

CASE REPORT

Endodontic Management of Maxillary First Molar with Seven Root Canals Diagnosed Using Cone-beam Computed Tomography: A Case Report

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ABSTRACT

Aim and objective: To present the endodontic treatment of maxillary right first molar with three roots and seven root canals diagnosed with cone-beam computed tomographic imaging and its successful management.

Background: The anatomic complexities and variations of maxillary first molar reported vastly in the literature are constant challenges for successful endodontic therapy. Detection of all the root canals and their disinfection is important for proper healing and long-term survival of the tooth. CBCT imaging is being used extensively over the past two decades for the diagnosis of teeth with multiple root canals. The use of CBCT and various diagnostic tools for the successful management of a maxillary first molar with multiple root canals is discussed herein.

Case description: This case report represents an unusual morphology of three roots and seven root canals in the maxillary first molar. A rare configuration of two mesiobuccal, two distobuccal, and three palatal root canals is reported. The diagnosis was done using multiple angulated radiographs and CBCT imaging. Nonsurgical endodontic treatment was performed followed by a full-coverage porcelain crown.

Conclusion: Clinicians should always be mindful of various possible aberrations in the canal morphology of maxillary molars. This necessitates the use of various diagnostic tools like CBCT and dental operating microscope (DOM). The use of these aids led to successful diagnosis and treatment in the present case, thereby avoiding possible endodontic failure.

Clinical significance: This case report along with the literature discusses and highlights the fact that maxillary first molars have the highest incidence of additional root canals. It also signifies the importance of CBCT and DOM as essential diagnostic tools in detecting the additional canals.

Keywords: Cone-beam computed tomography, Endodontic management, First molar, Multiple canals, Palatal root canals.

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BACKGROUND

Maxillary first molar typically has three roots and three root canals. The most common variation is the occurrence of an extra canal in the mesiobuccal root. The tooth's cross section shows a buccolingually broad mesiobuccal root and a rounded or ovoid distobuccal root. This distinct anatomy possibly explains the highest incidence of multiple canals in the mesiobuccal root.¹ There is an extensive range of disparity in the literature with respect to the frequency of occurrence of the number of canals in each root, the number of roots, and the incidence of their fusion.¹ Variation may result due to ethnic background, age, and gender of the population studied. Regarding the incidence of seven or more root canals in maxillary first molars, very few studies are available. Their occurrence is relatively a newer finding and studies are warranted regarding their incidence in specific populations.

Accurate diagnosis and detection of all the root canals is crucial for a successful outcome of endodontic treatment and complete healing of the lesion. The patient's history, thorough clinical examination, radiographs, and the clinician's expertise gives an insight into the diagnosis of the case. Also, many diagnostic imaging techniques, such as, computed tomography, tuned aperture computed tomography, and cone-beam computed tomography (CBCT) are available for studying root canal complexities. CBCT imaging stands unchallenged in the field of endodontics due to its three-dimensional imaging which gives details in all three planes. It is used for evaluating the presence of additional root canals, complex root canal morphology, perforations, separated

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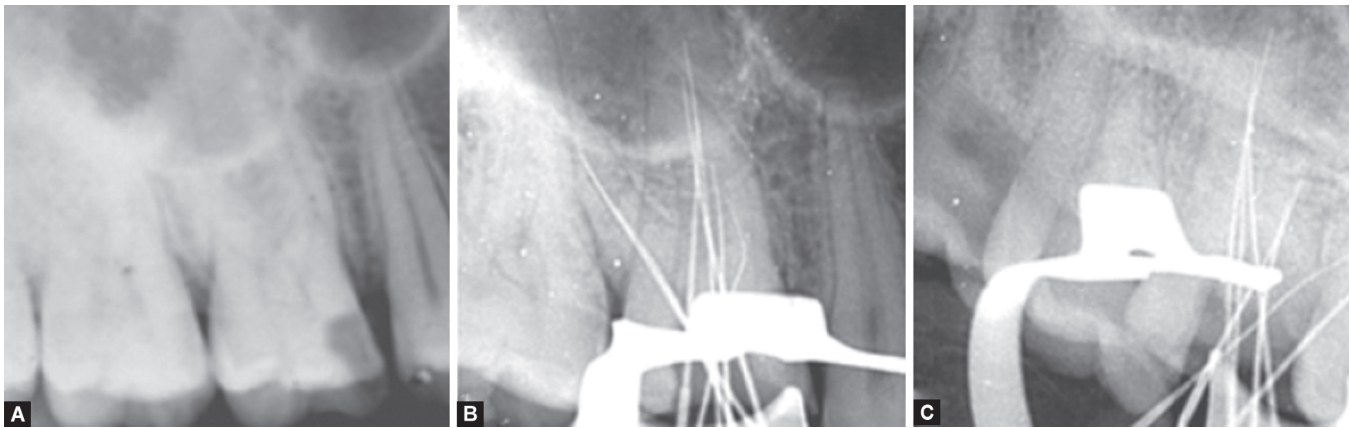
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instruments, root resorptions, etc. It gives information about the course of the root canals from the coronal to the apical third, their curvatures and obliterations if any. This is not always possible with conventional radiography which gives only two-dimensional images.

CBCT was used in the present case for detection and confirmation of the additional root canals. This case report describes the successful management of a maxillary right first molar (tooth number 16) with seven canals showing two mesiobuccal (MB1 and MB2), two distobuccal (DB1 and DB2), and an unusual configuration of three palatal root canals namely the main central palatal (P),



Figs 1A to C: (A) Preoperative radiograph; (B) Working length radiograph; (C) Working length radiograph from distal angulation

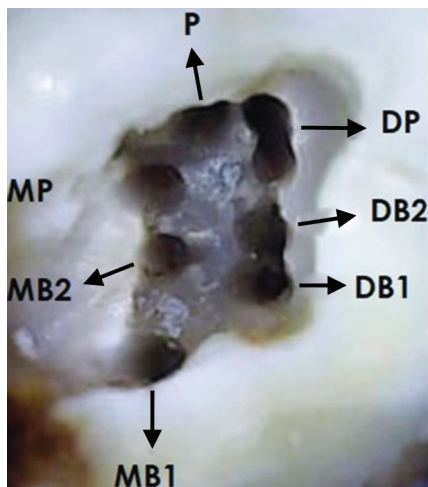


Fig. 2: Pulpal floor showing seven canal orifices. MB, mesiobuccal; DB, distobuccal; MP, mesiopalatal; DP, distopalatal; P, palatal

mesiopalatal (MP) and distopalatal (DP) canals. The occurrence of this configuration is uncommon in daily clinical practice. Previous literature on maxillary first molar reveals only two case reports with three canals in the palatal root and very few case reports of seven root canals in total.

CASE DESCRIPTION

A 25-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Sree Balaji Dental College and Hospital, Chennai in August 2019 with pain in the upper right back tooth region of the jaw for the past 1 month as his chief complaint. The patient gave a history of intermittent and dull pain which aggravated on mastication for the past 1 month. On clinical examination, a deep class II mesio-occlusal carious lesion was seen in tooth number 16, which was tender on percussion. There was no abnormality or tenderness detected on the buccal and palatal aspects of the tooth on palpation. From the preoperative intraoral periapical radiograph, it was evident that: a coronal radiolucency approximating the pulp extended on the mesio-occlusal aspect of the tooth and periodontal ligament space widening associated with the mesiobuccal and palatal roots (Fig. 1A). A diagnosis of chronic pulpitis with symptomatic apical periodontitis was established in relation to 16 after sensibility testing and thorough radiographic

examination. Nonsurgical endodontic treatment was suggested for tooth 16.

About 1.8 mL of 2% lignocaine with epinephrine concentration of 1:200,000 (Astra Zeneca Pharma Ltd., Bengaluru, India) was administered to induce local anesthesia. The isolation of the tooth was achieved using a rubber dam and endodontic access was prepared. The orifices of the mesiobuccal (MB), distobuccal (DB), and the palatal canals (P) were apparent and were initially located. The shape of the cavity was modified from triangular access to a trapezoidal shape (shamrock preparation) to gain access to any of the additional root canals present. The entire pulp chamber was viewed under a dental operating microscope (DOM) (Carl Zeiss Meditec AG, Germany). With the help of magnification and exploration of the pulp chamber floor with a DG 16 explorer (Hu-Friedy, Chicago, USA), MB2 and DB2 canals were located. The patency was confirmed with ISO #10 K-files (Mani Inc., Japan). The orifices were enlarged using Gates Glidden drills (Mani Inc., Japan) up to size #2 (Fig. 2). Initially, the working lengths were determined using an electronic apex locator (Root ZX; Morita, Tokyo, Japan), which were established and documented by intraoral periapical radiographs taken in multiple angulations (Figs 1B and C).

Informed consent was obtained from the patient and CBCT imaging was done to assess the root canal morphology. Before CBCT scanning, a sterile cotton pellet was placed inside the pulp chamber, over the root canal orifices and the access cavity was sealed by temporary restorative material: Cavit G (3M ESPE Dental Products, St Paul, MN, USA). A small field of view (FOV), CBCT scan of the maxilla in relation to tooth number 16 was conducted (Simulix Evolution; Nucletron Pvt Ltd., Chennai, India) with 100 kV tube voltage and 8 mA tube current. Cross-sectional images of 0.5 mm thickness were obtained in the axial, transverse, sagittal planes and were analyzed by CS 3D imaging software (Carestream Dental LLC, Atlanta, USA) to find out the canal morphology. The CBCT scan slices revealed additional root canals namely the mesiopalatal (MP) and distopalatal (DP). It also confirmed the presence of mesiobuccal₁ (MB1), mesiobuccal₂ (MB2), distobuccal₁ (DB1), distobuccal₂ (DB2), and the main palatal (P) canals (Fig. 3).

At the next appointment after 7 days, the patient did not report pain or discomfort. The tooth was again isolated using a rubber dam. Cleaning and shaping were performed using Neoendo Flex (Orkam Healthcare, Gurugram, Haryana, India) rotary instruments in a crown down technique. All the canals except the main palatal canal were enlarged up to size 25 and 0.04 taper. The main palatal canal was enlarged up to size 25 and 0.06 taper. Irrigation was



Figs 3A to C: Cone-beam computed tomography image of the root canals: (A) Cervical third; (B) Middle third; (C) Apical third



Figs 4A and B: Obturation radiograph: (A) Straight angulation; (B) Mesial angulation

performed using 2.5% of sodium hypochlorite and 17% of EDTA. All the canals were finally flushed with saline. The canals were dried with absorbent paper points and obturation was done using cold lateral compaction with gutta-percha points (Maillefer, Dentsply, USA) and AH Plus root canal sealer (Maillefer, Dentsply, USA) (Fig. 4) followed by composite core build-up. A full-coverage porcelain crown was advised to the patient, post the endodontic treatment. The patient was completely asymptomatic on his next follow-up visit after 90 days. There were no signs of inflammation seen.

DISCUSSION

Radiographs were taken at various angulations preoperatively, a thorough inspection of the pulpal floor with a DG 16 explorer, troughing the grooves with ultrasonics, staining the chamber floor with 1% methylene blue dye, performing the hypochlorite champagne bubble test, and visualizing the canal bleeding points are important diagnostic aids in locating canal orifices.² If any instrument impingement occurs due to the presence of an extra canal or a severely curved root, that portion of the access cavity wall needs to be extended so that the instrument will have straight-line access to the apical third of the root canal. This results in a cloverleaf appearance of the outline of the access cavity preparation also called Shamrock preparation (coined by Luebke).³ It changes the conventional triangular access to a rhomboidal shape and is one of

Table 1: Incidences of MB2 and DB2 in maxillary first molars given by various authors

Author	Year	Incidence	Population studied
Sert S and Bayirli GS	2004	DB2—1.6–9.5%	Turkish
Cleghorn et al.	2006	MB2—56.8% DB2—1.7%	Literature review
Neelakantan et al.	2010	MB2—38.5% DB2—7%	Indian
Zheng et al.	2010	DB2—1.12%	Chinese
Kim et al.	2012	DB2—1.25%	Korean
Martins et al.	2018	MB2—76.3%— males 71.8%—females	World-wide analysis

the main modifications for locating the extra canals. Magnification with loupes and the DOM can also be used as adjuncts for locating extra canals. In the present case, a microscope and CBCT were used to locate the additional canal orifices.

Various incidences of the second mesiobuccal canal (MB2) and the second distobuccal canal (DB2) in maxillary first molars are mentioned in Table 1.^{1,4–8} In the present case, the two mesiobuccal canals and the two distobuccal canals showed Vertucci type II canal configuration. They had two separate orifices exiting as

Table 2: Summary of case reports of maxillary first molar presenting with seven root canals

Author	Year	No. of roots	No. of canals	No. of MB canals	No. of DB canals	No. of palatal canals	Technique of canals' detection
Kottoor J et al. (India)	2010	3	7	3	2	2	DOM and CBCT
Kumar R (India)	2014	3	7	3	2	2	DOM and CBCT
Badole GP et al. (India)	2014	3	7	3	2	2	DOM and CBCT
Martins JN (Portugal)	2014	3	7	4	2	1	DOM and CBCT
Raghavendra SS et al. (India)	2014	3	7	3	2	2	DOM and CBCT
Munavalli A et al. (India)	2015	3	7	3	2	2	DOM and CBCT
Nayak G et al. (India)	2015	3	7	3	3	1	DOM and CBCT
Rodrigues E et al. (Brazil)	2017	3	7	3	2	2	CBCT
Venumuddala VR et al. (India)	2017	3	7	3	3	1	DOM and CBCT

a single apical foramen. The unique morphology of the three palatal canals in the present case report is classified under Sert and Bayirli's type XVIII canal configuration.⁶ It showed three separate orifices and a single apical foramen. The DP and MP canals joined the central palatal canal at the middle third and apical third, respectively, to exit into a single apical foramen. A review of the literature showed only two case reports presenting one palatal root with three canals.^{9,10} Wong⁹ and Maggiore et al.¹⁰ reported a Sert and Bayirli type IX canal configuration in the palatal root presenting with three canals. In both of the cases, the palatal root canal had a single orifice with a trifurcation in the apical third and three different apical foramina.

The dental literature reports many *ex vivo* studies on a maxillary first molar. The configuration of three roots and seven root canals in the maxillary first molar was first reported by Baratto Filho et al. in his study on extracted teeth.¹¹ A total of 140 maxillary first molars were examined, of which only one tooth showed seven root canals with three mesiobuccal, three distobuccal, and one palatal canal. A case of a maxillary first molar with seven root canals was first reported by Kottoor et al. in 2010 which showed three roots with a configuration of three mesiobuccal, two distobuccal, and two palatal root canals.¹² Since then, cases of seven root canals in maxillary first molar are being reported. A summary of case reports of a maxillary first molar with seven root canals diagnosed using CBCT published from the year 2010 to 2020 searched in PubMed database is given in Table 2.^{12–20} Out of the nine case reports mentioned, seven of them were recorded from India. It can be assumed that these multi-canal configurations may be a characteristic feature of this ethnic population.¹⁵ The present case report adds up to the presumption of multi-canal configurations of the maxillary first molar to be a feature of Indian ethnicity.

The role of CBCT scanning in endodontics includes improving the diagnostic accuracy and confirmation of the root canal morphology, thereby improving the quality of the treatment. It has advantages over conventional CT scans, such as, limitation of the X-ray beam, rapid scan time, and reduction in the dosage. It also has some limitations regarding the geometry in the projection of the beam, detector sensitivity, and lower resolution of the image. In the present case, CBCT was useful in detecting the MP and DP root canals which were inconspicuous during exploration of the pulpal floor. It also confirmed the overall unusual root canal morphology of the maxillary first molar.

CONCLUSION

Dental practitioners should be aware of various possible aberrations in the canal morphology of maxillary molars and must not neglect

them. This necessitates the use of various diagnostic tools, such as, CBCT and microscope. The present case report discusses the use of these diagnostic aids for the management of maxillary first molar with a unique configuration of three canals in the palatal root and seven canals in total and its successful endodontic outcome.

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