Endodontic management of maxillary first molar with atypical canal morphology: Report of three cases

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Abstract

Maxillary first molar with three roots and 3–4 canals is a common occurrence. However, extreme variations in their canal morphology have been reported ranging from one single canal and one root to as many as eight root canals. This article presents three cases of successful endodontic management of maxillary first molars with atypical canal morphologies, thus highlighting the fact that variations do occur and an endodontist should always be aware of aberrancies in root canal system apart from the knowledge of normal root canal anatomy.

Keywords: Atypical canal morphology, endodontic management, maxillary first molar

Introduction

Postendodontic disease is not a rare phenomenon and can occur in any tooth irrespective of the fact that the primary treatment is done by an expert. The main cause of such failure is incomplete cleaning and shaping and further inadequate obturation of the root canal system.[1] This can occur if there is any canal missing in the root canal system. Thus, a clinician should be aware of anatomic aberrancies that can occur especially in those teeth that have high frequency of variations.[2]

Maxillary first molar has been thoroughly investigated with special focus on mesiobuccal (MB) root. The incidence of second canal (MB2) in MB root is between 18% and 96.1%.[3,4] More than one canal has also been reported in distobuccal (DB) and palatal roots. The frequency of two canals in DB root is 1.9–4.3%.[4,5] There is 99% incidence of more than one canal in palatal root.[6]

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This article reports three cases of successful nonsurgical endodontic management of maxillary first molars with atypical morphologies in the palatal roots in two cases and MB root in the third case.

Case Reports

Case 1

A 23-year-old male patient with noncontributory medical history reported to the Department of Conservative Dentistry and Endodontics with chief complaint of pain in right upper back teeth. History revealed that he had undergone root canal therapy on upper first molar (#16) approximately 6 months ago at a private clinic. However, pain persisted and slowly increased in intensity, frequency, and duration to the present level. Extraoral examination was normal. On intraoral examination, tooth #16 was distally carious without any kind of permanent restorations and was slightly tender on percussion. A preoperative radiograph revealed faulty and inadequate endodontic treatment in tooth #16 [Figure 1a]. Therefore, a diagnosis of posttreatment endodontic disease with persistent symptomatic apical periodontitis was made. Nonsurgical retreatment was chosen as the treatment modality, explained to the patient, and his verbal consent was taken.

The tooth was anesthetized with 1.8 ml of 2% lignocaine containing 1:80,000 adrenaline (Xylocaine, AstraZeneca

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Pharma India Ltd., Bengaluru, India), and rubber dam (Hygenic Coltene Whaledent, Cuyahoga Falls, Ohio, USA) was applied. Carious tissue and old restoration were removed, and endodontic access was refined using Endo Access Bur (Dentsply Maillefer, Ballaigues, Switzerland) and Endo Z Bur (Dentsply Tulsa, Tulsa, OK, USA). The gutta-percha (GP) was removed using H File (Maillefer H Files Dentsply, USA). DG-16 (Hu-Friedy, Chicago, IL, USA) was used to explore the orifices of canals. Access preparation and canal orifices were refined under dental operating microscope (DOM) (Seiler IQ, St. Louis, MO, USA) using ultrasonic tips (Start-X ultrasonic tips, Dentsply Maillefer, Ballaigues, Switzerland). Two orifices were located in palatal root, two in MB root, and one in DB root [Figure 1c]. Coronal two-thirds of each canal was prepared using nickel-titanium (Ni-Ti) ProTaper Universal Instruments (Dentsply Maillefer, Ballaigues, Switzerland). The working length (WL) was established with Electronic Apex Locator (Raypex5, VDW, Munich, Germany) and verified with multiple periapical radiographs. The intraoral periapical radiograph (IOPA) revealed that the two canals in palatal and MB roots exited through single apical foramen confirming to Vertucci Type II configuration [Figure 1b]. After extirpating the remaining pulp tissue and removing debris from canals under copious irrigation with 3% sodium hypochlorite and normal saline, final irrigation was done with 2% chlorhexidine (Sigma Chemicals, St. Louis, MO, USA) and the root canals were given calcium hydroxide dressing (Metapex, Meta Biomed Co. Ltd., Cheongju, Korea). The provisional restoration with IRM (IRM Cement, Dentsply, DeTrey GmbH, Konstanz, Germany) was given.

On the second appointment, the patient was asympomatic. After removing provisional restoration, further cleaning and shaping of the canals was performed with the rotary Ni-Ti ProTaper Universal Instruments (Dentsply Maillefer, Ballaigues, Switzerland) in a crown down manner. Irrigation was performed with 3% sodium hypochlorite and 17% ethylenediaminetetraacetic acid (EDTA) (SybronEndo, CA, USA). The canals were further dried with absorbent paper points (Dentsply Maillefer, Ballaigues, Switzerland). Obturation was done with ProTaper GP cones (Dentsply Maillefer, Ballaigues, Switzerland) and AH Plus resin sealer (Dentsply DeTrey, Konstanz, Germany) using single-cone technique and the tooth was permanently restored with silver amalgam (Dispersalloy; Johnson and Johnson, East Windsor, NY, USA) [Figure 1d and e]. The patient was asymptomatic at 1-month follow-up examination.

Case 2

A 25-year-old male patient with noncontributory medical history reported with the complaint of pain in right upper back teeth since few days. History revealed that he had intermittent pain for the last 6 months which increased in intensity and duration for the last 3–4 days. The pain kept him awake the whole night. Intraoral examination revealed a deep carious lesion in tooth 16. The tooth was tender on percussion and gave delayed response to electric pulp testing (Parkell Electronics Division, Farmingdale, NY, USA). The tooth showed intensified pain on thermal test with heated GP and dry ice (R C Ice; Prime Dental Products, India).

Preoperative periapical radiograph [Figure 2a] revealed a three-rooted maxillary first molar with deep occlusal caries extending to the pulp chamber. The radiograph did not reveal unusual morphology associated with any of the three roots. A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made, and nonsurgical endodontic therapy was suggested to the patient.

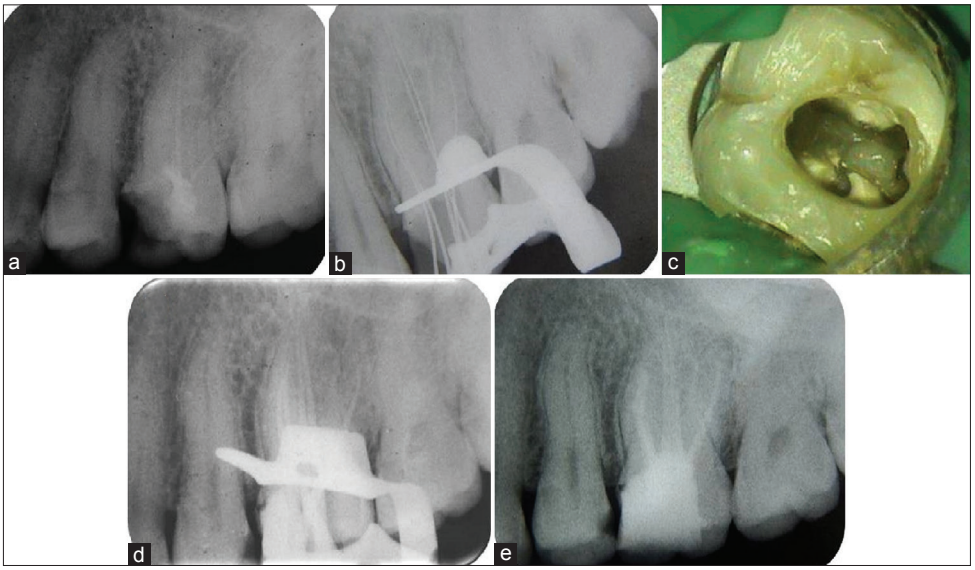

Figure 1: (a) Preoperative radiograph showing faulty and inadequate endodontic treatment in tooth 16, (b) working length, (c) photograph of prepared canals under dental operating microscope revealing two orifices in palatal, two in mesiobuccal and one in distobuccal root, (d) master cone, and (e) postoperative radiograph

Consent was taken from the patient. The tooth was anesthetized with 1.8 ml of 2% lignocaine containing 1:200,000 adrenaline, and rubber dam was applied. An endodontic access was established using Endo Access Bur and Endo Z Bur. DG-16 endodontic explorer and DOM were used to locate the canal orifices, and four orifices were appreciated. The access cavity was refined using ultrasonic tips. After coronal flaring of canals with Ni-Ti ProTaper Universal Instruments, the WL was established using electronic apex locater (Raypex 5) and confirmed by periapical radiograph [Figure 2b]. Two canals were found in palatal root and single canal each in MB and DB root [Figure 2c]. After removing the pulp tissue, temporary restoration with IRM was given.

On the second appointment, the patient was asymptomatic. Temporary restoration was removed and further cleaning and shaping was performed with Ni-Ti ProTaper instruments in crown down manner under copious irrigation with 3% sodium hypochlorite and 17% EDTA. A master cone radiograph was taken with gutta Percha inserted into the canals up to the WL to ensure adequate preparation of the canals [Figure 2d]. Obturation was done with GP and AH Plus resin sealer using single-cone obturation technique, and the tooth was permanently restored [Figure 2e]. The patient was asymptomatic at 1-month follow-up.

Case 3

A 27-year-old male reported with a complaint that he had restoration done in left upper back tooth, 1 week before, after which he had severe pain. Intraoral examination revealed permanent restoration on tooth 26. The tooth was tender on percussion. The tooth was not mobile, and periodontal probing was within physiological limits. Electric pulp testing elicited lingering positive response. Thermal tests with heated GP and dry ice exaggerated the pain.

The preoperative radiograph showed restored three-rooted maxillary first molar with restoration extending up to the pulp horns [Figure 3a]. Hence, a diagnosis of irreversible pulpitis with apical periodontitis was made, and the patient was advised to undergo root canal therapy for the tooth.

After the tooth was anesthetized, the permanent restoration was removed and access opening was done under rubber dam isolation and adequate magnification. Coronal enlargement was done with a Ni-Ti ProTaper series orifice shaper to improve the straight-line access. The pulp tissue was extirpated from the canals. The WL was determined with the help of an apex locator (Raypex 5) and later confirmed using a radiograph [Figure 3b]. Three canal orifices were located toward the MB root and one each toward DB and palatal roots [Figure 3c].

A glide path was made with the help of 15K and 20K hand files (Dentsply Maillefer, Ballaigues, Switzerland). The access cavity was sealed using Cavit (3M™ ESPE™, USA).

On the second appointment, the patient was asymptomatic and temporary restoration was removed. Cleaning and shaping was done in crown down fashion with Ni-Ti ProTaper files under copious irrigation with 5.25% sodium hypochlorite and normal saline. RC Prep (Premier Dental, PA, USA) was used as

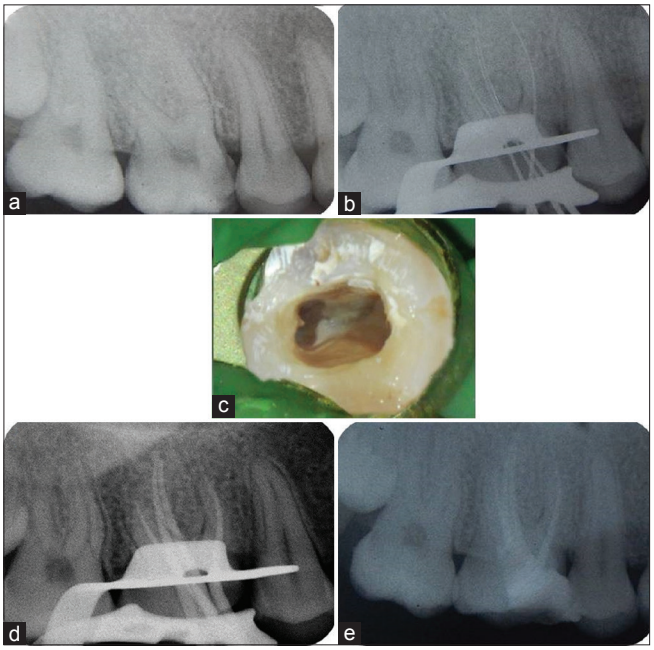

Figure 2: (a) Preoperative radiograph showing mesio-occlusal caries in tooth 16 approaching pulp horns, (b) working length radiograph, (c) photograph of prepared canals under dental operating microscope showing two canals in palatal root, (d) master cone, and (e) postoperative radiograph

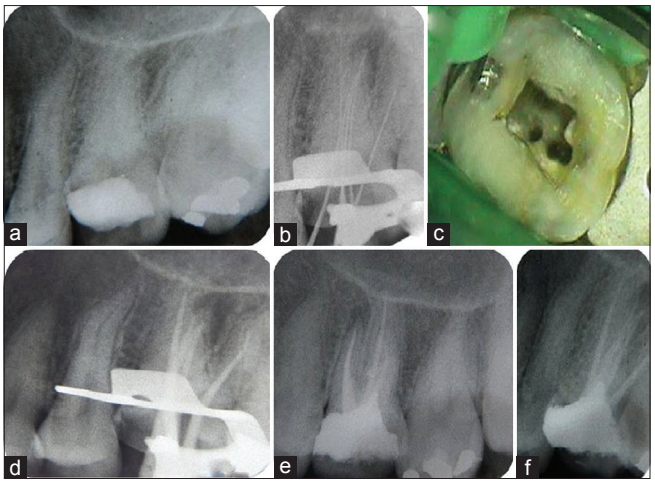

Figure 3: (a) Preoperative radiograph showing restored three-rooted maxillary first molar with restoration extending up to the pulp horns, (b) working length radiograph, (c) photograph of prepared canals under operating microscope showing three canal orifices toward the mesiobuccal root, (d) master cone radiograph, and (e and f) postoperative radiograph

a lubricant. Patency was checked at each step. A master cone periapical radiograph with gutta percha inserted into the canals was taken to ensure adequate chemo-mechanical preparation [Figure 3d]. Canals were dried with absorbent points and obturation was performed with ProTaper GP and AH Plus resin sealer using single cone obturation technique and the tooth was restored with a permanent restoration [Figure 3e and f]. The tooth was found to be asymptomatic at 1-month follow-up.

Discussion

Maxillary molar with three roots and four canals is a common occurrence.[7] However, extreme variations can occur ranging from single canal and single root to eight canals in maxillary first molar.[8] Weine *et al*. in 1969 observed maxillary molars and concluded that the maximum number of failures in maxillary first molars is due to MB root. They further investigated that the chances of four canals are more than three canals.[9] In 1977, Hession compared the canal morphology before and after instrumentation and concluded that the number of canals usually equals the number of roots.[10] However, it must be kept in mind that there is no rule to variations. Palatal root with two or more canals is a rare occurrence. Christie *et al*., in 1991, reported 16 cases of maxillary first molar that had two palatal canals in palatal root.[1] They classified them into three types as Types I, II, and III, according to root separation level and degree of divergence. In 2002, Baratto-Filho *et al*. reported that the frequency levels of extra roots and root canals in palatal roots are 2.05% (*ex vivo* results), 0.62% (clinical results), and 4.55% (cone-beam computed tomography results).[11] In a literature review, Cleghorn *et al*. studied root anatomy into three groups: Laboratory studies (*in vitro*), clinical root canal system anatomy studies (*in vivo*), and clinical case reports of anomalies. They found that the incidence of two canals in the MB root was 56.8% and of one canal was 43.1%. The incidence of two canals in the MB root was higher in laboratory studies (60.5%) compared to clinical studies (54.7%). Palatal root showed rare variation, and the results were reported from 14 studies comprising 2576 teeth. In the palatal root, the prevalence values of a single canal and a single foramen were 99% and 98.8%, respectively.[6] In our cases, maxillary first molar was treated and two cases were found to have two separate canals and orifices in palatal root.

Traditionally, the MB root of the maxillary first molar is most investigated root. In 1984, in his classic paper, Vertucci gave classification of root canal system. He found that maximum variations occurred in MB root of maxillary first molar which had two canals.[12] The third canal in MB root is a rare phenomenon and is not reported much. The third canal in MB root has been found by Prabu *et al*. in 2009,[13] Ayranci *et al*. in 2011,[14] Chourasia *et al*. in 2011,[15] Pais *et al*. in 2012,[16] and Horatti *et al*. in 2013[17] in their respective case studies. In our case, we treated maxillary first molar which had three canals and three orifices in MB root.

This case series highlights the importance of magnification and illumination. The use of microscope reveals that extra orifices during access opening as the area of interest can be seen at higher magnification. Buhrley *et al*., in an *in vivo* study, concluded that the frequency of identifying MB2 canal in maxillary first molars was 71.1% with DOM, 62.5% with magnifying dental loupes, and only 17.2% with naked eye.[3] A correct access opening is most important step to locate and negotiate the orifices of root canals. The use of ultrasonic tips can refine the access cavity and help in locating the extra orifices. Ultrasonic tips allow controlled and delicate removal of calcifications and other interferences to the canal orifices. Ultrasonic tips work best when used with light touch, medium power, and under operating microscope. Yoshioka *et al*.[18] found that both magnification and dentin removal under magnification were effective in detecting the presence of MB2 canals. Thus, the use of the operating microscope and endodontic probes such as the Hu-Friedy DG16 or the JW-17 (C K Dental Specialties Inc., USA) along with ultrasonic tips significantly facilitated the inspection of the pulp chamber floor and the finding of canal orifices.

Conclusion

The above three cases add to our knowledge that variations do occur in root canal morphology. Clinicians must look for extra canals because unidentified canals may be a reason for the failure of endodontic treatment. A proper access cavity is of paramount importance to localize the root canal orifices. In addition, to find hidden and extra canals, an adequate armamentarium is required; the DOM provides enhanced lighting and visibility whereas ultrasonic tips allow a controlled and delicate removal of interferences to the canal orifices.

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Conflicts of interest
There are no conflicts of interest.

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