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MAXILLARY FIRST MOLAR': AN ENIGMA FOR ENDODONTISTS

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ABSTRACT

Morphological variations found in the root canal system are not the exception but the rule. These variations occur with great frequency in the maxillary 1st molar. The identification, thorough debridement and obturation of the complex anatomy leads to successful endodontic therapy. The use of adjuncts such as CBCT imaging and operating microscope greatly aid in visualization and precision in treatment.

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KEY WORDS

Morphological variation; CBCT; Maxillary first molar; Endodontic therapy

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INTRODUCTION

Sound knowledge of the root canal system and its frequently encountered variations help clinicians in achieving successful endodontics [1] .Anticipating the presence of variations should be a routine practice while performing endodontic therapy. Maxillary first molars have the most complicated root canal morphology amongst the permanent dentition; therefore, their anatomy has been evaluated extensively in various studies.

Maxillary first molars usually present with three roots and three canals, with a second mesiobuccal canal (MB2) canal seen in 18- 96.1% of the cases [2]. Nevertheless, it can present with more or less number of roots or root canals than the accepted norm. Other variations for maxillary first molars include one [2], four [3], and five [4] roots, which may include unusual morphologies of root canal system within individual roots. Cases with five [5], six [6], seven [7], eight root canals [8] or a C-shaped canal configuration [9] have also been reported earlier. Two-rooted maxillary first molar with two canals have rarely been reported. Such anatomic variations have been reported in limited number of studies for maxillary second molar.

This case series presents maxillary first molars with unusual morphologies of patients who reported to the Department of Conservative Dentistry and Endodontics: 1. two roots and two root canals, 2. three roots with five canals (2 Distobuccal canals), 3.three roots with five canals (2 palatal canals) and 4. three roots with 6 canals (3 mesiobuccal and 2 distobuccal canals). The use of adjuncts such as the operating microscope and Cone Beam Computed Tomography (CBCT) are imperative in the identification and location of additional canals and therefore must be used during treatment.

CASE DESCRIPTION

Case 1

A 38-year-old female patient reported to the postgraduate clinic with the chief complaint of spontaneous pain in the upper right posterior tooth for the past 15 days. The patient reported symptoms of prolonged sensitivity to hot and cold beverages. On clinical examination, the right maxillary first molar (tooth #16) presented with features of hypoplasia with attrition. The tooth was tender on vertical percussion. The tooth was hyper-responsive to thermal testing (cold and heat test). Preoperative intra oral peri-apical radiographs (IOPAR) revealed an occlusal radiolucency involving the enamel, dentin and approaching the pulp space [**Figure– 1a**]. On close examination of

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the IOPAR only two root outlines were evident. A diagnosis of symptomatic apical periodontitis was made and root canal therapy was decided on as the definitive treatment option.

Local anesthesia was administered and rubber dam was placed. A conventional endodontic access opening was performed. On viewing the access cavity only two canal orifices were located, and thus the search for the other canals was undertaken using the dental operating microscope. The shape of the access cavity was dictated by the location of orifices. Root canals were explored with ISO #10 K-files. However, the attempt to locate another canal was unsuccessful. CBCT was advised in relation to tooth #16 to confirm the varied root canal morphology **[Figure– 1b]**.

CBCT confirmed the presence of two roots (buccal and palatal) with two canals. At the next appointment, working length was determined and a hybrid technique was used for chemo-mechanical preparation using standard irrigation protocol **[Figure– 1c]**. Buccal and palatal canals were instrumented with hand K files up to 70 and WaveOne primary file respectively. Obturation was performed using cold lateral compaction of gutta-percha (Dentsply Maillefer) for the buccal canal and WaveOne GP cones for the palatal canal using AH Plus resin sealer (Maillefer Dentsply, Konstanz, Germany) **(Figure 1d, 1e, 1f)**.

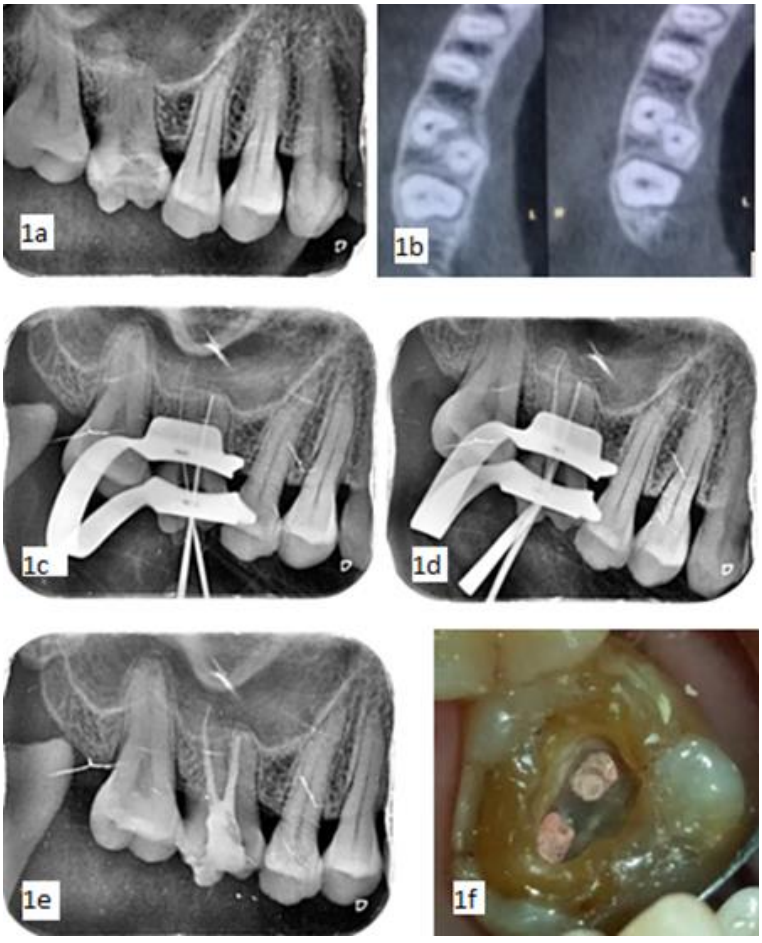

Fig: 1a. Preoperative periapical radiograph, **1b.** CBCT axial plane,1c. Working length determination, **1d**. Master cone selection,**1e.** Post-obturation radiograph, **1f.** Clinical image showing two canal orifices

Case 2

A 29-year-old male patient presented with pain in the right upper back tooth region since 2 days. The pain was spontaneous and severe in nature. On clinical examination deep dental caries was observed with tooth # 16. The tooth was also found to be tender on vertical percussion. An IOPAR revealed a radiolucency involving enamel,

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dentin and approximating the pulp on the mesial aspect. Widening of the periodontal ligament space was observed. As the patient was experiencing excruciating pain, emergency access opening was performed.

On performing the access opening 5 canal orifices were observed **[Figure– 2a].** The canals were scouted with standardized ISO #10 K files. An informed consent was obtained from the patient and a CBCT scan was advised to investigate the presence of any additional canals. The scan revealed the presence of 5 separate canals **[Figure– 2b]**.

Tooth #16 was isolated using rubber dam and coronal pre-flaring was done with a Protaper SX Rotary NiTi file. The working length was determined using an apex locator (Apex ID, Sybron Endo) and verified radiographically **[Figure– 2c]**. Chemo-mechanical preparation was done using RaCe rotary Ni-Ti files following standard irrigation protocol. The MB1, MB2, DB1 and DB2 canals were instrumented upto #25/0.06. The palatal canal was prepared till #30/0.06. The 5 roots were obturated with the corresponding size gutta percha cones using AH plus sealer **[Figure– 2d]**.

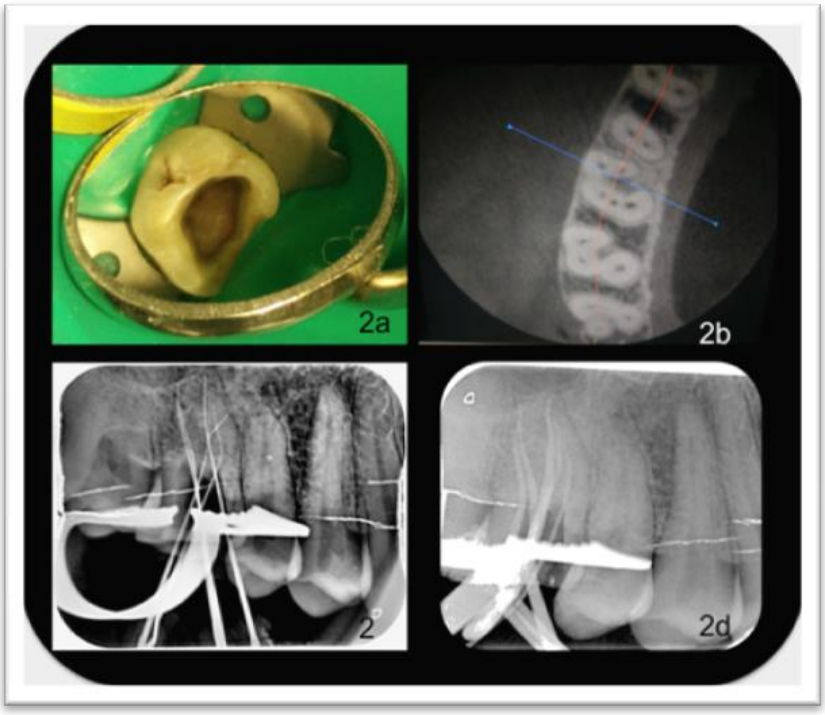

Fig: 2a. Clinical image showing 5 canal orifices, **2b.** CBCT image, **2c.** Working length determination, **2d.** Master cone selection and obturation

Case 3

A 27-year old male patient reported to the Department with the chief complaint of pain in the right upper back tooth region since a month. The pain was intermittent in nature and increased on mastication. The patient's medical history was non-contributory.

On clinical examination deep dental caries was observed with tooth # 16. The tooth was also found to be tender on vertical percussion. The IOPAR revealed a radiolucency involving enamel, dentin, extending to the pulp on the mesio-proximal aspect with periapical widening.

In the pulp chamber floor, the 3 root canal orifices were identified: MB, DB, and palatal. The pulp chamber floor was then scouted to locate the fourth canal in the MB root. After probing with a DG 16 (Dentsply) endodontic explorer and scraping calcifications with a spoon excavator, a small hemorrhagic point was noted in a groove

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approximately 2 mm from the MB orifice in a palatal direction. At the same time a similar hemorrhagic point was noted near the orifice of the main palatal canal.

To verify the presence of extra canals CBCT was taken w.r.t 16. The CBCT clearly showed the presence of 2 mesial orifices, 2 palatal orifices and a single distal orifice **[Figure– 3a]**. Protaper SX (Dentsply) was used for coronal pre-flaring, following which K files were used to clean and shape the canal system. The working length was determined using an apex locator (Apex ID, Sybron Endo) and verified radiographically (**Figure-3b**). This was followed by rotary instrumentation of all the canals up to 25/0.04 with Hyflex CM rotary NiTi files. The canals were obturated using AH plus sealer and 25/0.04 gutta-percha **[Figure– 3c & 3d]**.

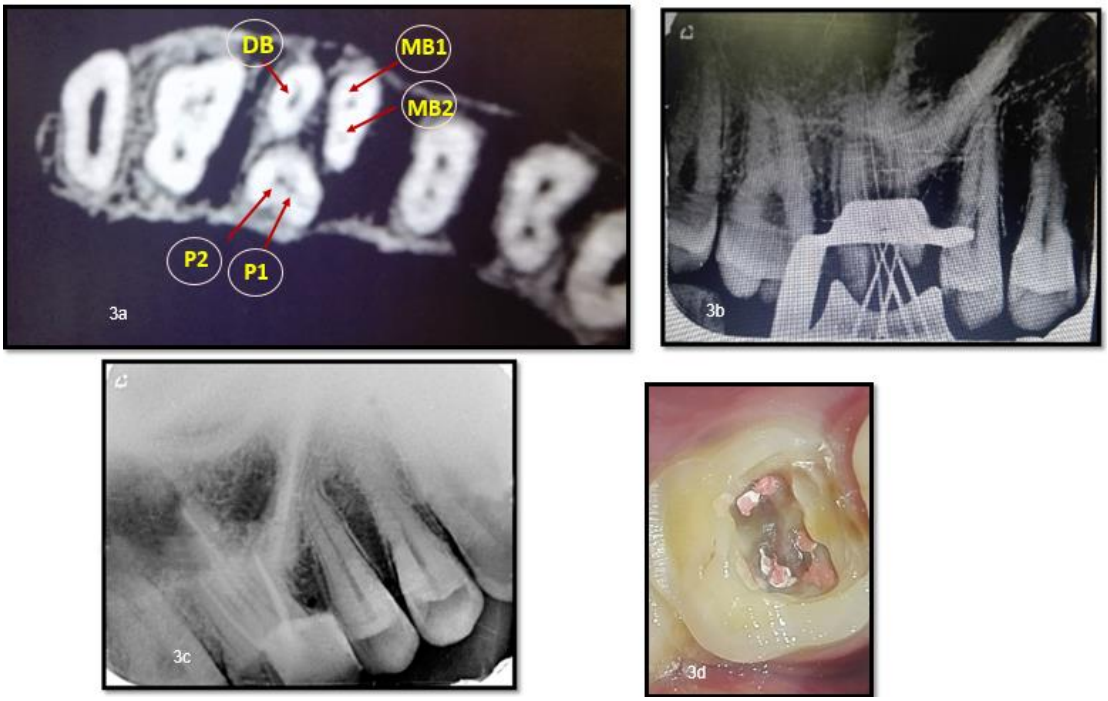

Fig: 3a. Working length determination, **3b.** Post-obturation radiograph, **3c**. Clinical image showing 5 canal orifices, **3d.** CBCT image

Case 4

A 28-year old female patient reported to the Department of Conservative Dentistry and Endodontics, with the chief complaint of severe pain in the left upper back region of the jaw. The patient was experiencing severe discomfort, hence emergency access opening was undertaken after administering an infiltration of local anaesthesia. On visualizing the access cavity, 7 canal orifices were visible- 3 mesio-buccal, 2 disto-buccal and 2 palatal [**Figure– 4a**]. To verify the number of canals present, a CBCT scan was advised.

The CBCT scan was viewed and 6 canals were found to be present: 3 mesio-buccal, 2 disto-buccal and one large palatal canal [**Figure– 4b**]. Rubber dam was placed and all the 6 canals were negotiated using ISO #10 K files. Coronal pre-flaring was done using Protaper Sx rotary Ni-Ti file. The working length was determined [**Figure– 4c**]and chemo-mechanical preparation was completed using Hyflex CM and RaCe rotary NiTi files. The MB1, MB2, MB3, DB1 and DB2 canals were enlarged to #25/0.04 using Hyflex CM rotary NiTi files. The palatal canal was enlarged to #30/0.06 using RaCe rotary NiTi files. Irrigation between files was done using 3% Sodium Hypochlorite solution. Final rinse was done with 1 ml of 17% EDTA followed by 2% Chlorhexidine gluconate solution with an intermediate rinse of distilled water. The 6 canals were obturated using gutta percha of corresponding sizes along with AH plus sealer [**Figure– 4d**]. A post-obturation CBCT scan was taken to re-confirm the obturation of all the canals [**Figure– 4e**].

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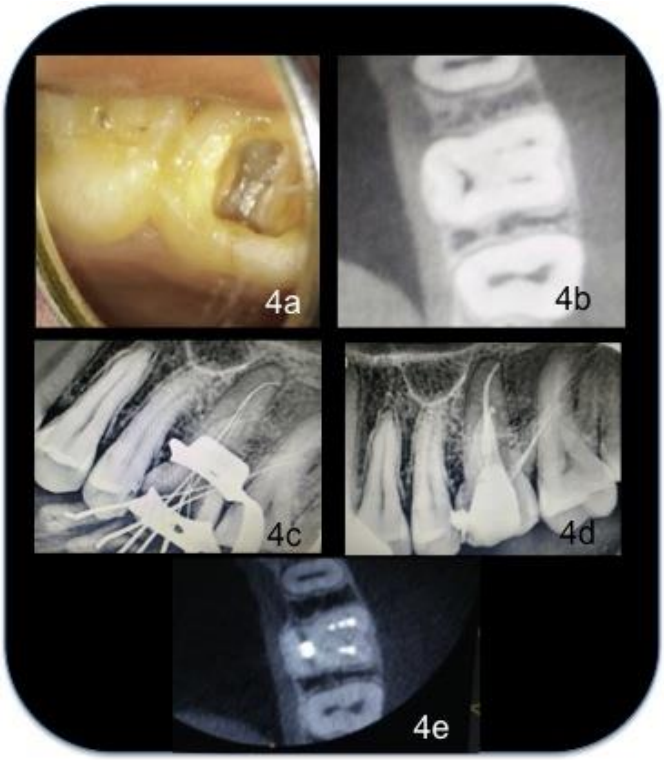

Fig: 4a. Clinical image showing 6 canal orifices, **4b**.CBCT image, **4c.** working length determination, **4d.** Post-obturation radiograph, **4e.** Post obturation CBCT image

DISCUSSION

Due to the varied morphology, endodontic treatment in multi-rooted teeth becomes a challenging task. The occurrence of a root with a tapering canal and a single foramen is the exception rather than the rule. A wide range of variations and complexities with regard to maxillary molar have been reported in literature [10]. It is not unusual to see one or more additional canals in a maxillary first molar and on the other hand finding canals less than the normal expected number is also plausible. An examination of the floor of the pulp chamber offers clues to the type of canal configuration present.

The development of roots involves formation of an epithelial diaphragm. In multi-rooted teeth, the epithelial diaphragm undergoes differential growth, which causes the division of the root trunk into two or three roots. Depending upon the number of divisions that occur, subsequent numbers of roots are formed.

In multi-rooted teeth the epithelial diaphragm is genetically programmed to undergo differential growth but under very rare condition this differential growth may fail to take place. And this may give rise to the formation of single or bi-rooted maxillary first molar [11]. Fusion of two buccal roots is one of the most common aberrations of maxillary molars. A total of 0.4% of first maxillary molars and 2.2% of second maxillary molars have been reported to have this variation [12].

Root canal morphology should be comprehensively examined on preoperative radiographs from different horizontal angles. The use of additional radiographic views with 20-degrees mesial or distal angulations is a good practice for the assessment of the root canal morphology and anatomy [9]. Nevertheless, it is not completely reliable because of its inherent limitation of it being a two-dimensional representation of a three-dimensional object.

The use of advanced diagnostic tools such as CBCT, aids in the accurate and conclusive assessment of cases with unusual canal morphology [8]. Reconstructing CBCT images require significantly lower radiation dosage as compared to alternative conventional computed tomographic scans. This is because in CBCT imaging, the raw

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data is acquired in the course of a single sweep of a cone-shaped x-ray source and a reciprocal detector around the patient's head. Efficient use of the radiation beam and elimination of a conventional image intensification system (used in conventional computed tomography scanners) has resulted in a huge reduction in the radiation exposure to the patient.

Carr et al affirms that the operating microscope has greatly improved the ability of the endodontist to visualize the internal anatomy of the root canal with greater clarity [13]. Magnification and imaging tools should be employed to confirm the root canal morphology and avoid procedural mishaps like gouging, perforation, missed canals etc. which may comprise the prognosis.

CONCLUSION

Clinicians must have adequate knowledge of the morphological variations that can occur in the root canals. It is important that the various canal morphologies be evaluated prior to and during endodontic treatment. Advanced diagnostic aids like CBCT and dental operating microscope can aid in achieving predictable treatment outcomes.

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CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

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