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Prevalence And Level of Occurrence of Second Mesiobuccal Canal in Maxillary First Molar of North Malabar Population - A Cone Beam Computed Tomographic Study.

[1]Mohammed Azharudheen P T, Postgraduate student, Department of Conservative Dentistry and Endodontics, Kannur Dental College, Kerala University of Health Science, Kerala, India.

[2]Noushad M C, Professor and HOD, Department of Conservative Dentistry and Endodontics, Kannur dental college, Kerala University of Health Science, Kerala, India.

[3]Anish Sebastian, Professor, Department of Conservative Dentistry and Endodontics, Kannur dental college, Kerala University of Health Science, Kerala, India.

[4]Arshitha V, Post Graduate Student, Department of Conservative Dentistry and Endodontics, Kannur dental college, Kerala University of Health Science, Kerala, India.

[5]Nithin AK, Assistant Professor, Department of Conservative Dentistry and Endodontics Kannur Dental College, Kerala.

Corresponding Author: Mohammed Azharudheen P T, Post graduate student, Department of Conservative Dentistry and Endodontics, Kannur Dental College, Kerala University of Health Science, Kerala, India.

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Abstract

Aim: To analyze the prevalence and variations in canals of the Mesiobuccal root of maxillary first permanent molar teeth of north Malabar population using CBCT.

Objectives

1. To determine the prevalence of second mesiobuccal (MB2) canal in maxillary first molar using CBCT imaging technique in north Malabar population

2. To determine the level of occurrence of second mesiobuccal (MB2) canal coronally 3mm,5mm,7mm from the tip of mesiobuccal root of maxillary first molar of north Malabar population

Methodology: 223 extracted maxillary first molar were collected from different clinics. Tooth were sectioned at CEJ. The sectioned teeth were mounted on rectangular template and placed on bite plate of CBCT ICAT 17-19 Next Gen Extra-Oral Imaging System.

The axial, coronal and sagittal sections of the entire sample were read through Invivo anatomage viewer software.

Results: It was found that 165(74%) teeth out of 223 sample showed second canal in mesiobuccal root. Out of 165 teeth where in second mesiobuccal canals were detected ,159 teeth showed orifice of the second mesiobuccal canal started at 7mm or more from the apex and 6 teeth showed orifice at 5mm from the apex. There wasn't any presence of second mesiobuccal canal at 3mm from the apex.

Conclusion: It was concluded that Prevalence of second mesiobuccal canal in maxillary first molar of north Malabar population is about 74% and CBCT scanning is a conservative tool that provides highly accurate 3D images with minimal distortion. It is considered as an excellent method for identifying the internal Summary 57 anatomy of maxillary first molars and is a reliable method in the detection of the MB2 canal.

Keywords: CBCT, Mesiobuccal, MB2 Canal.

Introduction

Successful endodontic treatment depends upon exploration of the entire root canal system, meticulous cleaning and shaping followed by obturation of prepared root canal system. For this the clinician should have thorough knowledge of root canal morphology and its anatomic variations. Any existing root canals that remain undetected by the operator during the entire course of endodontic treatment are one of the failures of root canal treatment.

Maxillary first permanent molars are frequently affected by caries at an early age and may necessitate root canal treatment. It is the largest tooth in total volume and is generally considered as the most anatomically complex tooth. Morphology of maxillary first permanent molars has been studied extensively for its complexity in canal configuration. Majority of the mesiobuccal roots have two canals because of its broad buccolingual dimension and concavities on mesial and distal surfaces. According to available literature, two separate mesiobuccal canals occur in percentages varying from 18%–88% of the maxillary first molar teeth[1].

Various methods have been used to identify this second mesiobuccal canal. These include clearing technique combined with dye penetration, Cross section analysis, Conventional radio graphic examination, macroscopic examination and magnification with dental operating microscope[2]. Limitations of conventional radiographic technique have led to introduction of advanced modalities such as Spiral Computed Tomography (SCT) and Cone-Beam Computed Tomography (CBCT).

Considering the limitations of conventional techniques for locating the second mesiobuccal canal, CBCT was used in the current study and a very few literatures exists which discuss the reliability of CBCT in the detection of MB2 canals.

There is little scientific literature available for root morphology of various teeth in North Malabar populations which include Kozhikode, Kannur, Kasaragod, Manan thavady taluk of Wayanad. Therefore, the present study was designed to evaluate the efficacy of CBCT in the detection of second mesiobuccal canals in the mesiobuccal roots of maxillary first molars of north Malabar population.

Aim and objectives

Aim

To analyze the prevalence and variations in canals of the mesiobuccal root of maxillary first permanent molar teeth of north Malabar population using CBCT.

Objectives

1. To determine the prevalence of second mesiobuccal (MB2) canal in maxillary first molar using CBCT imaging technique in north Malabar population
2. To determine the level of occurrence of second mesiobuccal (MB2) canal coronally 3mm,5mm,7mm

from the tip of mesiobuccal root of maxillary first molar of north Malabar population

Materials and methods

223 Extracted permanent maxillary first molar of north Malabar population (Kozhikode, Kannur, Kasargod, Mananthavadi thaluk of Wayanad) were collected from different clinics. Teeth were cleaned of any adherent soft tissue, bone fragment and calculus by scaling and polishing. These teeth were placed in a container with 5% Sodium hypochlorite solution which were changed daily for four days.

The inclusion criteria were Permanent maxillary first molar extracted for any reasons. exclusion criteria included unclear included Teeth with open apices, External resorption, Internal resorption, Caries extending to coronal 1/3rd of root surface, improperly formed roots, Aberrant anatomy, previously root canal treated teeth, Tooth with Vertical root fracture.

Materials used are Extracted human maxillary first permanent molar teeth, 5% Sodium hypochlorite solution, Modelling wax, CBCT-machine ICAT 17-19 NextGen, Software-INVIVO dental application.

The study basically consisted of three procedures.

- Tooth sectioning
- mounting on template of modelling wax
- cone beam computed tomographic analysis.

Sectioning

All collected samples were sectioned at cementoenamel junction (CEJ) using carbo random disc of 0.5 mm thickness.

Mounting On Template of Modelling Wax

A rectangle shaped template was made with modelling wax. 10 teeth were embedded in each template with the roots inside the wax and occlusal surface exposed. 22 samples were prepared to be mounted on extra-oral imaging system (CBCT). The base of the wax encasing was formed into a flat surface enabling the plate to sit stationary on top of the flat plastic bite plate. After placing on the bite plate the mounted teeth were Roughly Centered in the focal trough area and a preview picture were taken.

Cone Beam Computed Tomo graphic Analysis

The prepared sample plates were placed on to the biteplate of ICAT 17-19 NextGen Extra-Oral Imaging System. To confirm the internal anatomy, Axial, Coronal and Sagittal section CBCT images were taken with of ICAT 17-19 NextGen Extra-oral Imaging System with tube voltage of 90 KV and tube current of 10 mA. Details of the CBCT view of CBCT in the form of digital image were read through the Invivo anatomage software. Coronal sections at the level of 3-, 5-, and 7-mm apex to the CEJ were recorded for the presence of MB2 canals as it may not extend to the entire length of the root. The total findings of CBCT at 3-, 5-, and 7-mm apex to the CEJ and suggesting the presence or absence of MB2 were tabulated.

Statistical analysis

Sampling procedure

Cluster sampling Sample size: 223 Statistical analysis were done using N master software and calculated using following formula

• Formula- $N = Z2\ \alpha/2 \times p \times (1- p) \times DE2$

$Z\ \alpha/2$ = Normal deviate for two tailed hypotheses = 1.96

Results

Table 1: prevalence of second mesiobuccal canal.

	N	%
Yes	165	74
No	58	26

Graph 1:

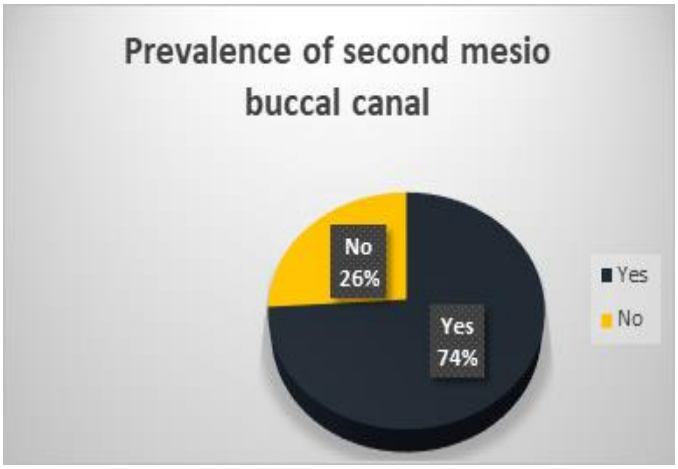


Table 2: level of occurrence.

	N	%
3mm from apex	-	
5mm from apex	6	2.7
7mm from apex	159	71.3

Graph 2:

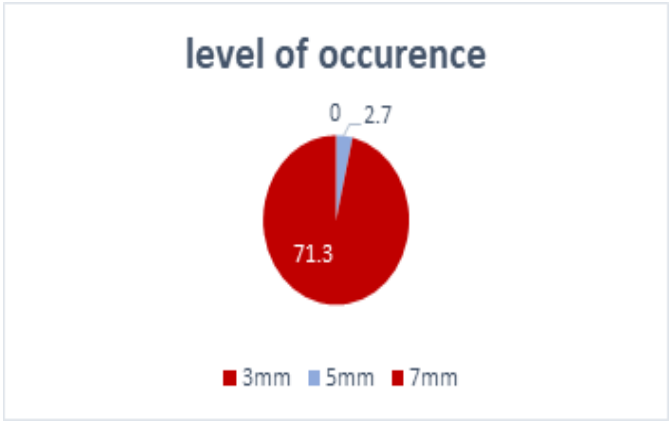
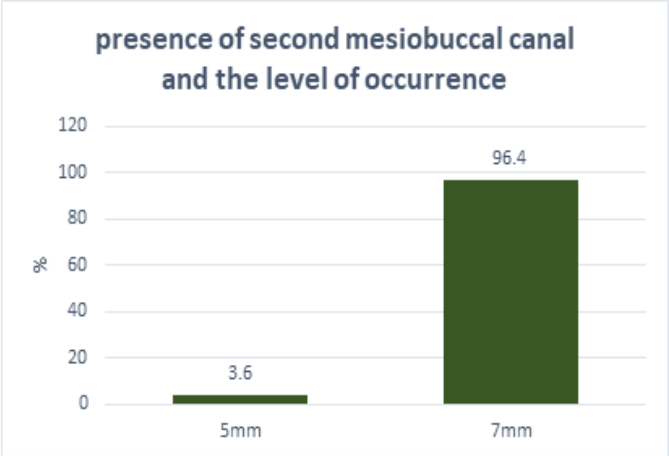


Table 3: association between presence of second mesio buccal canal and the level of occurrence.

	3mm	5mm	7mm	X^2 value	P value
No	0	0	0	22.3	<0.001**
Yes	0	6(3.6)	159(96.4)		

Chi square test; *p value <0.05 is statistically significant; ** <0.001 is statistically highly significant.

Graph 3:



Discussion

Detailed knowledge about the root canal morphology of the tooth and possible anatomical variations is vital for successful endodontic therapy. The incidence of missed canals and frequency of variations in internal anatomy are strictly linked with the complexity of the root canal system. It is generally accepted that a major cause for failure of root canal therapy is the inability to recognize the presence or inadequate treatment of all the canals of the root canal system. Weine et al., were one of the first to acknowledge that the failure of endodontic treatment of maxillary molars is likely due to the failure to locate and fill the second mesiobuccal canal[3].

Failure to find and obturate the second mesiobuccal canals in permanent maxillary first molars has been proven to pose the greatest challenge to adequate endodontic treatment, and it will likely result in the failure of the treatment as a whole[4]. Hess and Zurcher first noted its complexity, especially the presence of the second mesiobuccal canal[5]. The second mesiobuccal canal is usually curved and tiny, and its orifice is often covered by secondary dentin. Therefore, it is often difficult to diagnose its presence and achieve a straight line to the apex[6].

The second mesiobuccal orifice of the mesial buccal root is commonly located within the developmental groove

on an approximate line between the first mesiobuccal canal and the palatal orifice and parallel to the mesial marginal ridge (MMR). Knowing that all orifices originate on the pulpal floor and approximately lie on the same plane, the clinician must move mesiallyrather than chasing apically into the pulpal floor to identify the second mesiobuccal canal[7].

Because the root canal anatomy is related to genetics, similarities and variations in the root canal anatomy among populations could always be found. Variations in root canal configuration related to ethnicity have been reported in many studies. Therefore, evaluating the root canal anatomy of a certain population and comparing the results with those of other populations will help clinicians to understand the population's propensity in terms of root canal anatomy[8].North Malabar consist of Kozhikode, Kannur, Kasaragod, and Mananthavady taluk of Wayanad districts of Kerala state in India. Many endodontists in this area reported the presence of second mesiobuccal canal routinely in their practice.

CBCT in endodontic has been indicated and used to assess internal anatomy, to diagnose the presence of apical lesions, to detect root resorption, root fractures[9]. The prevalence of the second mesiobuccal canal has been reported in many studies using CBCT scanning. The findings of CBCT studies were compared with the averages that have been reported in many studies. A recent study performed by Martins et al. looking at the worldwide prevalence of MB2 canals in 21 regions of the world using CBCT as the gold standard concluded the overall prevalence to be 73.8%[10]. Patel et a[11]. and Blattner et al[12]. found CBCT to be a highly accurate, non-invasive three-dimensional tool to detect the presence of second mesiobuccal canal[13].

On exposing the sample the CBCT machine gives a 360° rotation[14]. Axial, coronal and sagittal section of the particular sample were appeared on the Invivo anatomage viewer software.

Axial sections of CBCT divide the tooth into superior and inferior parts. This section divides the tooth into different parts from coronal to apical. Images of each section can be viewed in the software and the level of this sections can be identified by lines on CBCT images. The distance between each line is called interslice distance. for a particular tooth or sample the interslice distance is set using the software. In the present study the inter slice distance is .400 mm. so from the CEJ as we move apically using the software, we get axial section images of .400 mm interval.

Majority of mesiobuccal root with dumbbell shape in axial cross sections shows additional canal, so the chances of finding additional canal in dumbbell shaped cross sections of mesiobuccal roots are high. Even though we can find the additional canals in axial sections the level of its orifice can be clearly measured using coronal sections.

Coronal section divides the posterior teeth in to mesial and distal parts. Coronal sections give the information about the location of orifice, whether the second mesiobuccal canal has separate portal of exit or whether it joins the first mesiobuccal canal and also any accessory canals at the apical portion of the mesiobuccal root. Coronal sections at the level of 3, 5, and 7 mm from apex to CEJ were measured using measuring tool in the Invivo anatomage viewer software. There is overlapping of first mesiobuccal and second mesiobuccal canals in sagittal section view of CBCT. So, to confirm the presence of second mesiobuccal canal the corresponding axial and coronal sections are used.

Prior studies using CBCT on Indian population have showed wide differences in prevalence. These differences can be explained by variations in

subpopulation group studied, sample size, study design, author's definition of what constitutes a canal and the average age of the population studied. Neelakantan P et al[15]., have reported prevalence of MB2 in maxillary first molars in Indian population to be 44.1%and Karunakar et al[16]., reported the prevalence to be 47.1%. Radhika Kewalramani et al[17]., have reported the prevalence of MB2 canal in three rooted maxillary first molar was 61.9% in Karnataka sub population[18].In Kerala similar study is not conducted till date. The prevalence obtained in our study was 74%. This higher prevalence in our study may be attributed to a larger sample size and different ethnicity of population.

According to the present study 71.3% of the sample shows the orifice location 7mm or more coronal to the apex. So majority of maxillary first molar in north Malabar population shows orifice location more coronally almost at the level of first mesiobuccal canal orifice.so it is important to search for the second mesiobuccal canal while endodontically treating this population.

Conclusion

As per the results obtained and discussed in this in vitro study, it can be concluded that Prevalence of second mesiobuccal canal in maxillary first molar of north Malabar population is about 74%.

Out of this 71.3% shows orifice location of second mesiobuccal canal 7mm or more coronal to the apex. No studies are there in Kerala regarding the prevalence of second mesiobuccal canal in maxillary first molar using CBCT.

CBCT is an imaging modality aid that helps clinicians to assess complex root canal morphology in a reliable manner. It is considered as an excellent method for identifying the internal anatomy of maxillary first molars and is a reliable method in the detection of the MB2 canal.

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Legend Figures

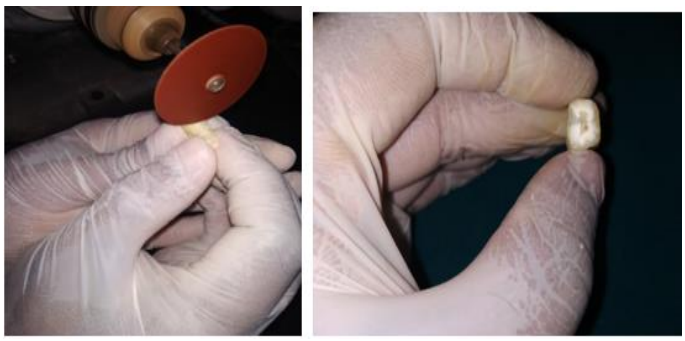

Fig 1: Sectioning of permanent maxillary first molar at CEJ level

Fig 2: Sectioned tooth mounted on rectangular template of modelling wax

Fig 3: Rectangular template placed on base plate of CBCT

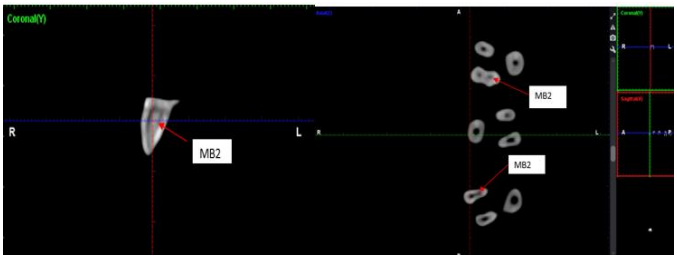

Fig 4: Axial, coronal and section of a mesiobuccal root showing MB2

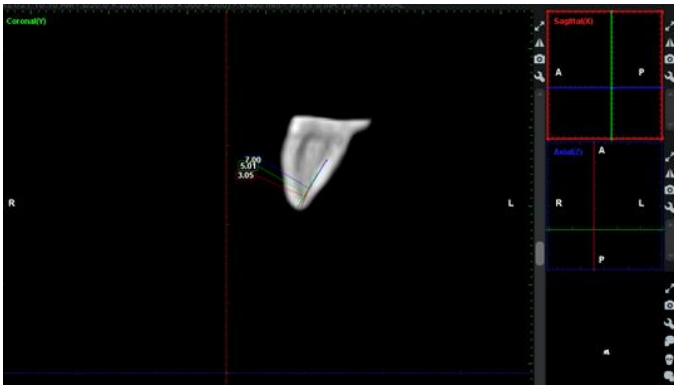

Fig 5: Level of occurrence of MB2 canal measured from 3mm,5mm,7mm from the apex in coronal section.