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CASE REPORT

# Mandibular first molar root canal retreatment with the presence of a missed middle mesial root canal: a report of two cases


## ABSTRACT

***Aim:*** *The purpose of the present case report is to document the root canal retreatment of two mandibular first molars with a previously unnoticed MMC.*
***Summary:*** *Mandibular molars may present a third root canal in the mesial root, defined as middle mesial root canal. This challenging anatomical variation should not be disregarded by the clinicians in order to minimize the possibility of an endodontic failure. This paper reports two cases of non-surgical endodontic retreatment of the mandibular first molar in which this complexity of the root canal system was missed in the first treatment, which may help to explain the treatment failure resulting in a periapical diagnosis of asymptomatic and symptomatic apical periodontitis in the first and second case, respectively.*
***Key learning points***
*• The use of magnification, with the dental operating microscope, and of ultrasonic tips was of the utmost importance in locating this additional root canal orifice.*
*• Both cases were able to achieve a successful outcome only after a correct chemical-mechanical disinfection and three-dimensional obturation of all identifiable anatomy.*



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## Introduction

In order to achieve the best root canal treatment prognosis, the root canal system space should be properly scouted, debrided, disinfected and obturated so the occurrence, or continuity, of periapical periodontitis can be minimized (1, 2, 3, 4).
Due to its small prevalence and small diameter, root canals such as maxillary molars third mesiobuccal (MB3) (5) or mandibular molars middle mesial canal (MMC) (3the incidence of MMC was 18.6% (48 out of 258 molars), may go unnoticed, which may compromise the root canal treatment.
The presence of an MMC in the mandibular molars was first reported by Vertucci et al. (6) and Barker et al. (7), both in 1974. Pomeranz et al. (8), has classified the MMC into three categories. According to the author, the MMC may be presented as: "fin", when an instrument can pass freely between the mesiobuccal (MB) or mesiolingual (ML) canal and the MMC; "confluent", when the MMC starts as an independent pulp chamber orifice and joins apically with the MB or ML root canal; and "independent" when the MMC starts as a separate pulp chamber orifice and ends in an independent apical foramen. Moreover, and according to the same author, a broad single mesial canal in which three master cones could be cemented to the apex simultaneously can also be described as an independent MMC (8).
According to a clinical study from Weinberg et al. (4), an MMC prevalence of 13.7% may be expected, whereas the proportion of an ambiguous isthmus may reach the 52.9%, both assessed clinically and on cone-beam computed tomography (CBCT) imaging. However, and among the studies that have reported it, the MMC prevalence may range from 0.3% (9) to 46.2% (10) depending on the study criteria. Furthermore, Azim et al. (10) concluded that regardless of the reports of a higher prevalence of intercanal communications in mandibular molars mesial root (up to 83.0%), success in locating and accessing an MMC ranges from 1.0% to 25.0%, and failure to locate it may jeopardize the therapy.
The purpose of the present case report is to document, following the PRICE guidelines (11), the root canal retreatment of two mandibular first molars with a previously unnoticed MMC.

## Case report

*Case #1*
A 47-year-old female patient was referred to the Endodontics Postgraduation clinic at University of Lisbon School of Dentist-

**Figure 1.**
Pre-operative radiograph of tooth 46.

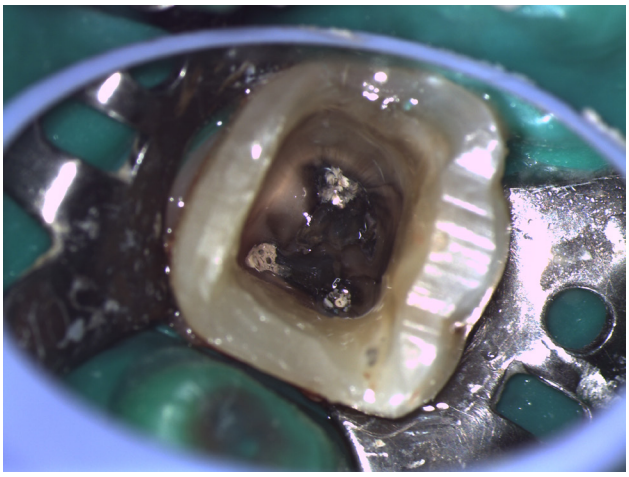

**Figure 2.**
After endodontic access, two mesial obturated root canals were identified.

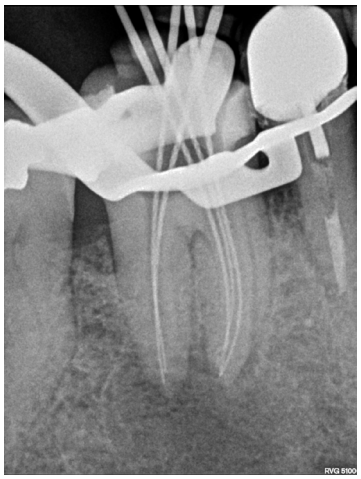

**Figure 3.**
Working length radiography after identifying the MMC.

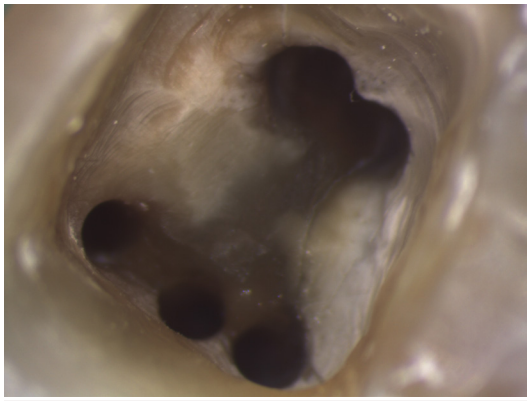

**Figure 4.**
Pulp chamber view of the root canals instrumented.

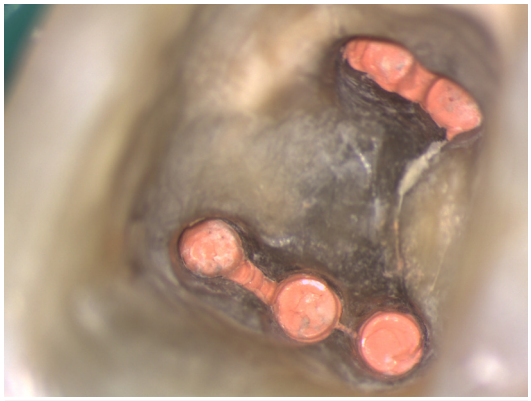

**Figure 5.**
Pulp chamber view of the root canals obturated.

**Figure 6.**
Final disto-angulated radiograph of tooth 46.

**Figure 7.**
12-month follow-up radiograph of tooth 46.

ry (FMDUL), in order to perform a non-surgical endodontic retreatment of tooth 46 (mandibular right first molar). Clinically a large restoration filling was present, and probing was within normal depths in all surfaces except distolingual, where a localized 7 mm pocket was observed. The tooth was asymptomatic and no pain to percussion was noted. Upon radiographic examination, a previous root canal treatment was observed, which was associated with a periapical lesion (Figure 1). According to the patient, the endodontic treatment had been performed a few years ago. A diagnosis of previous endodontic treatment and asymptomatic apical periodontitis was made. The root canal retreatment was suggested and accepted.

The treatment was performed under a Leica M320 dental operating microscope (M320, Leica Microsystems, Wetzlar, Germany), in multiple visits without using any intracanal medication in between visits. After proper anesthesia and rubber dam isolation, the access cavity was established (Figure 2) with round burs and improved with Start-X ultrasonic tips (Start-X, Dentsply Maillefer, Baillagues, Switzerland). The ultrasonics exploration of the isthmus connecting both mesiobuccal and mesiolingual canals, as previously documented (12), revealed an MMC. In addition two distal root canals were also observed. The root canals were negotiated with 0.10 and 0.15 stainless-steel K-files (Ready Steel, Dentsply Maillefer, Baillagues, Switzerland), and the working length determination was performed with a Root ZX electronic apex locator (Root ZX, Morita, Komuro, Japan) and confirmed radiographically (Figure 3). All root canals were shaped with R25 and R40 Reciproc files (Reciproc, VDW, Munich, Germany) according to the manufacturer's instructions (Figure 4). Copious irrigation with 5.25% sodium hypochlorite (Denta Flux, J. Ripoll SL, Murcia, Spain) using a 5 ml syringe and a 27G notched needle (CanalPro Slotted-End Tips, Coltene, Lezzenes, France) was performed throughout all the root canal treatment. In the last appointment, the root canals were dried with Zipperer paper points (Zipperer, VDW, Munich, Germany) and filled with gutta-percha and epoxy resin based sealer (AH Plus, Dentsply DeTrey, Konstanz, Germany) with a continuous wave of obturation technique (B&L, Biotech, Seoul, Republic of Korea) (Figures 5 and 6). The canals were sealed with a flowable composite resin (Supraflow, R&S CFPM, Tremblay-en-France France) and the crown was subsequently restored with a direct composite resin. At 12 months follow-up, the patient was completely asymptomatic and periapical radiography showed resolution of the periapical lesion (Figure 7).

*Case #2*

A 37-year-old female was observed in an endodontic appointment reporting permanent pain on tooth 36 (mandibular left first molar). Clinically it was possible to observe a large crown filling with no visible sec-

**Figure 8.**
Pre-operative radiograph of tooth 36.

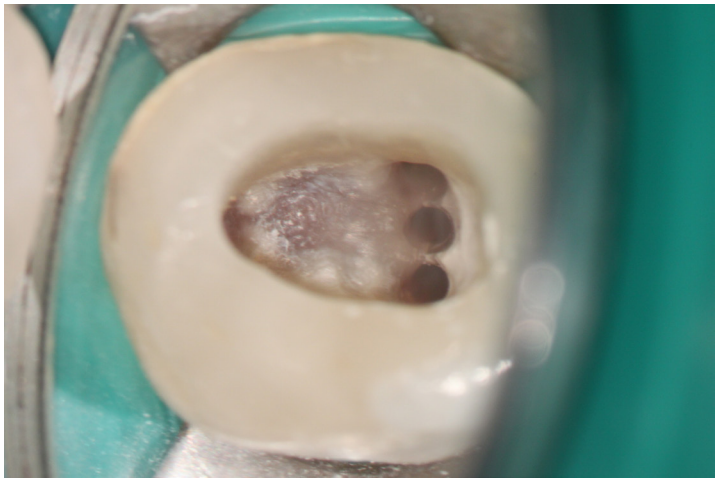

**Figure 9.**
Pulp chamber view of the root canals instrumented.

ondary decay or fractures. The mobility and periodontal probing were within normal limits and the tooth was tender to percussion. Tooth 35 presented normal response to the cold sensitivity test (Endo cold spray, Henry Schein, Langen, Germany). The radiographic examination revealed a previous root canal treatment with an associated periapical lesion (Figure 8). A diagnosis of previous endodontic treatment and symptomatic apical periodontitis was made. The root canal retreatment was proposed and accepted by the patient.

The treatment was performed in two appointments. The tooth was anaesthetized with a buccal infiltration using 4% articaine with 1:200.000 epinephrine (Artinibsa, Inibsa, Barcelona, Spain), and a proper rubber dam isolation was achieved. After initial occlusal reduction, the proper access cavity was achieved using a round diamond and endo-z high speed burs. The main root canals (mesiobuccal, mesiolingual and distal) were identified and the previous gutta-percha filling removed with the help of chloroform solvent. The root canals were negotiated with 0.10 stainless steel K-files (Ready Steel, Dentsply Maillefer, Baillagues, Switzerland), and

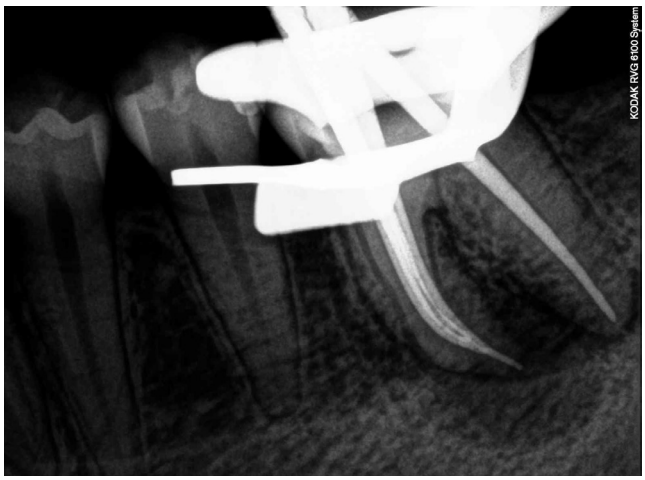

**Figure 10.**
Master cone fit radiograph of tooth 36.

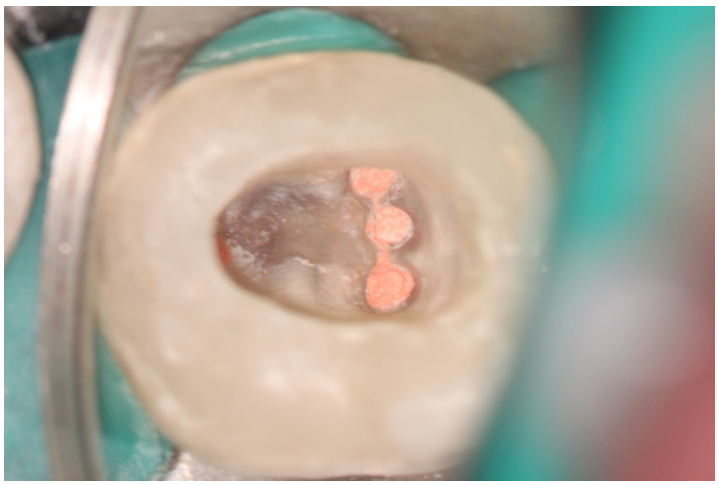

**Figure 11.**
Pulp chamber view of the root canals obturated.


**Figure 12.**
Final mesial-angulated radiograph of tooth 36.

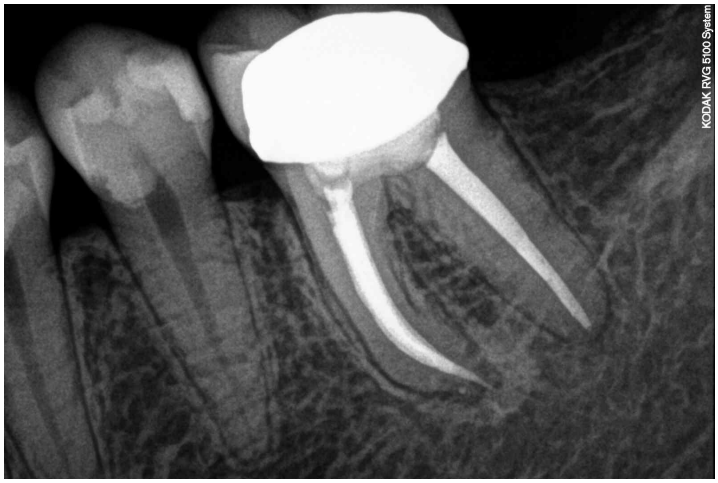


**Figure 13.**
32-month follow-up radiograph of tooth 36.

the working length determined by both radiograph and electronic apex locator (Root ZX, Morita, Komuro Japan). The identified root canals were shaped using the ProTaper Universal NiTi rotary system (ProTaper Universal, Dentsply Maillefer, Baillagues, Switzerland), according the recommendations of the manufacturer, up to F2 file in the mesial canals and F3 in the distal. Under the magnification of a dental operating microscope (Opmi Pico, Carl Zeiss, Jena, Germany) a groove in between mesial canals was explored using #2 ProUltra ultrasonic tip (ProUltra, Dentspy Maillefer, Baillagues, Switzerland), as recommended (12), and an MMC identified (Figure 9). This canal was shaped as previously mentioned for the others up to an F2 instrument. A continuous irrigation of 5.25% sodium hypochlorite was performed during the procedure. The root canals were dried and a calcium hydroxide paste (Ultracal, Ultradent, South Jordan, USA) was used as medication in between appointments. In the second visit the tooth was asymptomatic. A final irrigation protocol was performed with 17% EDTA and 5.25% sodium hypochlorite. The root canals were dried with paper points (ProTaper Universal, Dentsply Maillefer, Baillagues, Switzerland) and the final root canal filling was performed with gutta-percha and an epoxy resin based sealer (AH Plus, Dentsply DeTrey, Konstanz, Germany) using the continuous wave of obturation technique accomplished with a System B unit (System B, Sybron Endo, West Collins, USA) and with an Obtura II unit (Obtura II, Obtura Spartan, Chicago, USA) (Figures 10, 11 and 12). The crown was provisionally restored with Cavit (Cavit W, 3M ESPE, Seefeld, Germany). The tooth was sent to proper crown rehabilitation in the Oral Rehabilitation appointment. A radiographic 32 months follow up showed periapical healing and the patient remained asymptomatic (Figure 13).

## Discussion

Although several factors have already been shown to be associated with higher prevalence of periapical lesion (13, 14), missed anatomy is one of the main causes for root canal treatment failure 15). Cantatore et al. (1) stated that missed canals resulted in high percentage of apical periodontitis and failed endodontically treated teeth. Moreover, the prevalence of post treatment disease was more commonly found in multirooted molars where the chance of missing an extra canal was higher (1, 16). Traditionally, mandibular molars are described as presenting two roots with two root canals on the mesial root and one or two canals in the distal one (17). However, the mesial root internal anatomy can be highly variable and complex. Anatom-

ic features such as branching, accessory or dividing and rejoining main root canals, isthmuses and fins, at different levels, can be found on this particular root. Therefore locating an existing MMC, in order to decrease the microbial load in it, is of the outmost importance when aiming to maximize the root canal treatment success (2, 3, 18, 19). Regarding retreatment cases of mandibular molars a pooled success rate of 85.0% has been reported by Ng et al. (20), who also stated that the presence of pre-operative periapical lesion, apical extension of root canal filling and quality of coronal restoration, were significant prognostic factors that would, in fact, compromise the retreatment outcomes (20).

Methods of studying the tooth internal anatomy include the clearing technique (6, 8), plastic resin injection (21), histology (22), radiography (10, 17, 23), scanning electron microscopy (23), CBCT imaging (15, 22, 24), micro-computed tomographic (micro-CT) (16, 23, 25), micro-computed tomographic (micro-CT) imaging (2, 3, 26) or simply clinical findings (10, 17, 27). Each one of them presenting their own MMC proportions. When using magnification, such as loupes or microscope, the MMC percentages vary from 12.0% (8) to 46.2% (10). The results from populations assessment by using CBCT range from 0.3% in Korea (n=1952) (9) to 27.0% in Brazil (n=44) (28), although the sample size used in the latter was quite low. A large sample size screening on a Portuguese subpopulation confirms the lower MMC prevalence of 5.5% (n=450) (25). Regarding the micro-CT investigations, Versiani et al. (3) reported an MMC proportion of 18.6% (48 out of 258 mandibular first molars). A condition which was significantly higher in the Brazilians (22.1%) when compared to Turkish (14.8%) samples. Keles & Keskin (2), in a Turkey study, found 32 MMC in 106 mandibular first molars (30.2%) with 8 cases showing two MMC simultaneously. Such differences between methodologies might have origin on different sensitivity of the methods, the nature of the sample or different concepts of morphology (3, 10, 17).

Clinically, adequate coronal access and the use of the dental operating microscope are both crucial to overcome this challenge (28). Azim et al. (10) suggested troughing in the mesial root pulp chamber floor level, by 2-mm depth using a 1-mm-diameter round Munce bur head as a depth guide under a dental operating microscope visualization. However, this may result in iatrogenic mishaps while attempting to locate extra root canal orifices. The use of ultrasonic tips to clean the cervical isthmus, as performed on both presented cases, enables the identification of the majority of MMC (28), allows a more precise troughing and avoids iatrogenic procedural errors such as perforations or unnecessary weakening of the dentinal walls (3). On the other hand, and according to Keles & Keskin (19), 77.4% of the MMC orifices were located at the cemento-enamel junction level between the mesiobuccal and mesiolingual canal orifices, which means that troughing is not always mandatory in order to locate these extra canals.

The instrumentation of MMC with endodontic files is able to provide access and space for irrigating solutions into, otherwise inaccessible, isthmuses, reducing the bacterial load which can be suspected to be present in the initial radiographs of both presented cases (Figure 1 and 8) which presented apical radiolucencies. Choosing the right instrument to clean and shape the root canal space is as important as any other step, and in the present case report both reciprocation and rotary systems were use. It is known that the presence of the tissue remnants may affect the quality of canal filling and became a substrate for bacterial growth in unprepared areas (29), therefore several studies have been made comparing reciprocation and rotary instruments in regards to volume changes, increased surface area, and also the remaining unprepared areas (29). A recent systematic review on micro-CT studies concluded that both kinematics leave unprepared areas and produce changes in volume and surface area, and while reciprocating systems had higher volume and surface areas, the rotary ones left less unprepared surface areas (29). Having this into consideration both kinematics are apparently valid.

In the first case, the MMC was independent

at the orifice of the pulp chamber floor and confluent to the mesiobuccal canal at its apical third, such as presented by Weinberg et al. (4) in 85.7% of their assessed sample. As for the second case, all the three canals started independently and joined in a single one at the apical third, which in the available literature was also documented by Azim et al. (10) and Akbarzadeh et al. (18) in 78.3% and 76.0% of their cases, respectively. The finding by Versiani et al. (3) that in the case of specimens with independent root canal orifices, MMC opening was found at the same mean distance between the mesiobucal and mesiolingual orifices, can be applied in our cases too.

## Conclusions

Complex morphologies such as MMC may interfere with treatment prognosis. Nonetheless, as long as an effective chemo-mechanical disinfection and a three-dimensional obturation are achieved, the endodontic treatment outcome may turn out predictable and favorable.
This case reports highlights the importance of magnification and illumination when less common anatomic configurations are encountered. The clinician needs to be aware of the existence of this anatomy in order to achieve the best possible outcome.

## Clinical Relevance

Mandibular molars may present a third root canal in the mesial root, defined as middle mesial root canal. The use of magnification, with the dental operating microscope, and of ultrasonic tips was of the utmost importance in locating this additional root canal orifice.

## Conflict of Interest

None.

## Acknowledgements

None.

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