

## Case Report

# Endodontic management of maxillary first molar with seven root canals diagnosed using Cone Beam Computed Tomography scanning

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### Abstract

The main objective of root canal treatment is thorough cleaning and shaping of the entire pulp space and its complete filling with an inert filling material. A major cause of post-treatment disease is the inability to locate, debride or adequately fill all canals of the root canal system. The form, configuration, and number of root canals in the maxillary first molars have been discussed for more than half a century. Maxillary first molars commonly present with three roots and three canals, with a second mesiobuccal canal (MB2) also present. With the advent of improved magnification there are reports of multiple root canals in the maxillary first molars. Nonsurgical endodontic therapy of a left maxillary first molar with three roots and seven root canals was successfully performed under a dental operating microscope. The diagnosis of multiple root canals was confirmed with the help of Cone Beam Computed Tomography (CBCT) images.

**Key words:** Aberrant canal anatomy, cone beam computed tomography, dental operating microscope, maxillary first molar

### INTRODUCTION

The objective of root canal treatment is thorough cleaning and shaping of all the pulp spaces to be filled with an inert filling material.<sup>[1]</sup> A major cause of failure of the root canal treatment is the inability to locate, debride, or adequately fill all canals of the root canal system.<sup>[2]</sup> A successful root canal treatment depends on the diagnosis, treatment planning, good knowledge of the root canal system, and its frequent variations.<sup>[3]</sup>

There are numerous studies that examine the root and root canal anatomy of different populations using different methods like sectioning,<sup>[4]</sup> canal sectioning, and tooth clearing techniques,<sup>[5]</sup> conventional radiography,<sup>[6]</sup> digital radiographic techniques,<sup>[7]</sup> contrast medium-enhanced radiography,<sup>[8]</sup> and computed tomographic scanning.<sup>[9,10]</sup> The tooth

clearing methods have generally been considered the gold standard for analyzing the root canal anatomy, which involves making the tooth transparent and staining the canals for study, but these *ex-vivo* methods require the extraction of a tooth.<sup>[11]</sup>

There are case reports of the incidence of second mesiobuccal (MBI) canals ranging between 18 and 96.1%.<sup>[12,13]</sup> Generally, the permanent maxillary first molar has three roots and four canals.<sup>[14]</sup> The incidence of five canals is reported to be 2.25<sup>[15]</sup> – 2.4%,<sup>[16]</sup> and the incidence of six canals is reported to be 0.31<sup>9</sup> – 0.88%.<sup>[17]</sup>

The incidence of a second distobuccal (DBI) canal in the maxillary first molars has been reported to be as low as 1.7<sup>[18]</sup> and 1.25%.<sup>[10]</sup> Case reports with more than four root canals have also been reported in three-rooted maxillary first molars [Table 1]. An *ex-vivo* study by Baratto Filho, *et al.*, reported one maxillary first molar out of 140 samples having three roots and seven canals. They identified three

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mesiobuccal canals, three distobuccal canals, and one palatal canal.<sup>[19]</sup> Kottoor *et al.*, reported the endodontic management of the maxillary first molars with seven and eight canals, respectively.<sup>[20,21]</sup>

This case report discusses the endodontic management of an unusual root canal configuration in a maxillary first molar showing three roots and seven canals. This unusual morphology was confirmed with the help of cone beam computerized tomography (CBCT) scans.

## CASE REPORT

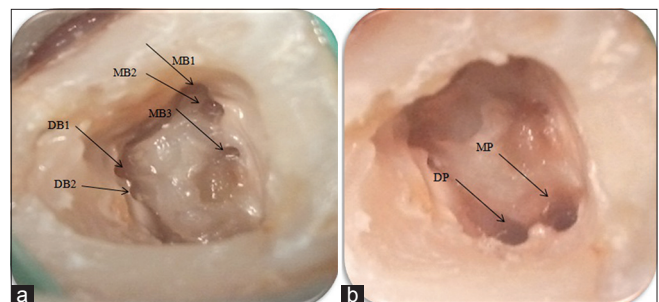
An 18-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Sinhgad Dental College and Hospital, Pune, with the chief complaint of spontaneous pain in the upper left posterior region of the jaw for the past five days. The patient gave a history of intermittent pain for the last two months, which had increased in intensity in the preceding five days. The tooth gave prolonged sensitivity to hot and cold. On clinical examination, a deep disto-occlusal carious lesion, which was tender on percussion, with no mobility, was seen in tooth 14. Vitality testing of the involved tooth with heated gutta-percha (Dentsply Maillefer, Ballaigues, Switzerland) caused an intense lingering pain, whereas, an electronic pulp tester (Parkell, USA) gave an early response. A preoperative radiograph revealed disto-occlusal radiolucency approaching the pulp space, with the periodontal ligament space widening in relation to the mesiobuccal root. From the clinical and radiographic examination, a diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made and nonsurgical endodontic treatment was recommended. Radiographic evaluation of the involved tooth did not indicate any variation in the root canal anatomy. Local anesthesia was induced using 1.8 ml of 2% Lignocaine and Adrenaline (Aqua Fine Injecta Pvt. Ltd., Pune, India). After caries excavation, the distal surface of the tooth was built up with composite resin (Matrix, Medicept Dental Prod, UK) to enable optimal isolation. A rubber dam was placed and a conventional endodontic access opening was established.

Initially, the MB1, DB1, and two Palatal canals (mesiopalatal (MP) and the distopalatal (DP)) were located. When viewing the floor of the pulp chamber under a dental operating microscope (DOM) (Moller Wedel, Germany), three additional root canal orifices (MB2, MB3, and DB2) were located and conventional triangular access was modified to a trapezoidal shape, to improve access to the additional canals [Figure 1a and b]. The patency of the canal

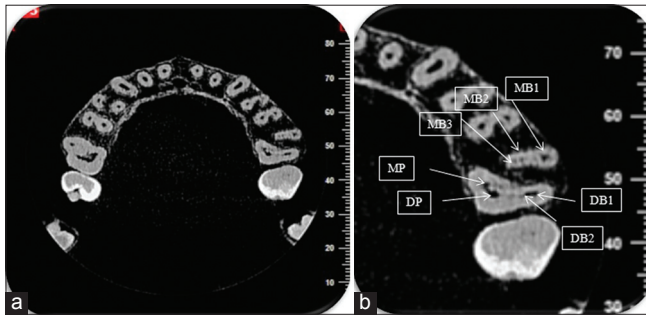
was confirmed with ISO #10 K-files (Mani, Japan). To confirm this unusual morphology, it was decided to perform CBCT imaging of the tooth. A sterile cotton pellet was placed in the pulp chamber and Cavit G (3M ESPE Dental Products, St Paul, MN) was used to seal the access cavity. Informed consent was obtained from the patient, and a multislice CBCT scan of the maxilla was performed with a tube voltage of 100 KV and a tube current of 8 mA. The involved tooth was focused and the morphology was obtained in the transverse, axial, and sagittal sections, of 0.5 mm thickness. The CBCT scan slices revealed seven canals (three mesiobuccal, two palatal, two distobuccal) in the left maxillary first molar [Figures 2a and b, 3a and b].

The CBCT images provided valuable information regarding the canal configuration and confirmed the seven canals that were not clearly seen in the conventional radiograph. At the next appointment, after two weeks, the patient was asymptomatic. The working lengths were determined with the help of an apex locator (Root ZX, J Morita, Tokyo, Japan), under rubber dam isolation, and intraoral periapical radiographs of the mesiobuccal, distobuccal, and palatal root were taken to confirm the working lengths [Figure 4a and b]. Cleaning and shaping were performed using nickel-titanium rotary instruments (M2, Dentsply VDW, Germany) using the crown-down technique. During root canal preparation, irrigation was performed using 2.5% sodium hypochlorite solution.

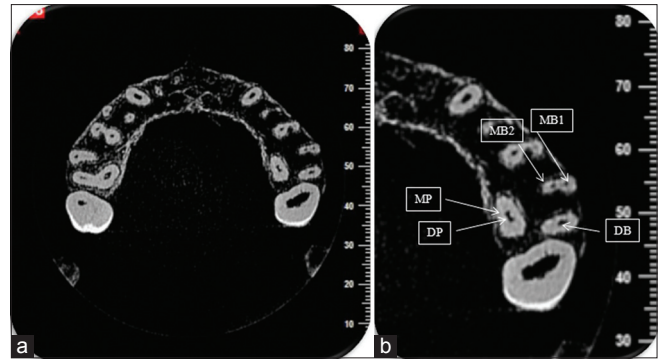
Final rinsing of the canals was performed using 2% chlorhexidine digluconate (Asep RC, Stedman Anabond, Chennai, India) together with passive ultrasonic agitation. A saline wash was performed. The canals were dried with absorbent points (Dentsply Maillefer, Ballaigues, Switzerland) and obturation was performed using cold lateral compaction of the gutta-percha (Dentsply Maillefer, Ballaigues, Switzerland) and AH Plus resin sealer (Dentsply deTrey, Konstanz, Germany). A radiograph was taken to establish the quality of the obturation [Figure 5a and b]. After completion of root canal treatment, the tooth



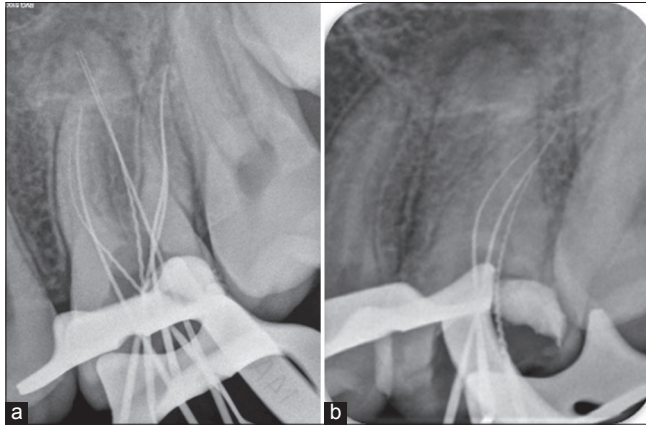
**Figure 1:** (a) Access opening (b) access opening



**Figure 2:** (a) Coronal section (b) coronal section



**Figure 3:** (a) Apical section (b) apical section



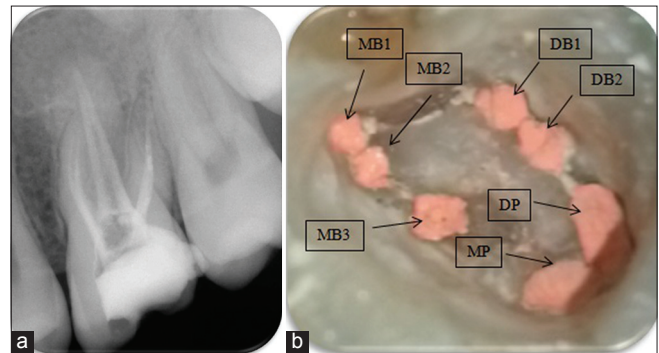
**Figure 4:** (a) Working length (b) working length – MB root

was restored with a posterior composite filling (Matrix, Medicept Dental Products, UK) and the patient was advised to have a full coverage porcelain crown. The patient was asymptomatic at the two-month follow-up.

## DISCUSSION

Before undergoing root canal treatment, prior knowledge of the roots and root canal anatomy of the teeth is required. In the maxillary molars, anatomic variations are not uncommon, with the number of canals, from one to eight. Vertucci identified eight pulp space configurations.<sup>[21]</sup> Recently, 14 new additional canal types were reported by Sert and Bayirli, highlighting the complexity of the root canal systems.<sup>[22]</sup>

In this case, CBCT scanning was used for a better understanding of the complex root canal anatomy. It helped to confirm the presence of multiple canals, which were otherwise not able to be identified, except through the microscope. The tenet of 'as Low as Reasonably Achievable' (ALARA) was considered, but the advantage of using CBCT outweighed the risks of additional exposure. A CBCT scan and surgical operating microscope confirmed the diagnosis of three roots and seven canals in the left maxillary first molar, namely,



**Figure 5:** (a) Obturation (b) Clinical view of the pulp chamber post obturation

MB1, MB2, MB3, DB1, DB2, MP, and DP. The CBCT axial images showed the mesiobuccal root had a Sert and Bayirli type XV canal configuration.<sup>[22]</sup> The distobuccal root presented with a Vertucci type II canal pattern.<sup>[21]</sup> The palatal root showed a Vertucci IV canal pattern.<sup>[21]</sup>

In the apical area, the MB2 and MB3 joined together to exit as one and the DB1 and DB2 joined to exit as one.

In clinical conditions, conventional periapical radiographs and digital radiographs taken in different angulations are an essential part of endodontic treatment for the identification of root and canal configuration. However they are taken in a buccal-lingual direction and give only two-dimensional information about a three-dimensional object.<sup>[7]</sup> In recent years, advanced techniques like computed axial tomography scanning are being used to evaluate root canal morphology, as a three-dimensional image. It allows the operator to view the tooth roots and their root canal systems at different levels,<sup>[23]</sup> which helps to identify a larger number of morphological variations than in the conventional radiographs.<sup>[24]</sup> CBCT images are reconstructed using significantly lower radiation doses when compared with the alternative conventional computed tomography scanning. This is because, with CBCT scanning, the raw data are acquired in the course of a single sweep of a cone-shaped x-ray source and reciprocal detector around the patient's head.



Of the various comprehensive maxillary first molar *ex-vivo* studies in dental literature, Baratto reported a maxillary first molar with three roots and seven root canals. Of the 140 extracted maxillary first molars evaluated, only one tooth showed seven root canals, which contained three mesiobuccal, three distobuccal, and one palatal canal. The frequency of the MB2 canals in the mesiobuccal root was reported to be 92.85% (based on *ex-vivo* results), 95.63% (based on clinical results), and 95.45% (based on CBCT results), whereas, the corresponding figures for the distobuccal root (DB2) were 1.15% (*ex-vivo*) and 3.75% (clinical), and those for the palatal root (second palatal canal) were 2.05% (*ex-vivo*), 0.62% (clinical), and 4.55% (CBCT).<sup>[19]</sup> Three canals in the mesiobuccal root were reported by various authors [Table 1]. Additional mesiobuccal canals were commonly found in the age group of 20 to 40 years.<sup>[10,25]</sup>

In the present case, the use of a dental operating microscope helped in the location and identification of additional canal orifices. This enabled the modification of the access opening to accommodate the extra canals. As an additional finding, the contralateral maxillary first molar had additional root canals, which were clearly appreciable in the CBCT.

**Table 1: Incidence of multiple canals in maxillary first molars<sup>1</sup>**

Year	Author	Canal configuration		
		Mesiobuccal	Distobuccal	Palatal
1981	Stone <i>et al.</i> <sup>[12]</sup>	1	1	2
1982	Cecic <i>et al.</i> <sup>[12]</sup>	2	1	2
1982	Hartwell and Bellizzi <sup>[12]</sup>	2	1	2
1983	Martinez <i>et al.</i> <sup>[12]</sup>	3	2	1
1984	Beatty <sup>[2]</sup>	3	1	1
1988	Bond <i>et al.</i> <sup>[2]</sup>	2	2	2
1991	Wong <sup>[2]</sup>	1	1	3
1997	Holzman <sup>[18]</sup>	2	1	2
1997	Hulsman <sup>[12]</sup>	1	2	1
2001	Johal <sup>[26]</sup>	2	1	2
2002	Maggiore <i>et al.</i> <sup>[2]</sup>	2	1	3
2005	Ferguson <i>et al.</i> <sup>[10]</sup>	3	1	1
2006	Chen and Karabucak <sup>[18]</sup>	1	2	1
2006	Favieri <i>et al.</i> <sup>[18]</sup>	3	1	1
2008	Poorni <i>et al.</i> <sup>[18]</sup>	1	1	2
2009	Aggarwal <i>et al.</i> <sup>[26]</sup>	1	1	2
2009	Holderrieth and Gernhardt <sup>[9]</sup>	2	1	2
2009	De Almeida-Gomes <i>et al.</i> <sup>[9]</sup>	2	2	2
2010	Patil <i>et al.</i> <sup>[10]</sup>	1	2	1
2010	Karthikeyan and Mahalaxmi <sup>[26]</sup>	2	2	2
2010	Albuquerque <i>et al.</i> <sup>[10]</sup>	2	3	1
		2	2	2
2010	Kottor <i>et al.</i> <sup>[20]</sup>	3	2	2
2011	Kottor <i>et al.</i> <sup>[21]</sup>	3	3	2
2012	Sharath	2	2	1
	Chandra <i>et al.</i> <sup>[26]</sup>	3	2	1
2012	Pais <i>et al.</i> <sup>[26]</sup>	3	1	1
2012	Prabha <i>et al.</i> <sup>[26]</sup>	1	1	2
2014	Badole <i>et al.</i> <sup>[26]</sup>	3	2	2

## CONCLUSIONS

Thorough knowledge of the root canal anatomy is an essential pre-requisite for endodontic success. The knowledge that aberrant canals are more common than earlier assumed is increasingly being proven. The clinician should use increased magnification and advanced diagnostic aids similar to CBCT, to ensure identification and location of additional canals.

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