

Mandibular Molars with Unique Middle Mesial Morphologies – Two Case Reports

***Pradeep Solete¹, Kavalipurapu Venkata Teja², Sahil Choudhari¹,
Delphine Priscilla¹ Antony, Surya. T. G³, Mylisha Kannaiyan³***

Root canal treatment primarily focuses on the effective chemomechanical debridement and three-dimensional sealing of the complex root canal system. Inherent root canal complexities make the treatment extremely challenging, even for experienced clinicians. Failure to identify these anatomical variations and inappropriate management of these complexities ultimately leads to treatment failures. Identification of the extra roots or root canals and usage of appropriate techniques in managing confluent canals could reduce the chances of possible iatrogenic errors. Owing to these facts, it's understood that updating the knowledge of root canal anatomy and underlying canal variations is of utmost importance for the clinician. This case report will address the finding of both of these aberrancies in two mandibular molars, along with the clinical management and outcomes of treatment. It will also review previous case reports that have documented similar aberrancies, providing a broader context for understanding these complex anatomical variations and their implications for successful root canal therapy.

Keywords: Endodontics, Aberrant root canals, Mandibular molars, Radix entomolaris, Root canal.

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1. Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, Tamil Nadu, India.
 2. Department of Conservative Dentistry and Endodontics, Mamata Institute of Dental Sciences Hyderabad, Telangana, India.
 3. Private Practitioner.
- Corresponding author: Pradeep Solete, email: pandu.pradeep@gmail.com

Introduction

Adequate knowledge and appropriate identification of the complex canal anatomy is a prerequisite for successful root canal treatment. Inability to appreciate the internal root canal anatomy and lack of proper approach often leads to treatment failures.^{1,2} Mandibular first molars are known for their anatomical disparity, which is most often missed during routine radiographic examinations.³ Literature shows the incidence of missed roots or canals requiring retreatment to be 42%,⁴ out of which, 86% of missed canals were found in distal roots and 14% of missed canals were found in mesial roots of the mandibular first molar.⁵

Carabelli (1844), was the first one to report an extra distolingual root in the mandibular molars. De Moor *et al.* (2004) named it Radix Entomolaris (RE).⁶ Chandra *et al.* (2011) reported the incidence of RE in the South Indian population to be 13.3%.⁷ The presence of Middle Mesial (MM) canals was first identified in 1922 by Lenhossék. Vertucci and Williams in 1974 reported the incidence of extra Middle Mesial (MM) to be less than 10% in mandibular first molars.⁸ Pomeranz *et al.* classified the MM canals into the fin, confluent type and independent type.⁹ Although most of the possible canal variations have been documented in the literature, we may be the first one to report a Radix Entomolaris case with novel canal variation presented in the mandibular molar of the South Indian race. This article highlights two cases of Radix Entomolaris (RE) with Middle Mesial (MM) canals of confluent with independent type and confluent type in mesial roots of the mandibular first molar.

Case Report 1

A 20-year-old male reported to our department with a complaint of pain in his left lower back tooth for the past 2 weeks. The pain aggravated on consuming hot or cold

food and intensified during the night. Clinical examination of tooth 36 revealed the presence of deep caries with pain on probing. The radiographic examination evidenced a radiolucency involving enamel, dentin and mesial pulp horn along with the presence of three roots (mesial, distal and radix) in the mandibular left first molar 36. The clinical and radiographic findings led to the diagnosis of dental caries with symptomatic irreversible pulpitis in 36.

Informed consent was obtained from the patient before initiating treatment. Single-visit root canal treatment was planned. The anaesthesia was obtained by administering Inferior Alveolar Nerve Block (IANB) using 2% Lignocaine HCl with 1:2,00,000 units of adrenaline (Lignox, Indoco Remedies Ltd, India). Access cavity was prepared using an endodontic access bur size 2 (Dentsply Sirona, USA) under dental dam isolation. The access cavity was refined using Endo-Z bur (Dentsply Sirona, USA), exploration of the pulp chamber was done using endodontic explorer. The canals were negotiated using a size 10 K file (Mani, Inc; Tochigi, Japan), and 5 canals were initially located, two mesial canals, two distal canals and one radix. An OPMI pico dental operating microscope (Carl Zeiss, Germany) was used to enhance the magnification during canal localization. A bleeding spot was identified between the MB and ML orifices, presumed to be a middle-mesial (MM) canal. Ultrasonic tips (Start-X tips, Dentsply-Sirona, USA) were used to explore the MM orifice and the canal was negotiated using a size 10 K file. Working length was determined using the Propex Pixi apex locator (Dentsply Sirona, USA). Finally, a total of seven distinct orifices were identified: Mesial roots four canals (mesiobuccal, middle mesial 1 - MM1 and middle mesial 2 - MM2, mesiolingual), and distal roots two canals (distobuccal, distolingual) and RM, respectively. The shaping and cleaning were achieved using

ProTaper Gold NiTi rotary instruments (Dentsply Sirona, USA) in a crown-down manner. Irrigation was performed using 3% sodium hypochlorite solution (Prime Dental, India) and 17% EDTA (Anabond Stedman Pharma Research (P) Ltd, India). After shaping and cleaning, the two distal canals merged making them oval canals. All canals were dried using paper points and obturation was done using warm vertical compaction with resin sealer (AH Plus sealer, Dentsply-Sirona, USA). A post-obturation radiograph revealed that the MM 1 canal merged with the mesio-lingual (ML) canal at the middle third region, the middle mesial (MM2) had an independent exit at the middle third of the mesial root, and both the distal canals merged at the coronal third, with a separate RM, respectively. The access cavity was restored using a composite restoration (3M ESPE Bulk Fill, USA). (Figure. 1)

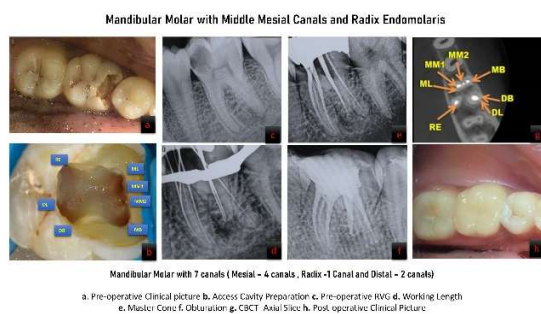


Figure 1: 7 Canals Mandibular Molar with Middle Mesial Canals and Radix Entomolaris

Case Report 2

A 35-year-old male patient-reported with pain in his lower right posterior tooth for the past week. History indicated that he had a tooth-coloured restoration done 18 months previously following which the restoration dislodged around 1 week ago. Upon consuming cold foods, the patient experienced severe pain. The radiographic examination showed the presence of three roots (mesial, distal and radix), with a radiolucency involving the mesial and distal pulp horn of the right mandibular first molar

46 with the presence of radiolucency at the radix. This finding was diagnosed to be secondary caries with symptomatic irreversible pulpitis and symptomatic apical periodontitis.

Multi-visit root canal treatment was planned for tooth number 46. In this case a total of six canals were identified; mesial roots 3 canals (mesiobuccal, mesiolingual and middle mesial canals), distal roots 2 canals (distobuccal and distolingual canals) and radix entomolaris were identified. The clinical protocol followed is similar to case report 1. Following shaping and cleaning, an intracanal medicament (calcium hydroxide) was placed and the cavity was sealed with IRM. During the second visit, the final shaping was done using ProTaper F2 (0,08 taper) and obturation was done using warm vertical compaction with resin sealer (AH Plus sealer, Dentsply-Sirona, USA). Post-obturation radiograph indicated the MM canal merged with the ML canal at the middle third region, and both the distal canals merged at the middle third region and RM in 46, respectively. Following completion of both the cases, post-operative CBCTs were taken to assess the filling of root canals. (Figure. 2)

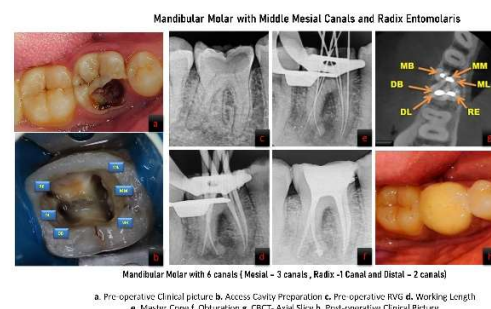


Figure 2: 6 Canals Mandibular Molar with Middle Mesial Canals and Radix Entomolaris

Discussion

Multiple angulated radiographs play a crucial role in identifying the extra canal/roots. Nevertheless, these may have no significant role in identifying the middle

mesial canals in the mandibular molar. The use of magnification aids along with abrasive coated ultrasonics helps to locate these canals, as it improves the visualization. The classic white line present between the mesial orifices of the mandibular molar invites the operator to locate the middle mesial canals.

This case report is unique in presenting a RE with middle mesial canals located in both cases. In both of these case reports we have found type III of RE according to De Moor *et al.*⁶ The uniqueness of case report 1 is the presence of two middle mesial canals, where the MM1 was merged with the MB canal at the middle third region, and the MM2 had a separate exit across the mid root level. Based on Pomeranz *et al.*⁹ we have found confluent with an independent type of MM canal in case 1 and confluent type alone in case report 2. In these cases, three-dimensional imaging modality (CBCT) verified all the portals had been managed.

The presence of the middle mesial canal with radix entomolaris was previously reported by Banode *et al.* 2016, Bhargav *et al.* 2017, Penukonda R *et al.* 2018, Sathyan *et al.* 2019 and Pathak *et al.* 2020, based on the canal configuration by Sert and Bayirli listed in Table 1. Chavda *et al.* analysed the detection of MMC using various magnification methods and CBCT. They concluded all these advanced methods of detecting additional canals increase the success rate of root canal procedures.

The presence of four canals in mesial roots mandibular molar was reported by Reeh in 1988, Kontakiotis and Tzanetakis in 2007, Subbiya *et al.* 2013, Arora *et al.* 2014, Kottor *et al.* 2014, Martins and Anderson in 2015, Jain D *et al.* 2015 and Bhargav *et al.* 2017 listed in Table 2. The presence of two MMC in the mesial roots of the mandibular molar defines the need for a thorough assessment of the canal morphology during root canal treatment. Aminsobhani M *et al.* reported a case with two middle mesial canals during

retreatment of a mandibular first molar with the help of magnification aid.¹⁰ Failure to identify these extra canals may affect the long-term prognosis.

Once the additional canals are located, the shape of the access cavity has to be modified to obtain a straight line view of the canal orifices. The orifices can be located with the help of long shank bur, muller bur, ultrasonic tips, JW 17 explorer and DG 16 explorer with the help of a dental operating microscope.^{1,11} Straight-line access is always required to maintain the canal curvatures during the shaping of the root canals. In case of multiple intercommunications in the canal system, disinfection of all the regions with the help of irrigant activation systems followed by three-dimensional sealing of all canals is essential.¹² However, management of all these challenges within the complex root canal system may be hindered by the focus on minimally invasive approaches.^{12,13}

Table 1: Case reports on Radix Entomolaris with Middle Mesial Canals in Mandibular molars

Author Name	Tooth and Country	Mesial root Canals	Distal root Canals	Sert and Bayirli			Total Canals	Type of MM canal (Pomeranz)
				Radix root	Mesial canal configuration	Distal canal configuration		
Ankur Mahesh Banode <i>et al.</i> 2016	46 India	1 (3)	1 (3)	1 Type I	3-2 (Type XV)	3-1 (Type XVIII)	7	Confluent
Bhargav K <i>et al.</i> 2017	46 India	1 (4)	1 (1)	1 Type I	4-2 (Type XIV)	1 Type I	6	Confluent
Penukonda R <i>et al.</i> 2018	46 India	1 (3)	1 (1)	1 Type I	3-2 (Type XV)	1 Type I	5	Independent
Midhula Sathyan <i>et al.</i> 2019	46 India	1 (3)	1 (2)	1 Type I	3-2 (Type XV)	2-1 (Type II)	6	Confluent
Ipsita Pathak <i>et al.</i> 2020	46 India	1 (3)	1 (1)	1 Type I	3-3 (Type VIII)	1 (Type I)	5	Confluent
Current Case Report 1	36 India	1 (4)	1 (2)	1 Type I	4-3 (Type not specified)	2-1 (Type II)	7	Confluent, Independent
Current Case Report 2	46 India	1 (3)	1 (2)	1 Type I	3-2 (Type XV)	2-1 (Type II)	6	Confluent

Table 2: Distribution of case reports on 4 canals (2 Middle Mesial Canals) in Mesial roots of Mandibular molar

Author	Tooth Number and Country	Mesial roots (Canals)	Distal roots (Canals)	Total roots	Sert and Bayirli		Total Canals	Type of MM canal (Pomeranz)
					Mesial canal configuration	Distal canal configuration		
Reeh 1998	36 USA	1 (4)	1 (3)	2	4-2 (Type XIV)	3-3 (Type VIII)	7	Confluent
Kontakioti and Tzanetaki 2007	36 Greece	1 (4)	1 (2)	2	4-1 (Type XXI)	2-1 (Type II)	6	Confluent
Subbiya et al 2013	36 India	1 (4)	1 (1)	2	4-2 (Type XIV)	1 (Type I)	5	Confluent
Arora et al 2014	36 India	1 (4)	1 (4)	2	4-2 (Type XIV)	4-2 (Type XIV)	8	Confluent
Kottor et al 2014	47 India	1 (4)	1 (3)	2	4-2 (Type XIV)	3-3 (Type VIII)	7	Confluent
Martins and Anderson 2015	36 USA	1 (4)	1 (2)	2	4-2 (Type XIV)	2-2 (Type IV)	6	Confluent
Jain D et al 2015	36 India	1 (4)	1 (2)	2	4-2 (Type XIV)	2-2 (Type IV)	6	Confluent
Bhargav K et al 2017	46 India	1 (4)	2 (2)	3	4-2 (Type XIV)	1 (Distal) Type I 1 (Radix)	6	Confluent
Current Case report 1	India	1 (4)	2 (3)	3	4-3 (Not Specified)	2-1 (Distal) (Type II) 1 (Radix)	7	Confluent, Independent

Conclusion

Root canal treatment in teeth with multiple canals is always a challenging task for the clinician. The inability to identify all these additional canals often affects the success of the treatment. Current case report identified the unique anatomy in mandibular molar and has specified the treatment protocol in such cases.

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Conflict of interest

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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Data Availability

The datasets analyzed during this study are not publicly available but are available from the corresponding author on reasonable request.

Consent

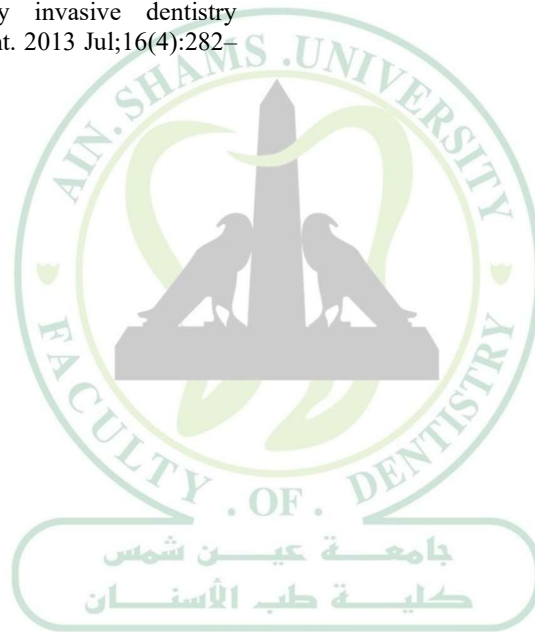
Written informed consent was obtained from all patients before collecting the data.

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