ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.52789-52793, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

CASE REPORT

A RARE PRESENTATION OF MANDIBULAR FIRST MOLAR WITH FOUR ROOTS AND ITS ENDODONTIC MANAGEMENT: A CASE SERIES

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ARTICLE INFO

Article History:
Received 03rd March, 2017
Received in revised form
18th April, 2017
Accepted 06th May, 2017
Published online 30th June, 2017

Key words:
Mandibular First Molar,
Four Roots,
Root and Canal Morphology.

ABSTRACT

Introduction: Thorough knowledge of root canal morphology and its anatomical variations is essential for successful endodontic therapy.
Methods: This report presents 3 rare cases of unusual tooth morphology involving mandibular first molar with 4 roots and variable number of canals.
Results: The use of DOM, proper radiographic interpretation and modified access opening in these cases greatly contributed toward making a confirmatory diagnosis and successful endodontic treatment of four-rooted mandibular first molars with variable canal anatomy.
Conclusions: Root canal anatomy often presents challenging situations that requires diagnostic approaches, access modification, and clinical skills to perform a successful endodontic treatment.

Citation: Pritesh Agrawal. 2017. "A rare presentation of mandibular first molar with four roots and its endodontic management: a case series", *International Journal of Current Research*, 9, (06), 52789-52793.

INTRODUCTION

The success of endodontic treatment depends on thorough mechanical and chemical cleansing of the entire pulp cavity followed by complete coronal & apical seal. In spite of introducing new technologies, instruments and materials, the overall outcome, especially of nonsurgical endodontics, has not increased significantly (de Pablo, 2012). Retreatment cases showed 42% incidence of missed canals (Hoen and Pink) (Mohammadi, 2013; Vaghela et al., 2013). Thus, an understanding of the tooth anatomy and its variations is very essential for the successful endodontic treatment. Although possible aberrations of canal anatomy should be considered for all teeth, some teeth should be highlighted. The mandibular first molar is possibly the most treated and least understood posterior tooth (de Pablo, 2012; Kottoor et al., 2012; Chen et al., 2009). The number of roots remains the most common variation, particularly related to certain ethnicities (de Pablo, 2012). Usually mandibular first and second molars have 2 roots. Sometimes an additional root (Carabelli) called radix entomolaris in the distolingual location or radix paramolaris in the mesiobuccal location may be found (Rhythm Bains, 2009). But there are very few case reports describing four rooted mandibular first molars.

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This case series presents 3 different cases of successful nonsurgical endodontic management of a four rooted permanent mandibular first molar with each root containing its own independent root canal or canals.

Case Series

Case 1

A 20-year-old Indian male patient reported to the Department of Conservative Dentistry & Endodontics, GDCH, and Nagpur, India complaining of an inability to chew with lower left posterior tooth for the preceding few days. The patient had undergone incomplete endodontic therapy on the same tooth by a general dentist. His medical history was non-contributory. Clinical examination revealed access opening with left mandibular first molar. The tooth was tender to percussion. Radiographic examination (Fig. 1A) revealed periapical lesion in relation to both the mesial and distal roots of the tooth. The tooth did not give any response to electric pulp testing and hence considered nonvital. Intra oral periapical radiographs with horizontal angulations (0degrees) revealed the presence of an additional periodontal ligament space along both mesial and distal roots bilaterally. Other radiographs (Fig.1 B, C) at different angulations (20 degrees mesial and distal) confirmed the presence of extra distolingual and mesiobuccal roots. Non surgical endodontic treatment was planned for the teeth.

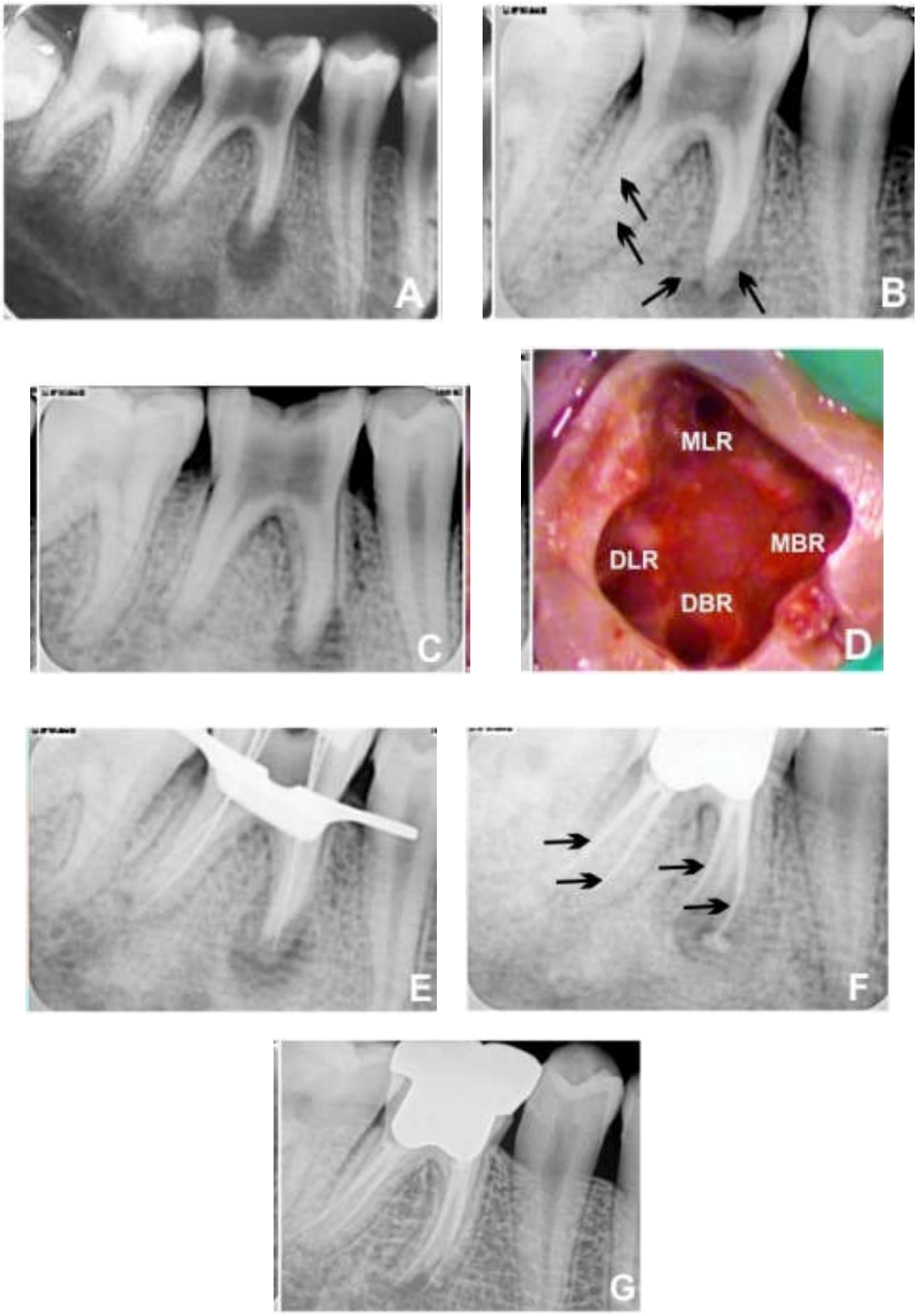

Fig.1 (A,B and C) Preoperative radiograph taken at different horizontal angulation (D) Access opening showing 4 separate canal orifices (E) working length determination radiograph (F) immediate postoperative radiograph (G) 12-month recall

After local anesthesia and isolation with rubber dam (Hygenic Dental Dam, Colte´ne Whaledent, Langenau, Germany), the endodontic access cavity was modified. The previous access opening revealed 3 root canal orifices. Upon visual inspection with a dental operating microscope (Opto dental microscope, Opto DM PRO model), a dark line was observed between the distal canal orifice and the distolingual corner of the pulp chamber floor. At this corner, overlying dentin was removed with a diamond bur with a non cutting tip (Diamendo, Dentsply Maillefer) and a second distal canal orifice was located with endodontic explorer (DG-16 Endodontic Explorer, Ash Instruments, Dentsply, Gloucester, United Kingdom). Due to this distal extension, the final access cavity acquired a trapezoidal form. It revealed four distinct orifices: Mesiobuccal (MBr), mesiolingual (MLR), distobuccal (DBR), distolingual (DLR) (Fig. 1D). The naming for the canals in this case is based on new anatomically based nomenclature system proposed by Denzil Valerian Albuquerque *et al*. (2012; Valerian Albuquerque et al., 2012). Canal patency was checked & working lengths were determined using an apex

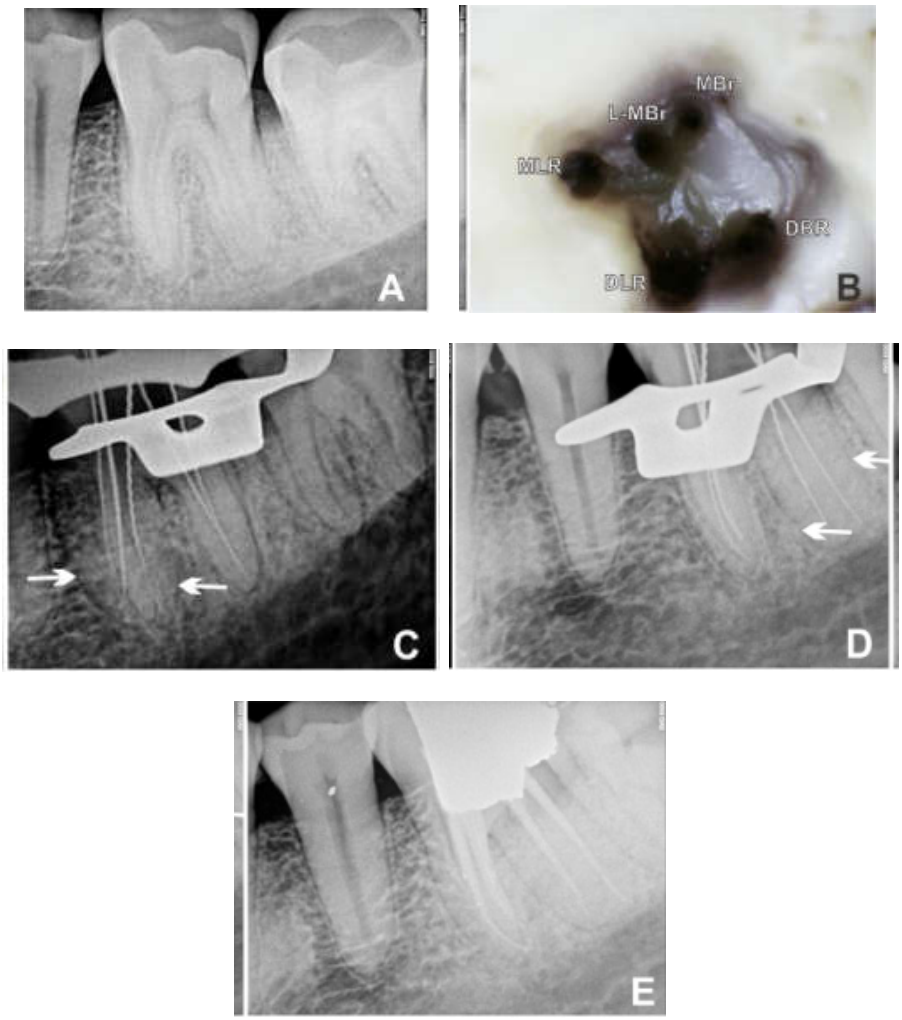

Fig.2 (A)Preoperative radiograph (B) Access opening showing 5 separate canal orifices (C&D) Working length determination radiograph (E) Immediate postoperative radiograph

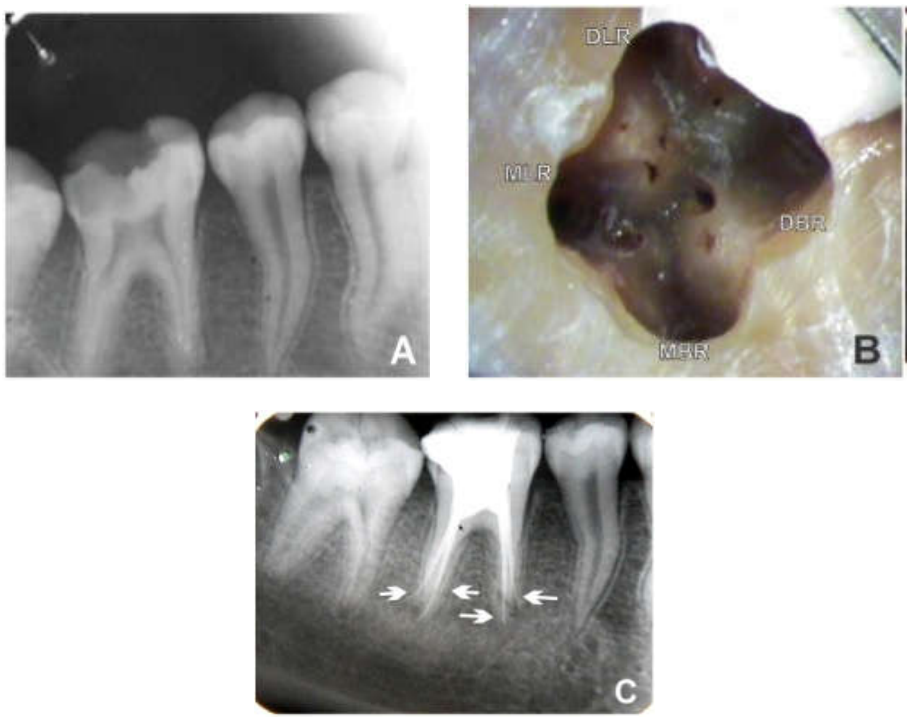

Fig.3 (A) Preoperative radiograph (B) Access opening showing 4 separate canal orifices (C) Immediate postoperative radiograph

locator (Root ZX; Morita, Tokyo, Japan) and then confirmed with a periapical radiograph (Fig. 1E). The working-length radiograph confirmed the presence of four roots. Cleaning and shaping of the root canals were performed using the crown-down technique with ProTaper® nickel-titanium rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) under abundant irrigation with 5% sodium hypochlorite solution and EDTA (Glyde®, Dentsply Maillefer). The canals were dried with paper points (Dentsply Maillefer) and obturated with cold, laterally condensed gutta-percha (Dentsply Maillefer) and AH Plus sealer (Dentsply Maillefer) (Fig 1F). At 12 months follow up the tooth was asymptomatic and there was radiographic evidence of periapical repair (Fig. 1G).

Case 2

A 43-year old male patient visited to the department with a chief complaint of pain in lower right back tooth region since one month. On clinical and radiographic examination, a diagnosis of symptomatic irreversible pulpitis with lower right mandibular first molar was made and endodontic therapy was planned. Vague outline of the root and twin periodontal ligament outline in radiograph revealed presence of supernumerary roots (Fig. 2A). Following local anesthesia administration, the tooth was isolated under rubber dam and access cavity preparation was done with round bur and Endo Access bur. Four distinct orifices: Mesiobuccal (MBr), mesiolingual (MLR), distobuccal (DBR), distolingual (DLR) were detected with the help of DG 16 explorer (Fig. 2B).

Careful examination of the fissure connecting the mesiobuccal and mesiolingual orifices at the floor of the pulp chamber under the operating microscope at 12X magnification (Opto dental microscope, Opto DM PRO model) revealed an extra orifice in between the two mesial canals suggestive of middle mesial canal (Fig. 2B).Working length was determined (Fig.2C, D) with radiographs at different angulations which confirmed presence of four roots and five canals. Cleaning and shaping of the root canals were performed using the crown-down technique with stainless steel hand K files followed by ProTaper® nickel-titanium rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) under abundant irrigation with 5% sodium hypochlorite solution and EDTA (Canalarge, Ammdent). The canals were dried with paper points (Dentsply Maillefer) and obturated with cold, laterally condensed gutta-percha (Dentsply Maillefer) and AH Plus sealer (Dentsply Maillefer) (Fig. 2E).

Case 3

A 19 year old female patient with pain in the lower left back tooth region was referred to the Department of Conservative Dentistry and Endodontics. The patient gave the history of strong throbbing pain for the past several days. The past medical history was found to be non-contributory. On clinical examination carious involvement was seen with left mandibular first molar. On clinical and radiographic examination (Fig. 3A) it was diagnosed as irreversible pulpitis with the left mandibular first molar and hence indicated for root canal treatment. Following endodontic access cavity preparation, two mesial and two distal canal orifices were identified. Upon visual inspection of the floor of the pulp chamber using a dental operating microscope, it was found that the angle formed between the DRFLs joining both the mesial and distal orifices was more acute; presenting in the form of a letter "X" (Fig. 3B).

This finding made us suspect of presence of an additional root both mesially and distally (4). After taking working length, the canals were instrumented followed by obturation and a coronal composite restoration. The presence of four different roots can be clearly visualized in the post obturation radiograph (Fig. 3C).

DISCUSSION

The dentist should have thorough knowledge of the internal and external anatomy of the teeth while performing endodontic treatment. Inability to properly treat all the canals will lead to root canal treatment failure. A number of anatomical variations have been described in the mandibular first molar. Presence of three (Fabra-Campos, 1985) or four (Reeh, 1998) mesial root canals has been reported. Kottoor et al. (2010) reported the presence of three distal canals, while Ghoddusi et al. (2007) reported the presence of four distal canals. Variations in number of roots have also been reported. The major variant in this tooth type is the presence of an additional distolingual root called radix entomolaris. Its prevalence varies in different populations ranging from 3% of the African population (Sperber et al., 1998) to more than 30% of the Mongoloid population (Walker, 1985).

An extremely rare variation of an additional mesiobuccal root is called the radix paramolaris (RP) (Calberson, 2006). Among various extensive laboratory studies in different population and ethnic groups, only the one conducted by Morita (Morita, 1990) reported presence of a four-rooted mandibular first molar, which formed 0.04% of the total sampled Japanese population (16–18). Very few case reports have previously described the presence of four rooted mandibular first molar (Kottoor, 2012; Friedman, 1986; Lee et al., 2005). Some have reported three distal and one mesial root and very few have reported cases of mandibular first molar with two mesial and two distal roots. This article describes 3 cases of four-rooted mandibular first molar with two mesial and two distal roots with variable number of root canals. Here , a new anatomically based nomenclature system proposed by Denzil Valerian Albuquerque *et al* is used for naming the root canals .This nomenclature helps us to understand the variation of roots in relation with the root canals unlike other nomenclature system which considers only the variation in the root canal morphology without giving any consideration to the number of roots and its relation with root canals (Valerian Albuquerque, 2012).

A proper clinical and radiographic examination is essential in endodontic treatment. Accurate preoperative radiographs taken at different angulations are essential in providing clues as to the number of roots that exist. Careful interpretation of the periodontal ligament space may suggest the presence of an extra root or canal. In this report also vague outline of the root and presence of twin periodontal ligament outline of the roots revealed presence of supernumerary roots. Also radiograph taken at multiple angulations confirmed presence of four roots. Radiographically in all the cases presented here, the 4 root canals ended in their own distinct foramen. Out of 3 cases presented here, 2 cases had 4 roots with one independent canal each while the second case had total five canals with 2 canals in mesiobuccal root. Gingival recession may reflect the furcal morphology in these teeth and thus hint at the presence of two buccal roots. Probing the buccal sulcus to feel the root eminences and furcal anatomy may also help to identify the presence of two buccal roots if present (Mohammadi et al.,

2013). Also before creating the access cavity, attention should be paid to the number of cusps. An additional root is often associated with an additional cusp (Lalit Boruah, 2010).

In tooth suspected to have extra roots or root canals at the diagnosis stage, the outline form has to be modified to search for and the ultimate cleaning, shaping and filling of the extra roots and root canals. The role of microscopy in endodontics should not be underestimated. Magnification & illumination through dental operating microscope makes canal location much easier (Coelho de Carvalho and Zuolo) (Mohammadi et al., 2013). In the present cases also the successful treatment of mandibular first molar containing 4 roots was almost impossible using the conventional technique without magnification.

In mandibular first molars with two roots and each root having two distinct canals (for instance, mesiobuccal and mesiolingual canals in the mesial root), the angle formed between the developmental root fusion lines (DRFLs) joining these canal orifices is more obtuse. This can be visualized in both the mesial and distal DRFLs of such two-rooted mandibular first molars. In the case 3 presented here, the angle formed between the DRFLs joining both the mesial and distal orifices was more acute; presenting in the form of a letter "X". This could be an indication to the presence of two additional roots (Kottoor et al., 2012). Many reports deal with 3 independent canals in the mesial root, but very few described 4 independent canals in 4 separate roots or five canals and four roots in mandibular first molar indicating a rare anatomic configuration. This report points out the importance of looking for additional canals and unusual canal morphology, because knowledge of their existence might occasionally enable clinicians to treat a case successfully that otherwise might have ended in failure. It may contribute to our knowledge of the root canal systems and the anatomy of mandibular first molars. Proper knowledge of the anatomy, interpretation of radiographs and use of magnification helps to manage such morphological variations accurately.

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