Case Report

Endodontic management of a maxillary first molar with three roots and six root canals

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Abstract

Variations in the root canal anatomy of a maxillary first molar are often challenging to diagnose and treat; thus, clinicians must have a thorough knowledge of the same. This case report highlights the successful nonsurgical endodontic management of a maxillary first molar with an unusual morphology of three roots and six root canals. A total of six root canals (mesiobuccal [MB] 1, MB2, MB3, distobuccal [DB] 1, DB2, and palatal) were detected after initiating root canal therapy and access cavity preparation. Conventional root canal treatment was completed, and postoperative cone-beam computed tomography scanning was done to verify the total number of canals and ensure the adequacy of root canal fillings. Managing such cases with rare variations in the root canal systems could be arduous and thus, clinicians should be well-versed in the methods to identify and manage such complexities to facilitate the successful outcomes of endodontic treatment.

Keywords: Additional canals; cone-beam computed tomography; maxillary first molar; root canal anatomy

INTRODUCTION

The successful outcome of root canal therapy mainly depends on thorough shaping and cleaning of the root canal space followed by three-dimensional obturation to achieve a hermetic seal. The inability to locate and debride existing canals in a tooth is a major cause of posttreatment disease or persistent apical periodontitis.[1] Thus, clinicians must have adequate knowledge of the root and root canal anatomy along with its variations to avoid plausible failure of endodontic therapy. Maxillary first molars are commonly present with three roots and three or four root canals.[2] The occurrence of a second mesiobuccal canal (MB2) in maxillary first molars ranges from 48.0% to 97.6%.[3]

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Apart from these common anatomical configurations, a few rare variations of the root canal complex in the maxillary first molars have been reported in the literature. These include maxillary first molars having one root and one canal,[4] two root canals,[5] five root canals,[6] six root canals,[7] seven root canals,[8] and eight root canals[9] as well. The occurrence of an additional palatal root[10] and C-shaped canal[11] in maxillary first molars has also been documented. These root canal variations may be challenging to the clinician and pose difficulty in their detection, debridement, shaping, cleaning, and adequate filling. This case report presents the successful nonsurgical endodontic management of a maxillary first molar with a rare anatomical variation of three roots and six root canals.

CASE REPORT

A 20-year-old male patient reported a complaint of spontaneous pain in the right back region of the upper jaw for a week. The patient had a history of intermittent pain for a month that had intensified in the past week. The patient also revealed episodes of lingering pain on

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the consumption of hot and cold food as well as nocturnal pain radiating to the ear. There was no relevant past medical history. Clinical examination revealed that the right maxillary first molar (tooth #3) had a deep occlusal carious lesion which was tender on vertical percussion. The probing sulcus depth and mobility were within the physiological limits. Thermal and electric pulp testing showed that the tooth was vital. Radiovisiography revealed an occlusal radiolucency approaching the pulp chamber and a slight widening of the periodontal ligament space around the palatal root [Figure 1a]. The preoperative radiograph seemed very routine with the presence of three roots (mesiobuccal, distobuccal, and palatal) and their respective root canals. However, the mesiobuccal root showed a fast-break appearance, suggestive of presence of additional canals [Figure 1a]. Based on the clinical and radiographic evaluation, the case was diagnosed with symptomatic irreversible pulpitis with symptomatic apical periodontitis. The patient was advised nonsurgical root canal treatment of tooth #3. Informed consent was obtained from the patient before initiating the procedure.

The tooth was anesthetized by administering 1.8 mL of 2% lignocaine with 1:80,000 epinephrine (Lignox 2% A; Indoco Remedies Ltd, Mumbai, India). After rubber dam isolation, caries excavation was done followed by conventional access cavity preparation. On initial exploration, three principal root canals were located: MB1, DB1 and palatal. Further probing with DG16 endodontic explorer (Hu-Friedy, Chicago, IL, USA) and after scrapping off the calcifications, MB2 and MB3 root canal orifices were identified palatal to MB1. Furthermore, a DB2 root canal orifice was located palatal to DB1. To achieve straight-line access to these additional canals, the conventional triangular access was modified to a trapezoidal shape with Endo-Access bur and an Endo-Z bur (Dentsply Tulsa, Tulsa, OK) [Figure 1b]. Removal of calcifications occluding the canal orifices was carried out with ultrasonic troughing (Satelec/Acteon, Merignac, France). However, no magnifying aids were employed during the clinical procedure. Orifice enlargement and coronal flaring were done with ProTaper Gold SX rotary NiTi file (Dentsply Maillefer, Ballaigues, Switzerland). The working length was determined with an apex locator (Root Zx II; J Morita, Tokyo, Japan) and confirmed with radiographs taken in different angulations [Figure 1c and d]. Shaping and cleaning of the root canal spaces were done in a crown-down manner with ProTaper Gold rotary NiTi file system (Dentsply Maillefer). All the root canals were instrumented till ProTaper F2 except for the palatal canal. The palatal canal was enlarged till ProTaper F3. The root canal spaces were irrigated with 3% sodium hypochlorite solution sequentially after each instrument change followed by final irrigation with 17% ethylenediaminetetraacetic acid solution for 1 min. Irrigation was performed with a 30G side vented needle (Denmax®, Tamil Nadu, India) and the irrigants were activated with EndoActivator (Dentsply Maillefer). The root canals were then rinsed with normal saline and dried with absorbent paper points (Dentsply Maillefer). A sterile dry cotton pellet was placed in the pulp chamber and the access cavity was temporarily sealed with Cavit G (3M, St. Paul, MN, USA). The patient was recalled after 1 week.

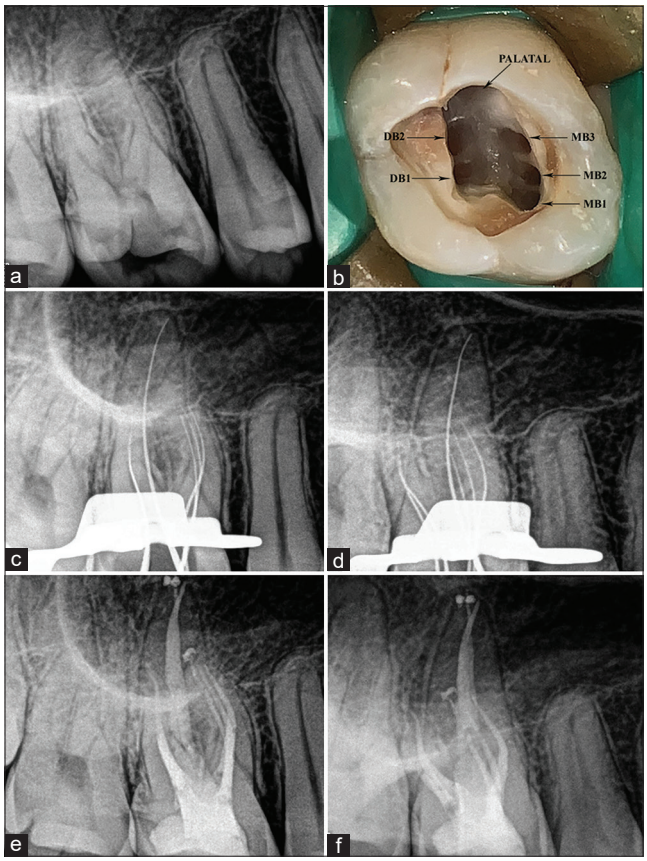

Figure 1: (a) Preoperative radiograph of tooth #3. (b) Access cavity showing six root canal orifices. (c and d) Angulated radiographs to confirm the working length. (e and f) Postoperative radiographs. DB: Distobuccal, MB: Mesiobuccal

At the second appointment, the patient was asymptomatic. The temporary filling was removed and all the root canals were obturated with gutta-percha (Dentsply Maillefer) and AH Plus resin sealer (Dentsply Maillefer, Konstanz, Germany) using the cold lateral compaction technique. The access cavity was then restored with light-cure composite resin (Filtek P60; 3M, St. Paul, MN, USA). Postoperative radiographs were taken in different angulations to confirm adequate filling of all the root canals till the determined working length [Figure 1e and f]. However, due to the limited information with two-dimensional imaging, the patient was referred for a cone-beam computed tomography (CBCT) scan after obtaining informed consent. The rationale behind a postoperative CBCT scan was to verify the total number of detected root canals and their patterns, to ensure that all the canals were adequately filled and to rule out any possibility of an undetected

canal. The scanning was done with a CBCT scanner (CS 9300, Carestream Dental, Mumbai, India) and axial and coronal slices of 0.5 mm thickness were obtained at different levels. The axial slices confirmed that tooth #3 had three roots and six root canals (MB1, MB2, MB3, DB1, DB2, and palatal) that were adequately filled at different levels [Figure 2a-c]. The coronal slices showed that all six root canals were adequately filled to their appropriate lengths [Figure 2d-f]. The CBCT scan also confirmed that there were no additional canals apart from the six canals that were detected during the clinical procedure. The patient was regularly followed up for 6 months and was asymptomatic during the follow-up period.

DISCUSSION

Variations in the root canal anatomy, especially of a multirooted tooth are a constant challenge to the clinician while performing root canal treatment. Based on the variations that may exist, Weine *et al*.[12] classified the canal configurations into four types. Vertucci[13] described a more precise classification that characterized the root canal space into eight types. Later on, Sert and Bayirli[14] described an additional 15 types of root canal configurations. An additional seven types of root canal systems were also reported by Gulabivala *et al*.[15] The current case presented three roots and six canals in the right maxillary first molar. The MB root had three root canals (MB1, MB2, and MB3) with Vertucci's Type VIII configuration (3-3). The DB root had two root canals (DB1, DB2) with Vertucci's Type II configuration (2-1), whereas the palatal root had one root canal with Vertucci's Type I (1-1) configuration.

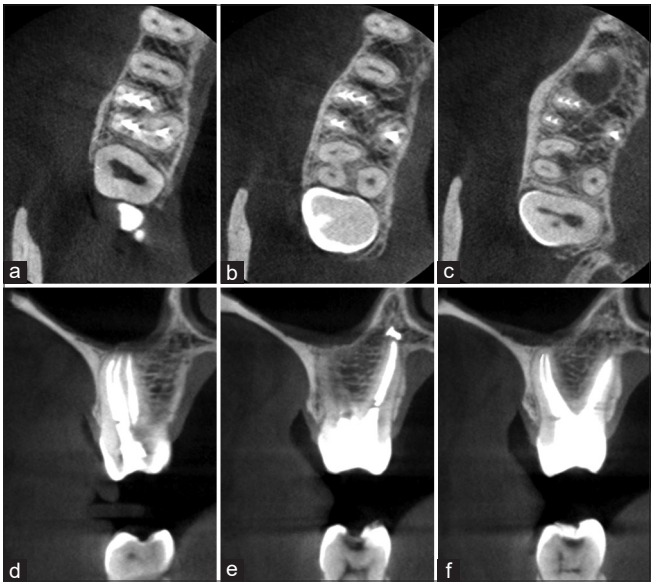

Figure 2: (a) Postoperative axial section cone-beam computed tomography (CBCT) image of tooth #3 at the cervical, (b) middle, and (c) apical level showing three roots and six root canals. (d) Postoperative coronal section CBCT image of tooth #3 showing adequately filled three root canals in the mesiobuccal root, (e) one root canal in the palatal root, and (f) two root canals in the distobuccal root and one root canal in the palatal root

Martínez-Berná and Ruiz-Badanelli[16] were the first to report three cases of six canals in a maxillary molar with an incidence of 0.88%. All the three cases had three root canals in the MB root, two in the DB root and one in the palatal root; similar to the case discussed in this article. Few other authors have also reported the presence of three root canals in the MB root.[17,18] Kim *et al*.[19] studied 113 MB roots with extra canals and found that only 0.9% of the specimens had Vertucci's Type VIII (3-3) configuration. Ahmad and Al Jadaa[20] reported that the laboratory studies in the literature showed a higher incidence (2.3%–12.5%) of three canals in the MB root as compared to the clinical studies (0.2%–3.4%); with the most common canal configuration being 3-2. However, the occurrence of a 3-3 configuration (as detected in the current case) in the MB root was relatively rare. The third root canal in the MB root can also be named mesiobuccopalatal according to the nomenclature of additional canals suggested by Karthikeyan and Mahalaxmi.[21]

The occurrence of a second root canal in the DB root is merely 1.12%–9.5%, with 98% of cases having a single apical exit;[22] similar to that reported in the current case. The palatal root of a maxillary first molar often has only one canal that exits as a single foramen.[2,22] However, few case reports have documented the occurrence of an additional canal in the palatal root.[23]

One plausible reason for the presence of additional canals could be the broad buccolingual dimension of the MB root.[2] Such anatomy was also confirmed from the axial slices of the CBCT scan of the current case [Figure 2a-c], which possibly explains the occurrence of three root canals in the MB root. In this case report, the patient was 20 years old. This could be another reason for additional canals in the MB and DB roots; a majority of studies confirmed that younger patients (20–40 years) have a higher incidence of additional root canals when compared to older individuals.[24] This may be due to the increase in calcifications of the root canal spaces and orifices with advancing age, hindering the detection of additional canals in older patients. The anatomical variations could also be attributed to demographic factors such as sex and ethnicity as well as geographical location.

Various methods have been suggested for the detection of additional canals. These include taking angulated/eccentric radiographs, CBCT imaging, use of magnifying loupes and/or dental operating microscope, tracing the dentinal map with an endodontic explorer, modifying the access cavity design, use of ultrasonics and specific burs for troughing and removal of calcifications, looking

for haemorrhagic spots, champagne-bubble test, and the use of dyes.[25] Most of the authors who have reported six or more root canals used magnification and CBCT imaging as aids to detect/confirm the presence of additional canals. In the present case, probing with an endodontic explorer, use of ultrasonics, modification of the access cavity (triangular to trapezoidal) with access burs, and angulated radiographs were used to identify the additional root canals. However, a postoperative CBCT scan confirmed adequately filled six root canal systems [Figure 2]. Badole *et al*.[18] also performed a postoperative CBCT scan to confirm adequate obturation and verify the canal configurations. CBCT images provide a detailed three-dimensional view of the internal structure of the tooth, making it easier to detect the presence of additional canals accurately.[26] Moreover, the inherent limitations of two-dimensional intraoral radiography such as low reliability in identifying complex anatomy[27] or delusional images of well-condensed root canal fillings[28] dictate the need for a three-dimensional imaging modality. In addition, a small field of view and low radiation dose are the other advantages of CBCT imaging.[26]

Eliminating the vital as well as necrotic tissue remnants and micro-organisms is essential for successful root canal treatment. However, the presence of fins, isthmuses, anastomosis, cul-de-sacs, and other complexities of the root canal space might hinder thorough cleaning and disinfection.[29] Activation of the chemical irrigants with sonic and ultrasonic instruments allows disinfection of the inaccessible areas of the root canal system.[30] As a result, sonic activation was performed in this case to ensure thorough debridement of all six root canal systems.

CONCLUSION

Maxillary first molars with six root canals are rare but can occur. Clinicians must acknowledge the variations in the root canal anatomy of multirooted teeth and consider routine clinical methods along with advancements (CBCT imaging and magnification) to identify and successfully manage such complexities.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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