

Middle Mesial Canals - A Review

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Abstract: Understanding the root canal morphology of the tooth as well as its variations is necessary for successful endodontic treatment as it helps in efficient root canal preparation and three dimensional obturation of the root canal system. However, complexity in the internal root canal anatomy imparts difficulties that can lead to failure of endodontic therapy. Mandibular molars often exhibit variations like middle mesial canal, C shaped canal, Radix entomolaris and Radix paramolaris. There are various ways to detect the canal variations like radiographs, endodontic explorer, special trougheningburs, ultrasonic tips, microscope, loupes, CBCT and so on. Recent advancements like cone-beam computed tomography enables the clinician to understand the three-dimensional analysis of root canal morphology. This literature review gives a overview of middle mesial canal, its identification, identification, location, negotiation and obturation.

Keywords: Middle mesial canal, Cone beam computerized tomography, Troughing, Radiographs, Root canal morphology, Explorers

1. Introduction

Successful endodontic treatment depends on complete debridement of root canal space and creating a fluid impervious seal. For periapical healing to take place, a favourable environment has to be created, which is free of microbes and necrotic tissue should. However with unusual canal morphologies this is not always possible. These root canal anatomy variations are more susceptible to treatment failures when there is insufficient knowledge of canal anatomy. For a successful root canal treatment, locating all root canals, thorough cleaning and shaping and sealing them completely with an inert obturation material.¹⁻³

Mandibular first molars normally have two roots and three to four canals (two mesial and one or two distal).⁴ Variations like C-shaped canals, additional third canal in the mesial root, middle mesial in mesial root, distal root, radix entomolaris, radix paramolaris are all reported frequently and well reported in literature.⁵⁻⁶ The middle mesial (MM) canal lies in the developmental groove between the mesiobuccal (MB) and mesiolingual (ML) canals. Vertucci and Williams as well as Barker et al. in 1974 were the first to report its existence, later which the MM canal has been studied extensively. Incidence has been reported to be 0-46%.⁷

2. Classification

Pomeranz et al. classified MM canals into three categories – (1) **Fin:** When at any stage during debridement, the instrument could pass freely between the mesiobuccal or mesiolingual canal and the middle mesial canal. (2) **Confluent:** When the prepared canal originated as a separate orifice but apically joined the mesiobuccal or mesiolingual canal. (3) **Independent:** When the prepared canal originated as a separate orifice and terminated as a separate foramen. A broad single mesial canal in which three master cones could be cemented to the apex at the same time was also included as an independent middle mesial canal.⁸

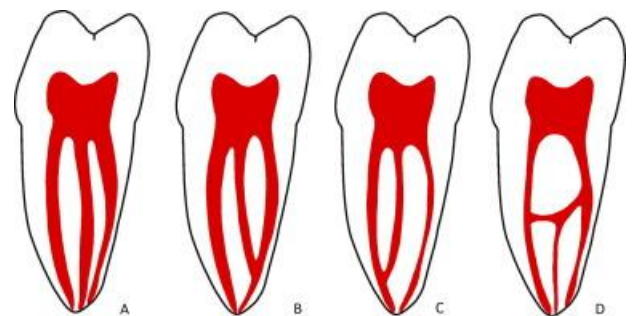
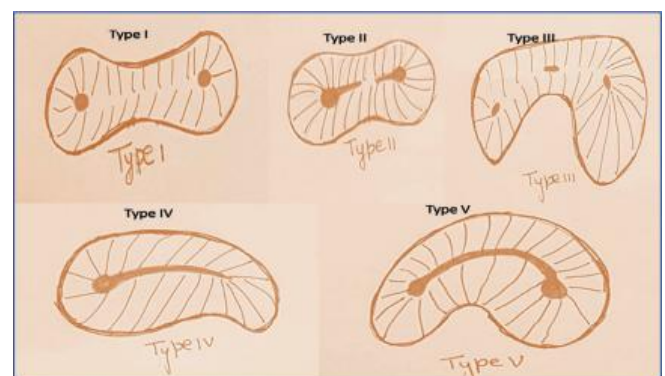


Figure 1: Represents: A) Independent B&C) Confluent D) Fin

On the Basis of Number of Isthmus:

Kim SY et al⁹ divided apex into five types:

- Type I: Two canals at root tip without any connection.
- Type II: Two canals with incomplete connection between them.
- Type III: Three canals at root tip without any connection.
- Type IV: Extension of main canal resulting in a shape of tear.
- Type V: Two canals with complete connection between them.



Incidences

Various studies on the incidence of middle mesial canal (MMC) has been reported in the literature. It differs with the ethnic background of the population studies. It has been reported in the range of 1 to 15%. [Weinberg EM et al-13.725%,¹⁰ Navarro LF et al-14.81%,¹¹ Versiani MA-0.26% to 53.8%.¹²]

Role of aging in detecting MM Canal:

Peiris et al (2008) suggests that the incidence of MM canal is higher in the 30–40 year age group coinciding with the completion of root canal differentiation. One of the theory put forth by Peiris et al states that could be the changes in root canal configuration or maturation after the completion of root development or during the closure of the apical foramen. Besides there will be continuous deposition of secondary dentin occurring within the root canals leading to a more complicated root canal configuration and the possibility of developing a third root canal in the mesial root of the first and second molars.¹⁷ Pomeranz et al (1981) and Azim et al (2015) suggests that locating the MM Canal is progressively more difficult as age increases as their will be deposition of secondary dentin, leading to calcification and blockage of the MM canal.¹⁷

Steps to locate the MM canal:

Fabra-Campos suggested few steps to locate MMC which is as follows:

- **Step 1:** Ultrasonic tips or round bur can be used after access cavity preparation in the dentinal protuberance area which separates the entrance to the mesiobuccal and mesiolingual canals.
- **Step 2:** While suspecting MM canal in the intermediate depression in the groove connecting the mesiobuccal and mesiolingual canal an explorer can be used.
- **Step 3:** Presence of bleeding spots helps in identifying MM canal in teeth with vital pulp can be observed which may indicate MMC
- **Step 4:** Usually a #08 or 10 file is used in the third canal in an alternating 45 degree rotating motion to identify the canal. Then the canal entrance can be enlarged with sequential files.
- **Step 5:** Mostly the intermediate canal joins at the apical or middle third with either the MB or ML canal and ends in one foramen. Commonly these intermediate canals join with the mesiobuccal canal.¹⁵

Ways to detect MM canals:

Meticulous examination of radiographs preferably a straight and 20 degree angulated radiograph is very essential for identification of MMC. Primary importance should be given to access cavity preparation in locating all the canal orifices and the pulp chamber floor should be examined with an endodontic explorer or ultrasonic tips which can be used for troughing the grooves, Methylene blue dye of 1-2% can be used for staining the pulpal floor. On radiographic examination, lateral apical rarefaction on the root in cases of necrotic pulp, fast break, eccentric location of an endodontic file while working length determination or sinus tract that traces laterally away from the main canal are all signs for locating MM canals.¹⁶

Recent advances in management of MM Canal:

- 1) Use of dental operating microscope or loupes offers an excellent magnification and illumination of the operating field which improves the visualization of canal orifices.¹⁸

- 2) Digital radiography has many advantages compared to conventional radiography like comparatively radiation exposure is less, fast image acquisition without need of chemicals and advanced processing tools like magnification.¹⁹
- 3) In 1990, Computed tomography (CT) for endodontic applications was first reported by Tachibana and Matsumoto where CT uses a fan shaped beam and requires multiple exposure around an object to reveal internal structure of an object. However there is various limitations like inadequate image details and high cost.¹⁰
- 4) Cone beam computed tomography (CBCT) is used commonly where a cone shaped beam instead of the regular fan shaped one.^{20, 21} Advantage of CBCT is in imaging anatomic as well as pathologic dentofacial structures and has higher accuracy.²²
- 5) Ultrasonic tips – can be used to locate accessory canals where minimal dentin removal between MB and ML canals of mandibular molars is done to view root canal orifices.²³
- 6) C+ Files – can be used for easier location of canal orifices, better negotiation of calcifications and gives better tactile feel.
- 7) Control memory files – extremely flexible to adapt to canal anatomy to significantly reduce the risk of perforation of the canal. This also allows pre-bending similar to stainless steel files and is perfect for extremely curved root canals.

3. Conclusion

Middle Mesial canals are commonly encountered more frequently than expected. Prompt identification and management of MM canal are essential for enhancing success of root canal treatment.

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