CBCT Analysis of Maxillary First Molar in Indian Population

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ABSTRACT

Aim: This study aimed to assess the variations in root canal morphology of permanent maxillary first molar with the use of cone-beam computed tomography (CBCT).

Materials and methods: One hundred extracted teeth were cleaned and arranged in U shape template mimicking natural arch in set of five teeth. These arches were scanned in CBCT and were analyzed by expert radiologist for number of roots, number of canals per root, and Vertucci classification.

Result: A maximum number of permanent maxillary first molars had three roots, and only 2% had two roots. All the palatal roots and 99% of distobuccal roots had one canal, but one of the distobuccal roots had two canals. Incidence of two canals in MB root is more frequent (60%) than incidence of one canal. The most common type of Vertucci's classification for MB root is a type I, followed by type IV, type II, type VI, type V, type VII.

Keywords: CBCT laboratory study, Maxillary first molar, Root canal morphology, Variation.

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INTRODUCTION

A good understanding of the anatomy of teeth is vital before beginning the endodontic treatment.[1] The dentist may use this information to locate all of the canals in the patient's body, debride them, and then fill them with a root canal filling. It is important to note, however, that no two root canals are the same. First permanent molars in the maxillary arch often develop infected at a young age and may need endodontic treatment.[2]

Successful endodontic therapy involves a detailed grasp of the root canal system's complicated 3-dimensional (3D) architecture. It is because of this that much research has been done on root canals in the maxillary first molar MB system. A wide variety of researchers have studied the anatomy of this complicated and ever-changing canal.[1] Individuals' medical records, X-rays, and clinical evaluations during endodontic therapy have been analyzed retroactively in clinical investigations using either magnification or without it. The extraction of teeth was used in *in vitro* laboratory trials to perform several clearing tests involving decalcification with India ink or other colors, as well as endodontic access, radiography, scanning electron microscopy, grinding, and sectioning.

By obtaining consecutive 2-dimensional segment X-ray pictures, computed tomography builds 3-dimensional views of an item. Additional advantages of CT imaging over conventional radiography include its power to remove anatomical noise and its high contrast resolution, which allows the delineation of tissues with physical density variations as low as 1%, as compared to the 10% difference required by conventional radiography for tissue distinction.[3]

This means that CBCT is better than other diagnostic modalities in a number of respects. There is now research being conducted to determine the quantity and form of permanent maxillary first molar root canals, as well as the role of CBCT in this assessment.

MATERIALS AND METHODS

The Sri Aurobindo College of Dentistry, Madhya Pradesh, worked with Hitkarini Dental College and Hospital, Jabalpur, Madhya

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Pradesh, to perform this study, which was authorized by the Hitkarini Dental College and Hospital, Jabalpur (MP), ethics committee prior to its completion (MP). The Department of Oral and Maxillofacial Surgery at Hitkarini Dental College and Hospital in Jabalpur provided 100 human maxillary first teeth for the study (MP).

Inclusion Criteria Include

- Permanent maxillary first molar extracted for periodontal reasons
- Carious permanent maxillary first molar extracted with intact roots.

Exclusion Criteria Include

- Teeth with open apices
- Teeth with external resorption or internal resorption
- Teeth with fractured teeth involving root
- Teeth with aberrant anatomy

Fig. 1: Arrangement of hundred teeth on twenty templates of modeling wax

Fig. 2: Scanning of sample by CBCT

• Teeth with root canal treated teeth.

Brushing and rinsing the teeth under running water and soap were the last steps.[4] They used ultrasonic scaling tools if calculus could be found and kept in formalin solution (10%) on their roots.

Using modeling wax, a "U" shaped template mimicking the natural arch form was created. Roots and occlusal surfaces were revealed on all five teeth in each arch. Twenty of these specimens were processed and put on an extraoral imaging device (Fig. 1).

Using the wax encasing as the basis, we created a level surface on top of which the bite plate could rest. A preview picture was captured in the focal trough area. The imaging system's biteplate was loaded with the freshly produced sample plates (Fig. 2).

At 90 KV tube potential, 5 mA tube current, 300 µm voxel size, and 11.30 meter/second exposure duration, Carestream Health's Kodak CS9300 digital radiographic machine acquired 20 full-volume scans.

A professional radiologist examined CBCT images in the axial, coronal, and sagittal sections to verify the internal architecture. Each root's number of roots, number of canals per root, and Vertucci classification were all recorded.

The readings obtained during the scanning procedure were put to statistical analysis. It was determined by using descriptive statistics how many root canals there were, how many canals were in each type of root, and how Vertucci classified the canals. Testing for statistical significance by means of a Chi-squared test was carried out here.

RESULTS

A maximum number of permanent maxillary first molars (98%) had three roots, and only 2% had two roots (Table 1 and Fig. 3). All the palatal roots and 99% of distobuccal roots had one canal, but one of the distobuccal roots had two canals. Incidence of two canals in MB root is more frequent (60%) than incidence of one canal (Table 2 and Fig. 4).

The most common type of Vertucci's classification for MB root is a type I (39.8%), followed by type IV (25.51%), type II (22.45%), type VI (5.1%), type V (4.08%), type VII (3.06%) (Table 3 and Fig. 5).

DISCUSSION

The therapeutic goal of endodontic treatment is to provide a bacteria-free canal system. Endodontic treatment outcomes
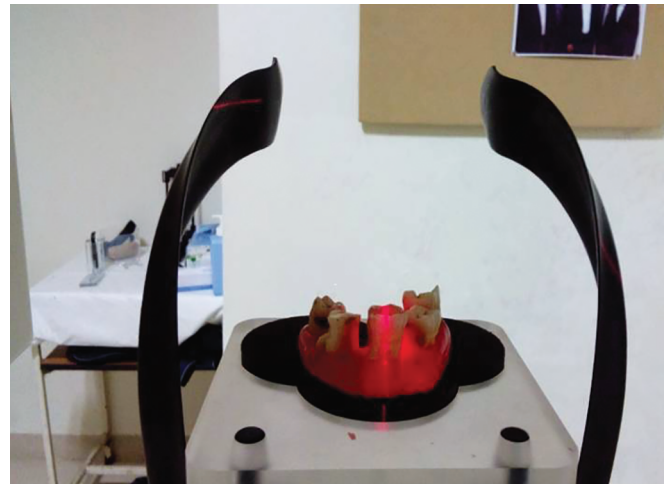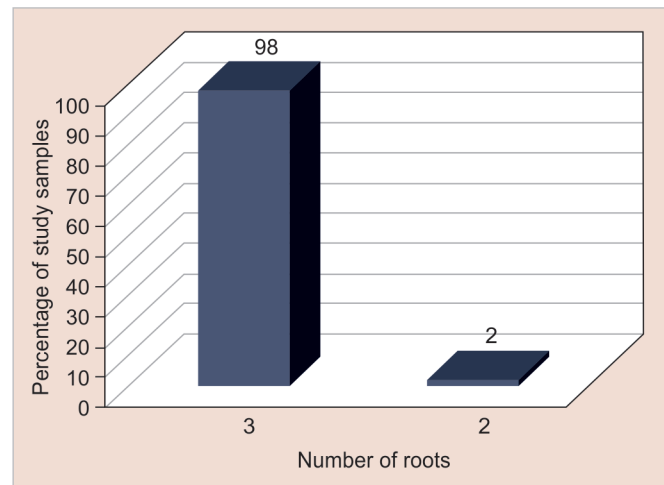

Fig. 3: The number of roots in each study sample was distributed

Table 1: Distribution of study samples according to number of roots

Number of roots	n (%)
03	98 (98.0)
02	02 (2.0)
Total	100 (100.0)

have been proven to improve significantly with meticulous chemomechanical debridement of the root canal system, despite the fact that failures are not uncommon.[5]

It has been claimed that the root canal system's intricacy, the existence of untreated canals, or insufficient root canal instrumentation may be to blame for these failures.[4] Effective debridement and obturation of the root canal system need knowledge of the internal anatomy of the system.[6]

Other than its diagnostic accuracy and practicality, CBCT has no negative impact on the tooth structure as is the case with many laboratory studies. In addition, compared to staining and clearing, it saves time during root canal morphology laboratory assessments. Dental practices may now use CBCT scans as a diagnostic and treatment planning tool because they are now commonly accessible to them.

Table 2.: Distribution of study sample according to number of canals in roots

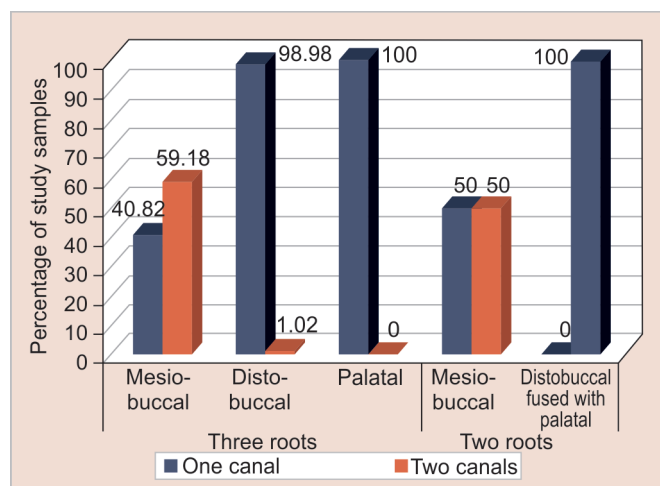| Number of roots	Type of roots	Number of canals n (%)		Total teeth	Chi-square test	p value
		One	Two			
03	Mesiobuccal	40 (40.82)	58 (59.18)	98 (100.0)	$\chi^2 = 140.246$, df = 2	0.000 (< 0.001)
	Distobuccal	97 (98.98)	01 (1.02)	98 (100.0)		Significant difference
	Palatal	98 (100.0)	00 (0.0)	98 (100.0)		
02	Mesiobuccal	01 (50.0)	01 (50.0)	02 (100.0)	Not applied	Not applicable
	Disto buccal fused with palatal	00 (0.0)	02 (100.0)	02 (100.0)		

Fig. 4: Study samples were distributed according to the number of canals in the roots

Maximum molar teeth have the highest clinical failure rates for endodontic treatment. This is likely due to the tooth's complex canal anatomy, particularly in the MB roots.[6]

Caries in the maxillary arch's first permanent molars can occur as early as childhood, necessitating root canal therapy.[7]

As a result, the current investigation focused on the maxillary first molar. An "U" shaped wax template was produced to mimic the natural arch form for this investigation. Additionally, it helped place samples onto an additional oral imaging system in the proper spot because of its "U" shaped arch, which represented the jaw's natural arch. Roots were inserted vertically into the wax, and the occlusal surface was left free. A full-volume CBCT test was performed on each of the prepared sample plates.

Number of Roots

After analysis, in a present study, out of one hundred permanent maxillary first molars, ninety-eight teeth (98%) had three roots, and two of them (2%) had two roots. In teeth having two roots, distobuccal and palatal roots fuse to create a single root. According to Ng et al. and Alavi et al. all the maxillary first and second molars in the Burmese and Thai populations had three roots, consistent with our findings. Ninety-six percent of the Irish population had three roots in their maxillary first molars, as compared to just 2.4% who had two. In the Indian population, 96% of maxillary first molars had three roots, according to Neelakantan et al.[8] research. Some of our findings are similar to those of Irish and Indian populations.

Number of Canals

In the present study, in MB roots of three rooted teeth, there was the presence of one canal in forty roots (40.82%) and two canals in fifty-nine roots (59.18%). These results are in accordance with studies by Kim et al.[9] (63.59%), Zhang et al.[4] (52%), Alavi et al.[10] (65%), and Weine et al.[11] (58%) were reported similar incidence of second MB canal (MB2). According to Al Shalabi et al.,[12] the proportion of maxillary first molars with the second MB canal (MB2) in an Irish population was 78%, but Imura et al.[13] found a lower percentage of the second MB canal (MB2) (47%) in an American population (MB2). In the fused root of these teeth, two canals are present in both (100%) of the teeth. There is scarce information regarding the fusion of roots in the maxillary molar, so findings are not compared.

In distobuccal roots of three rooted teeth, ninety-seven roots (98.98%) had one canal, and one root (1.02%) had two canals. All the ninety-eight palatal (100%) roots of three rooted teeth had a single canal. This is in accordance with Vertucci's,[14] Caliskan et al.[15] Alavi et al.[10] and Zhang et al.[4] found one canal in both distobuccal and palatal roots, whereas the rare occurrence of two canals is also seen with distobuccal root. Conversely, Ghoddusi et al.[16] described two symmetrical maxillary first molars with separate canals in their DB roots.

Vertucci's Classification

In the present study, roots were classified according to Vertucci's classification, and MB roots of three rooted teeth had a maximum frequency of type I (39.8%), followed by type IV (25.51%), type II (22.45%), type VI (5.1%), type V (4.08%), type VII (3.06%) and none of the canal had type III and type VIII. Vertucci's type I and type IV canal systems were the most common in Thai, Japanese, and Indian people, according to Alavi et al.[10] type I was substantially more prevalent in the current study than in previous ones by Weine et al[11] and Neelakantantan et al.,[8] respectively. According to Christie et al.,[17] type II was the most common in the Caucasian population. According to Yemi et al.,[9] the most common canal configuration among Koreans was type IV. In the present study, distobuccal root type I (98.98%) was most frequent, followed by type V (1.02%). In all the ninety-eight (100%) palatal roots type I of Vertucci's classification was seen. In two fused roots (100%), type IV was seen. It should be mentioned that type I has been reported to be the most prevalent in nearly every study, including Weng et al.,[18] Ng et al., Zang et al., Alavi et al., Neelakantan et al. and Yemi et al. for the distobuccal and palatal root canal systems.[6,8–10,19] In two teeth having two roots, the MB root of these teeth had type I in one root and type VI in another root. Since fusion of roots is not a common finding in maxillary first molar and very less literature is available regarding their root canal configurations.

Table 3: Vertucci's classification of root canal

|	Number of roots				
	03			02	
	Type of root canal			Type of root canal	
Vertucci classification	Mesiobuccal n (%)	Distobuccal n (%)	Palatal n (%)	Mesiobuccal n (%)	Distobuccal fused with palatal n (%)
Type I	39 (39.80)	97 (98.98)	98 (100)	01 (50.0)	00 (0.0)
Type II	22 (22.45)	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)
Type III	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)
Type IV	25 (25.51)	00 (0.0)	00 (0.0)	00 (0.0)	02 (100.0)
Type V	04 (4.08)	01 (1.02)	00 (0.0)	00 (0.0)	00 (0.0)
Type VI	05 (5.10)	00 (0.0)	0 (0.00)	01 (50.0)	00 (0.0)
Type VII	03 (3.06)	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)
Type VII	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)	00 (0.0)
Total	98 (100.0)	98 (100.0)	98 (100.0)	02 (100.0)	02 (100.0)
Chi-square test	$\chi^2 = 141.000$, df = 10			Not applied	
p value	0.000 (<0.001) Significant difference			Not applicable	
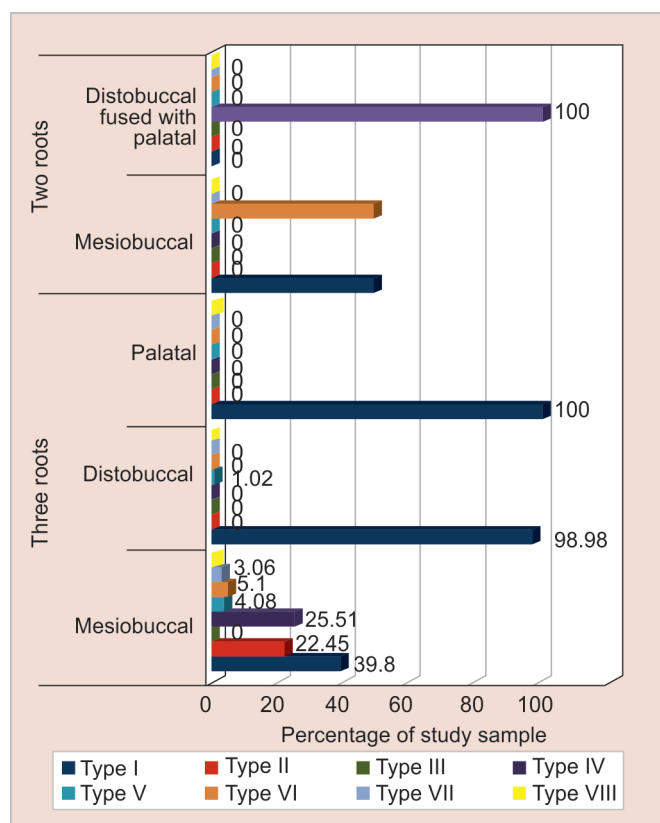
Fig. 5: Vertucci classification of root canals

Variations in this study can be attributed to a variety of factors. The shape of the root canal of a tooth can be exceedingly diverse and perplexing. The results may vary based on the ethnicity, age, and gender of the population studied.[11] Other possible explanations include sample size, research methods (in-vivo or in-vitro), and methods for detecting canal configuration that was used. The Dravidian race is a term used to describe the Indian people, who are typically regarded as a mix of Caucasian, Mongoloid, and Negroid ancestry. As a result, deviations are to be anticipated.

Most of the limitations of intraoral radiographs are solved by CBCT. A more precise diagnosis and monitoring, as a result of the additional diagnostic data, could lead to better management decisions for complicated endodontic diseases. It is a desirable addition to the endodontist's armamentarium.

Conclusion

Endodontic treatment for maxillary molars can benefit greatly from the use of CBCT, as improper root canal detection is a common cause of endodontic treatment failure. An advantage of CBCT over conventional radiography examination is its high accuracy, low radiation dose, and increased treatment success rate in the identification of endodontic diseases. So CBCT can be effectively used to assess the root canal morphology of any teeth, while endodontic procedures increase the success rate of treatment.

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