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### Abstract

Aberrant root canal morphology in multi-rooted teeth is a constant challenge for diagnosis and successful endodontic treatment. Presence of extra canals, lateral canals and deltas are commonly encountered. Modifications in endodontic access and detection techniques along with advancement in illumination and magnification technology have aided in location of and treatment of extra canals in teeth. Case reports illustrating the endodontic treatment of maxillary first molar tooth with complex root canal system exhibiting canals i.e. MB<sub>1</sub>, MB<sub>2</sub>, DB & two Palatal canals are presented here.

**Key Words** Multi rooted tooth, Palatal root canal, Accessory root canal, Endodontic treatment failure.

## INTRODUCTION

The main objective of root canal treatment is thorough mechanical and chemical debridement of the entire pulp space followed by three dimensional obturation with a inert filling materials. Therefore it is imperative to identify the aberrant root canal anatomy prior to and during the treatment.

The anatomy of the root canal system is most uncertain. According to Cohen and Burns, *canals are not treated as they are not located*. Burns also described the *maxillary first molar as "...possibly the most treated least understood posterior tooth."*

Maxillary molars generally have three roots and can have as many as three mesial canals, two distal canals and two palatal canals. The mesiobuccal root usually has two canals MB<sub>1</sub> and MB<sub>2</sub> though a third canal had also been reported.<sup>1</sup>

The incidence of MB<sub>2</sub> canal has been reported to be between 18% and 96.1%.<sup>2</sup>

Mb<sub>2</sub> was consistently located mesial to or directly on a line between the MB<sub>1</sub> and the palatal orifices, within 3.5 mm palatally and 2 mm mesially from the MB<sub>1</sub> orifices. Negotiation of the MB<sub>2</sub> canal is often difficult due to a ledge of dentine that covers its orifices, the mesiobuccal inclination of its orifices on the pulpal floor and its pathway which often takes one or two abrupt curves in the coronal part of the root. Most of these obstructions can be eliminated by 'troughing or countersinking' with ultrasonic tips mesially and apically along the mesiobuccal-palatal groove. This procedure causes the canal to shift mesially necessitating moving the access wall further mesially. Troughing may have to extend 0.5–3mm deep. Not all MB<sub>2</sub> orifices leads to a true canal. An apparent MB<sub>2</sub> canal could not traced beyond orifices in 16% cases.<sup>1</sup>

Weine's classification has been used to describe four common configurations of the maxillary MB root. **Type I**

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is a single canal from orifice to apex, **Type II** has two orifices that converge to one, **Type III** has separate and distinct canals from orifice to apex, and **Type IV** begins as one canal and diverges into two separate canals.<sup>3</sup>

### Protocol for Locating MB<sub>2</sub> Canals<sup>3</sup>

- **Road Map** - Using a rhomboid access, follow the road map that the developmental grooves form on the pulpal floor. The MB<sub>2</sub> canal is palatal and often mesial (under the marginal ridge) to a line drawn between the MB<sub>1</sub> and palatal canal.
- **Remove Mesial Shelf** - After locating the MB<sub>1</sub> canal, remove the mesial dentin shelf which represents the roof of the pulp chamber overlying the MB<sub>2</sub> orifice. Enter the MB<sub>2</sub> canal from a flat pulpal floor angling a precurved file from the distal toward the mesial.
- **Highlight** - Use stains (1% methylene blue or dentin powder created by drilling) to highlight the pulp chamber anatomy.
- **Trough** - Trough and search with low-speed burs or ultrasonic tips, beginning from the MB<sub>1</sub> orifice. Also try not to exceed a depth of 2 mm to 3 mm as this could weaken the mesial furcation.
- **Bubble Test** - A bubble test with Sodium hypochlorite in the pulp chamber may be helpful in detecting organic tissue within the MB<sub>2</sub> canal.
- **Chelate** - Chelating agents (ie, EDTA) can assist in removing the smear layer and softening calcifications inside the pulp chamber, allowing for easier access to canal openings.
- **Remember the Isthmus** - Maxillary MB roots are not perfectly round in cross-section. Different anatomic configurations are present at different levels of the same root, especially in the apical 4 mm.

The presence of two palatal canals in maxillary first molars is a rare phenomenon. The incidence of two canals in palatal root of *maxillary molars* has been reported to be 2-5.1%.<sup>2</sup> Incidence of two palatal canals in *maxillary first molars* is also low i.e. 1%.<sup>4</sup>

Acosta vigouroux and trugeda Bosaans reported 5 canals in 2.25% of maxillary first molars Whereas Gray reported 2.4% and Beatty reported a case of maxillary molar with 5 canals.<sup>5</sup>

### Two canals in a single palatal root may present in one of the following types:

- a. Two separate orifices, two separate canals and two separate foramina.
- b. Two separate palatal roots, each with one orifice, one canal and one foramen.
- c. One palatal root, one orifice, a bifurcated canal and two foramina.<sup>6</sup>

Traditionally the methods like staining the pulp chamber with 2% methylene blue, bubbling test with warm 2.6% Naocl, use of sharp endodontic explorer, bleeding points, red line test, white line test and off angled radiographs are commonly used to locate the extra canals. But with the advancement in illumination and magnification systems Head lamps, Loups and Surgical Operative Microscope are commonly used as the recent aids in detecting the extra canals.

CBCT scanning is also a newer diagnostic imaging modality that has been used in endodontics for the effective evaluation of the root canal morphology.<sup>2</sup>

## CASE PRESENTATION

### CASE: I

A male patient of 30 yrs of age came to the Department of Conservative Dentistry & Endodontics of Burdwan Dental College & Hospital, Burdwan with the complain of pain on maxillary molar teeth on the right side.

Clinical exploration revealed that his maxillary 1st molar tooth, 16 was cariously exposed and also tender on percussion. Radiological evaluation also revealed carious exposure and thickening of PDL space in relation to 16.

Irreversible pulpitis of maxillary 1st molar tooth, 16 was diagnosed. So the endodontic treatment of the affected tooth was the choice of treatment.

Under local anaesthesia, Lignocaine, an access cavity was prepared on maxillary 1st molar tooth, 16 using Endo-access-Z set and coronal pulp tissue was removed with endodontic excavator. Canals were identified with endodontic explorer, DG-16 and explored with K-file no. 15. At the time of probing with DG 16 endodontic explorer, two small hemorrhagic points was observed, one in a groove approximately 2 mm from the MB orifice in a palatal direction and another near the orifice of the main palatal canal. Therefore in search of extra canals access cavity was modified from triangular to trapezoidal. Finally root canal system of that maxillary 1st molar tooth, 16 showed five canals i.e. MB<sub>1</sub>, MB<sub>2</sub>, DB, two Palatal canals (MP & DP).

The working length of these canals were measured electronically and verified with radiograph. The canals were then biomechanically prepared with endodontic rotary file system, ProTaper and irrigation system using sodium hypochlorite solution (5.25%) and EDTA(17%). Calcium hydroxide paste was used as intra-canal medicaments. Finally the root canals were obturated with ProTaper gutta percha points and AH-Plus sealer. The access cavity was thereafter sealed with silver amalgam.

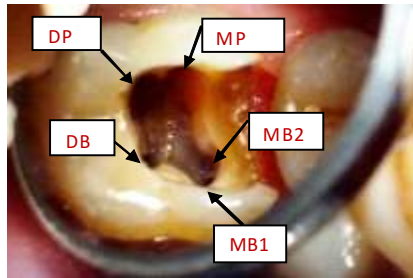


Figure1. Access Cavity showing five canals under magnification



Figure2. Pre-operative radiograph

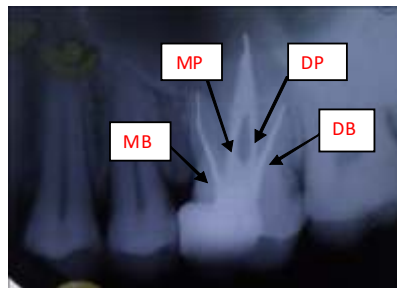


Figure3. Post - operative radiograph showing four canals



Figure 4. Post - operative radiograph showing MB1 and MB2 canals

## CASE: II

Another male patient of 40 yrs of age came to the Department of Conservative Dentistry & Endodontics of Dr. R. Ahmed Dental College & Hospital, Kolkata with the complain of pain on maxillary molar teeth on the right side.

Clinical exploration revealed that his maxillary 1st molar tooth, 16 was cariously exposed buccally and tender on percussion. Radiological evaluation also revealed thickening of PDL space in relation to 16.

Irreversible pulpitis of maxillary 1st molar tooth, 16 was diagnosed. And the choice of treatment of the affected tooth is same as Case : I, i.e. endodontic treatment and the same procedure was executed to treat the affected teeth but four canals i.e. MB, DB, DP & MP are detected in Case: II .

## DISCUSSION

Endodontic treatment may sometimes be influenced because of morphological variations of



Figure1. Pre-operative radiograph

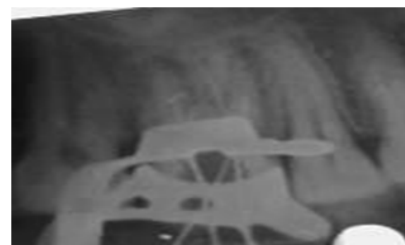


Figure2 . Working length radiograph



Figure3. Post -operative radiograph showing four canals



Figure 4. Post -operative photograph of Access Cavity

the tooth that adversely affect the treatment outcome. Failure to detect aberrant root canals and to identify extra roots along with incomplete debridement and incomplete obturation of pulp tissue space are the most common cause of endodontic failure. Therefore the proper knowledge of the complex root canal anatomy of the particular tooth to be treated is the pre-requisite for the success of root canal treatment.

Though the conservation of tooth structure is important for successful restoration of tooth after root canal treatment, the access cavity should be designed according to the need i.e. to allow straight line access to the apical 3rd of root canals and also to search the additional root canals.<sup>5</sup>

In search of the possibility of additional canals one should

- 1) Understand the complexity of root canal system of tooth involved.
- 2) Have different off- angled radiographs .
- 3) Modify the access cavity that ensures straight line access to the root canals and improves visibility.
- 4) Examine the pulpal floor in respect of anatomical landmark.
- 5) Search for additional bleeding points indicating extra canals.
- 6) Use of SOM, Loups and Head lamps .

Newer diagnostic methods such as computerized axial tomography (CT) scanning greatly facilitate access to the internal root canal morphology. As CT scanning allows to visualise multiple slices of tooth roots and their root canal systems, CBCT scanning is a relatively newer diagnostic imaging modality, used in endodontics for the effective evaluation of the root canal morphology.<sup>2</sup>

## CONCLUSION

A clear understanding of the root morphology and canal anatomy is an essential pre-requisite to achieve clean, disinfected and 3-dimensionally obturated root canal systems after endodontic treatment.

Undetected extra roots or root canals can directly affect the outcome of endodontic therapy. Though the etiology of endodontic failure is multifaceted, a significant percentage is related to inability in locating and properly treating root canals. Therefore the clinicians should ought to be aware of complex root canal structures, the cross sectional dimensions and the iatrogenic alterations of the canal anatomy together with the diagnosis and treatment planning as the basic requirements for achieving a successful treatment outcome.<sup>7</sup>

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