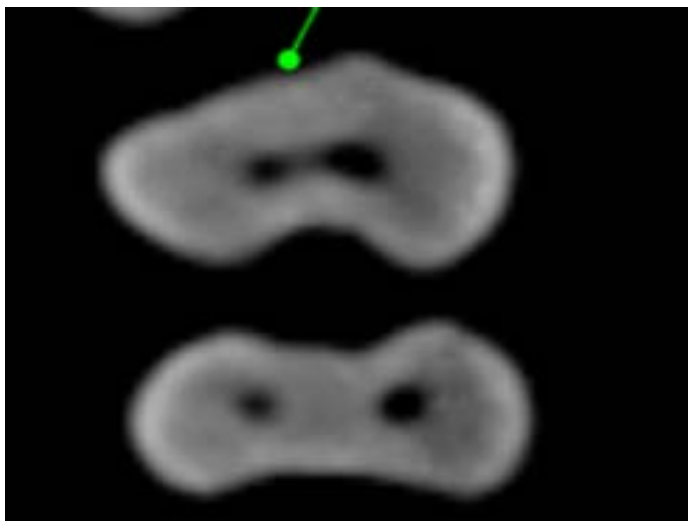
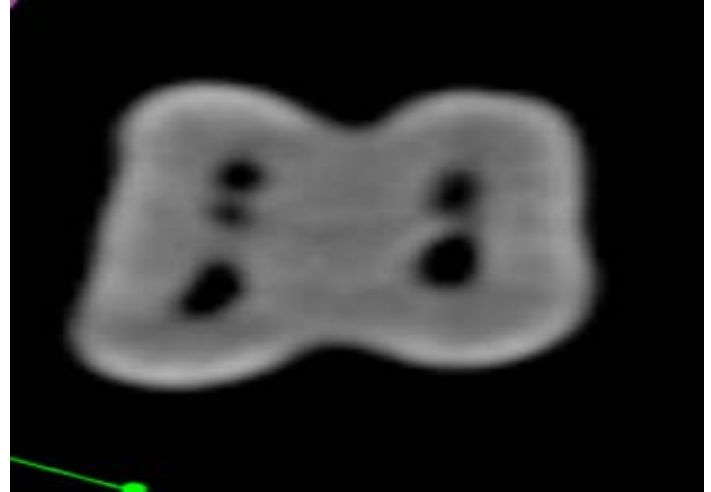


Figure 7: Five canals



Conclusion

Preoperative assessment of number of roots & canals and its canal configuration is very important for a successful endodontics. CBCT imaging has opened new vistas as the diagnostic tool due to its accurate and high quality 3 dimensional imaging.

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