Report of a Rare Case: A Maxillary First Molar with Seven Canals Confirmed with Cone-Beam Computed Tomography

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**ABSTRACT**

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**Introduction:** Coronal anatomic variations in permanent maxillary molars are unusual, conversely variations involving the number of root canals or number of roots are more common. **Methods and Materials:** This case report presents a successful nonsurgical endodontic therapy of left maxillary first molar with three roots and seven root canals. This unusual morphology was diagnosed using a dental operating microscope (DOM) and confirmed with the help of cone-beam computed tomography (CBCT) images. **Results:** CBCT axial images showed that both of the palatal and distobuccal roots had Vertucci type II canal pattern, whereas the mesiobuccal root canal showed a Sert and Bayirli's type XV configuration. **Conclusion:** The use of a DOM and CBCT imaging in endodontically challenging cases can facilitate a better understanding of the complex root canal anatomy, which ultimately enables the clinician to explore the root canal system, and therefore treat it far more efficiently.

**Keywords:** Cone-Beam Computed Tomography, Dental Operating Microscope; Maxillary First Molar; Root Canal Therapy; Tooth Abnormalities

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**Introduction**

The variation of pulp cavity morphology, especially in multi-rooted teeth, is a constant challenge for diagnosis and successful endodontic therapy. Knowledge of the most common anatomic characteristics and their possible variations is fundamental because missing one canal can lead to endodontic treatment failure. Anatomic characteristics of permanent maxillary first molars are generally described as teeth with three [naming palatal (P), mesiobuccal (MB) and distobuccal (DB)] roots; each one containing a single canal, with the occurrence of a second mesiobuccal canal being common. The incidence of second mesiobuccal canal has been reported to be between 18% and 96.1% [1, 2, 3].

Case reports with one [4], two [5], four [6], five [7] and six [8-12] root canals or with a C-shaped configuration of the canals [13] have also been reported earlier. Martinez-Berna and Ruiz-Badanelli reported a maxillary first molar with six root canals; three MB, two DB, and one P canal [14], whereas Maggiore et al. reported a maxillary first molar having six canals with two MB canals, three P canals, and one DB canal [15]. For the first time, Kottoor et al. reported maxillary first molars having seven [16] and eight [17] root canals. Alavi et al. [18] and Thomas et al. [19] reported the incidence of two canals in the DB root to be 1.90% and 4.30%, respectively. The incidence of two root canals in the P root of maxillary molars has been reported to be 2-5.1% [20]. Of the various comprehensive in vitro studies on the anatomy of maxillary first molars in the dental literature, only Baratto Filho et al. reported a maxillary first molar with three roots containing seven canals [21].

Recently advanced diagnostic aids like the dental operating microscope (DOM) and cone-beam computed tomography (CBCT) have helped the clinician to detect the hidden canals and to understand the variations in the root morphology. CBCT offers many advantages to the clinician due to its three dimensional reconstruction of root canal system and precise visualization of the radicular anatomy.

The present case is the second reported case in the literature which discusses the successful endodontic management of a maxillary first molar with three roots and seven root canals; three MB canals, two DB canals, and two P canals. This unusual morphology was confirmed with the help of CBCT and DOM.
Case Report

A 20-year-old male patient referred to the department of Conservative Dentistry and Endodontics, with a chief complaint being spontaneous dull pain in posterior maxillary left region. The medical history was non-contributory. Intraoral examination revealed a deep proximal carious lesion in maxillary left first molar with tenderness upon percussion. Clinical examination was suggestive of irreversible pulpitis in maxillary left first molar. A preoperative parallel radiograph revealed radiolucency in distal and occlusal areas of the crown, approaching the pulp space with widening of the periodontal ligament space surrounding the roots (Figure 1A). Initial radiographs of tooth suggested the presence of an unusual complex root anatomy with roots superimposed on each other. From the clinical and radiographic findings, a diagnosis of symptomatic apical periodontitis was made and endodontic treatment was offered to the patient.

The local anesthesia was performed using buccal infiltration injection of 2% lidocaine with 1:100,000 adrenalin (Lignox; Indoco Remedies, Mumbai, India). The tooth was isolated with rubber dam (Hygienic Dental Dam, Coltène Whaledent, Germany). After excavation of caries, a conventional endodontic access cavity was prepared and four canals were located (Figure 1B). During examination of the pulpal floor with DOM (Global Surgical Corporation, St. Louis, MO, USA), and an endodontic explorer (Star DG16) and a special ultrasonic tip (Start-X #3, Dentsply Maillefer, Ballaigues, Switzerland) two canal orifices were located in each of the three roots. After careful double checking, a third canal was located midway between the MB and P orifices. After exploring all the seven canals with #15 K-files (Kerr Manufacturing Co., Romulus, MI, USA), coronal enlargement of the root canals was done with ProTaper orifice shaper (Dentsply Maillefer, Ballaigues, Switzerland) to improve the straight line access (Figure 1B). The working length was determined with the help of an apex locator (Root ZX; Morita, Tokyo, Japan) and later confirmed with a radiograph. Individual intraoral periapical radiographs for the P (Figure 1C), MB (Figure 1D), and DB roots (Figure 1E) were taken to confirm the working lengths.
A maxillary molar with seven canals

Table 1. Review of case reports of maxillary first molars with 6 and 7 canals

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of roots (canals)</th>
<th>Root (No. of canals)</th>
<th>Year</th>
<th>Type of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond et al. [10]</td>
<td>3 (6)</td>
<td>MB (2), DB (2), P (2)</td>
<td>1988</td>
<td>Clinical case-radiograph</td>
</tr>
<tr>
<td>Maggiore et al. [15]</td>
<td>3 (6)</td>
<td>MB (2), DB (1), P (3)</td>
<td>2002</td>
<td>Clinical case-radiograph</td>
</tr>
<tr>
<td>de Almeida-Gomes et al. [8]</td>
<td>3 (6)</td>
<td>MB (2), DB (2), P (2)</td>
<td>2009</td>
<td>Clinical case-radiograph</td>
</tr>
<tr>
<td>Karthikeyan and Mahalaxmi (4 cases) [24]</td>
<td>3 (6)</td>
<td>MB (2), DB (2), P (2)</td>
<td>2010</td>
<td>Clinical case-CT and radiograph</td>
</tr>
<tr>
<td>Albuquerque et al. (3 cases) [12]</td>
<td>3 (6)</td>
<td>MB (2), DB (2), P (2)</td>
<td>2010</td>
<td>Clinical case-CT and radiograph</td>
</tr>
<tr>
<td>Du Y. et al. [13]</td>
<td>3 (6)</td>
<td>MB (3), DB (1), P (2)</td>
<td>2011</td>
<td>Clinical case-CT and radiograph</td>
</tr>
<tr>
<td>Kottoor et al. [16]</td>
<td>3 (7)</td>
<td>MB (3), DB (2), P (2)</td>
<td>2010</td>
<td>Clinical case-CT and radiograph</td>
</tr>
<tr>
<td>Present case</td>
<td>3 (7)</td>
<td>MB (3), DB (2), P (2)</td>
<td>2013</td>
<td>Clinical case-CT and Microscope</td>
</tr>
</tbody>
</table>

Final working length radiograph was taken with an ideal angulation for confirmation of file position within the canals (Figure 1E). However, the radiographs did not clearly reveal the number and morphology of the root canal systems.

To ascertain this rare and complex root canal anatomy of the tooth, CBCT imaging was planned. Access cavity was sealed with IRM cement (Dentsply De Trey GmbH, Konstanz, Germany) and an informed consent was obtained from the patient and a multi-slice CBCT scan (CS9300, Carestream Health Inc, Rochester NY) of the maxilla was performed with a tube voltage of 100 kVp and a tube current of 8 mA. The involved tooth was focused, and the morphology was obtained in transverse, axial, and sagittal sections of 0.2 mm thicknesses. The CBCT images revealed that the tooth had three separated roots with seven distinct canals; three MB canals, two DB canals, and two P canals (Figure 2A-D). During careful examination of the CBCT scan, the contra lateral tooth also showed three separated roots and seven distinct root canals (Figure 2A).

Discussion

Most endodontic literature describe the human maxillary first molar with three roots and 3 to 4 root canals but great number of variations can occur in formation, number and shape of the roots [22]. Hence, changes in the operative procedures may be necessary. It is extremely important that endodontists use all the armamentarium at their disposal to locate and treat the entire root canal system [23]. Conventional radiographs, surgical operating microscope, ultrasonic instruments and CBCT are some of the useful diagnostic aids in endodontics [24,25]. The main disadvantage of a conventional film-based radiograph is that it provides a 2-dimensional image of a 3-dimensional object, resulting in superimposition of anatomical structures. As a newer diagnostic method, CBCT greatly facilitates the visualization of the internal root canal morphology [25]. One distinct advantage of CT scanning over the conventional radiograph is that it allows the operator to look at multiple slices of tooth roots and their root canal systems [26]. Various clinical studies have highlighted the role of CBCT as an objective analytic tool to ascertain root canal morphology [9,25].

Among the various case reports regarding the maxillary first molars in dental literature, only Kottoor et al. reported a maxillary first molar with three roots and seven root canals, which contained three MB, two DB, and two P canals [16]. Case reports of maxillary first molars presenting with six and seven canals are summarized in Table 1. The frequency of second canal in the MB root was reported to be 92.85% (based on in vitro results), 95.63% (based on clinical results), and 95.45% (based on CBCT results), whereas the corresponding figures for the DB root (DB2) were 1.15% (in vitro) and 3.75% (clinical) and for the P root the incidence of the second canal was 2.05% (in vitro), 0.62% (clinical), and 4.55% (CBCT) [16,17]. Most of the in vitro studies about the anatomy of MB root have not reported the presence of a third canal in the MB root [27,28]. Two of these studies have reported their incidence to be between 1.1% to 10% [27,29,30].

In the present case, CBCT scanning was used for a better understanding of the complex root canal anatomy. The use of CBCT in dentistry has increased dramatically in the past two decades [31,32]. With CBCT scans, it is possible to reconstruct overlapping structures at arbitrary intervals and thus the ability to resolve small subjects, is increased. Compared to conventional CT, they have drastically reduced scan time and effective dosages. In this case, CBCT axial images confirmed the presence of three roots and seven root canals, namely MB1, MB2, MB3, DB1, DB2, mesiopalatal (MP) and distopalatal (DP). The contra lateral tooth appeared to have the same root canal anatomy (Figure 2A and B). CBCT axial images also showed that both of the P and DB
roots present a Vertucci type II canal configuration (i.e. two canal orifices that join together and exit as one apical foramen) [33], whereas the MB root canal showed a Sert and Bayirli’s type XV configuration (i.e., MB1and MB2 joined at the middle third of the root and exited in one apical foramen) [34], whereas MB3 had a separate canal orifice and one apical foramen (Figure 2C and D). The MB2 canal is usually located more palatally and mesially from the MB1, but in this particular case the MB2 canal was located midway between the MB1 and DB1 canals (Figure 1B) and this peculiar location was confirmed in the CBCT axial images (Figure 2C and D). Thus, CBCT scanning was pivotal in the diagnosis of this unusual root canal system and towards its successful endodontic management.

**Conclusion**

Knowledge of dental anatomy is fundamental for good endodontic practice. When root canal treatment is indicated, the clinician should be aware that both external and internal anatomy may be abnormal. The frequency of maxillary first molars with more than six root canals is very rare; however, each case should be clinically and radiographically investigated carefully to detect the anatomical anomaly. The present case report discussed the endodontic management of a maxillary first molar with seven canals and highlighted the role of DOM and CBCT scanning as objective analytic tools that enhance the overall success of endodontic therapy.

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Conflict of Interest: ‘None declared’.

**References**


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