Endodontic treatment of second mandibular molar with presence of middle mesial canal: case report

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ABSTRACT

Introduction: Identification of possible anatomical variations is crucial for the correct diagnosis and planning of endodontic therapy. **Objective:** To report the endodontic treatment of tooth #37, in which a third canal was located in the mesial root (middle mesial canal - MMC). **Methods:** Tooth #37 was diagnosed with symptomatic irreversible pulpitis and referred for endodontic treatment. Coronary cracks were found during coronal access using a dental operating microscope (DOM). A cone-beam computed tomography (CBCT) was requested. CBCT revealed cracks involving the pulp chamber floor and a third root canal in the mesial root, between the mesiobuccal and the mesiolingual canals. Endodontic treatment was performed with the WaveOne GOLD reciprocating system. The chemical-mechanical preparation was performed with 5.25% sodium hypochlorite and 17% EDTA to remove the smear layer, followed by another irrigation with sodium hypochlorite. The canals were dried with absorbent paper points. The root canal obturation was performed with the continuous wave of condensation technique. **Results:** The root canals of tooth #37 were correctly instrumented and obturated. The patient did not present with any postoperative symptoms, and was referred for final prosthetic rehabilitation. **Conclusion:** CBCT and DOM were paramount for the correct planning of the case, as regards the presence of cracks and the detection of the middle mesial canal.

Keywords: Anatomy. Endodontics. Microscopy. Molar. Cone-Beam Computed Tomography.

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Introduction

Endodontic treatment aims to eradicate microorganisms from the root canal system. Knowledge of internal dental anatomy is crucial for effective chemical-mechanical preparation.[1] The complexities of the internal anatomy of mesial roots of lower molars have been extensively researched and reported in some studies.[2,3] Usually, in mandibular molars, the mesial root has mesiobuccal and mesiolingual canals interconnected by an isthmus. Few studies have reported the presence of a third independent canal, called the middle mesial canal (MMC), or the central mesial or just mesial accessory.[4-9]

Despite reports of the high prevalence of communication between the canals in the mesial mandibular root,[10,11] reporting on the access and location of the MMC has been scarce, ranging from 1% to 25% of all the reports available in the literature.[6,7,12] The methods used to study and detect the MMC have included plastic models,[13] diaphanization,[14] scanning electron microscopy,[15] images from computed microtomography (micro-CT),[16] magnification using dental loupes, operating microscope,[17] and cone-beam computed tomography[18] (CBCT). Among these methods, CBCT and micro-CT allow the internal anatomy of the root canal system to be evaluated non-destructively for sample analysis purposes. Comparatively, micro-CT provides a better evaluation due to its high image resolution.[4] However, only visual magnification, dental operating microscope (DOM), and CBCT are available for clinical use.

CBCT allows complete visualization of the roots and anatomy of the root canal system by enabling a three-dimensional view of the tooth.[19] Despite its limitations, such as high cost, radiation dose, and technical knowledge required to interpret the exam, CBCT is becoming increasingly more common in dental practice, and is recommended as an auxiliary means for identifying and locating canals and isthmuses.[20] The purpose of this case report was to demonstrate the importance of CBCT and DOM as auxiliary diagnostic tools for identifying cracks, locating the middle mesial canal, and planning endodontic therapy.

Case Report

A female patient, leucoderma, 42 years old, was referred to receive dental treatment, owing to spontaneous pain, sensitivity to thermal agents, and pain when chewing with tooth #37 (left lower second molar). Clinical examination revealed extensive coronary restoration, absence of fistula, and loss of insertion. Radiographic examination was performed with EzSensor digital sensor (Vatech, Hwaseong, South Korea) (Fig 1), and no periapical bone rarefaction was observed. Pulp sensitivity tests were positive and intense, and revealed long-lasting sensitivity to cold and heat, confirming the diagnosis of symptomatic irreversible pulpitis. Endodontic access was achieved with high-speed drill #1558 (KavoBurs, Joinville, Brazil), and a distal mesial crack was observed in the pulp chamber roof after removal of the restoration (Fig 2). Following coronal access, the mesiobuccal, mesiolingual, and distal canals were located. The cracks were examined using DOM (DF Vasconcellos, Rio de Janeiro, Brazil), and apparently did not involve the pulp chamber floor or the branching region of the root (Fig 3). A CBCT was requested to allow better evaluation of the cracks. Camphorated paramonochlorophenol (Biodinâmica Química e Farmacêutica, Ibiporã, PR, Brazil) was used as an intracanal dressing, and coronary sealing was performed with IRM (Intermediate Restorative Material; Dentsply Tulsa Dental, Tulsa, USA). The patient was referred for a

Figure 1. Preoperative radiograph.

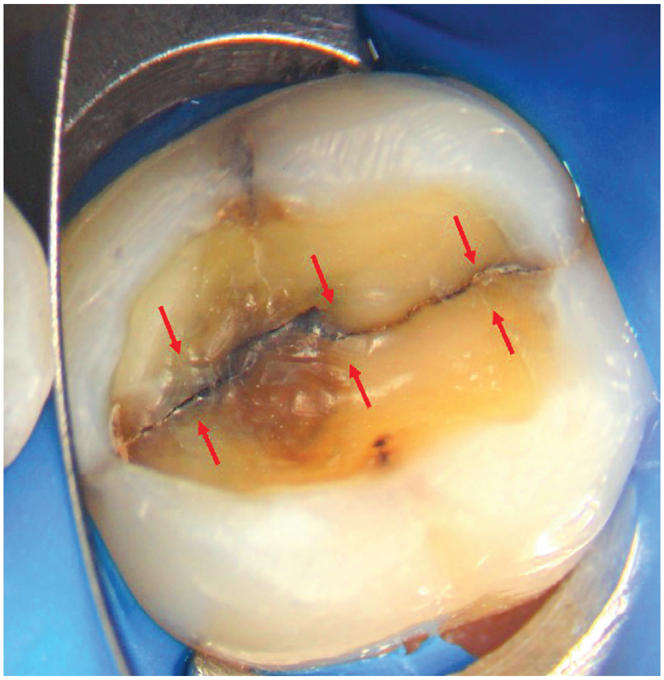

Figure 2. Visualization of crack in the pulp chamber roof region using DOM.

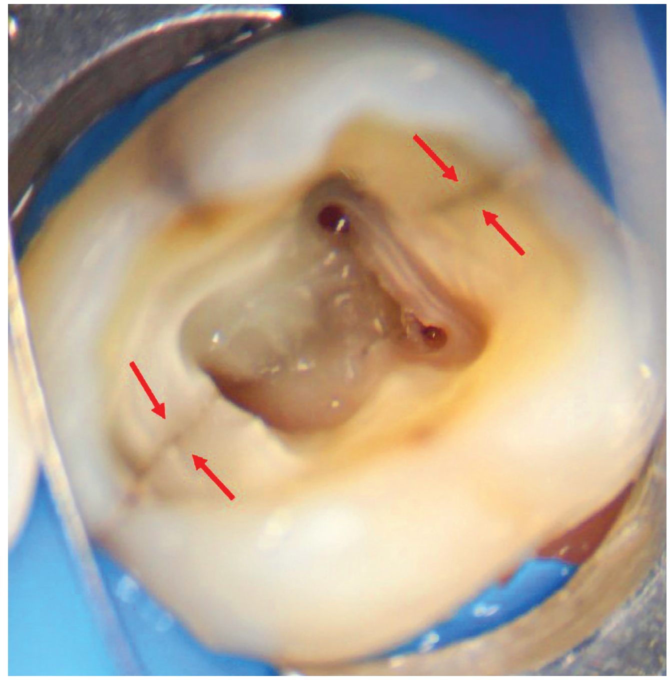

Figure 3. Visualization of cracks and the pulp chamber floor.

CBCT scan. The tomographic exam was obtained using the PreXion 3D™ device (Teracom, San Mateo, USA), with exposure factors of 90kV, 10mA, 33.5 seconds of exposure, scanning with 5.6 cm x 5.6 cm field of view (FOV) and 0.09 mm isotropic voxel. The images showed a longitudinal hypodense coronary line in the distal mesial direction suggestive of a crack, without the involvement of the bifurcation region of the roots (Fig 4). Another canal was also identified between the mesiobuccal and mesiolingual canals, both in tooth #36 and #37 (Fig 5).

Careful evaluation with CBCT enabled sound endodontic preplanning to manage the case better. The initial exploration was performed with a special series of K-files (06, 08, 10 - Dentsply Maillefer, Ballaigues, Switzerland) and irrigation with 5.25% sodium hypochlorite (Lenzafarm, Belo Horizonte, Brazil). The MMC was identified and then explored with a #06 K-type file, using CBCT and DOM (Fig 6).

The MMC was explored, after which the working length was obtained by the electronic device, Root ZX II locator (J Morita, Tokyo, Japan). The canals were enlarged with hand files, the glidepath was obtained first with the Proglider™ rotary file (Dentsply Maillefer, Ballaigues, Switzerland), and then by the WaveOne GOLD reciprocating system (small size, 21.07) (Dentsply Maillefer, Ballaigues, Switzerland), always using copious irrigation with 5.25% sodium hypochlorite. The chemical-mechanical instrumentation of the root canals was followed by irrigation for 3 minutes with 17% EDTA (Lenzafarm, Belo Horizonte, Brazil), and then irrigation with sodium hypochlorite. The root canals were dried with standard small WaveOne GOLD absorbent paper points (Dentsply Maillefer, Ballaigues, Switzerland).

The root canal was filled with FM gutta-percha cones (Odous de Deus, Belo Horizonte, Brazil), along with Kerr Pulp Canal Sealer EWT™ cement (Sybron Dental Specialties, Orange, USA), using the continuous-wave condensation technique[21] and System B electric heat plugger (Analytic Endodontics, Orange, CA). The heat plugger (size FM heated) was used 4 to 5 mm short of the working length. After the plugger was removed, the heated gutta-percha inside the root was compacted (down packing) with previously selected hand-held pluggers. The middle and cervical portions of the canals were filled with gutta-percha heated with the Obtura II system (Obtura Spartan, Fenton, MO). Lastly, the distal root was prepared to place an intraradicular post (Fig. 7). Coronary sealing was performed with IRM, and a final radiograph was taken (Fig 8).

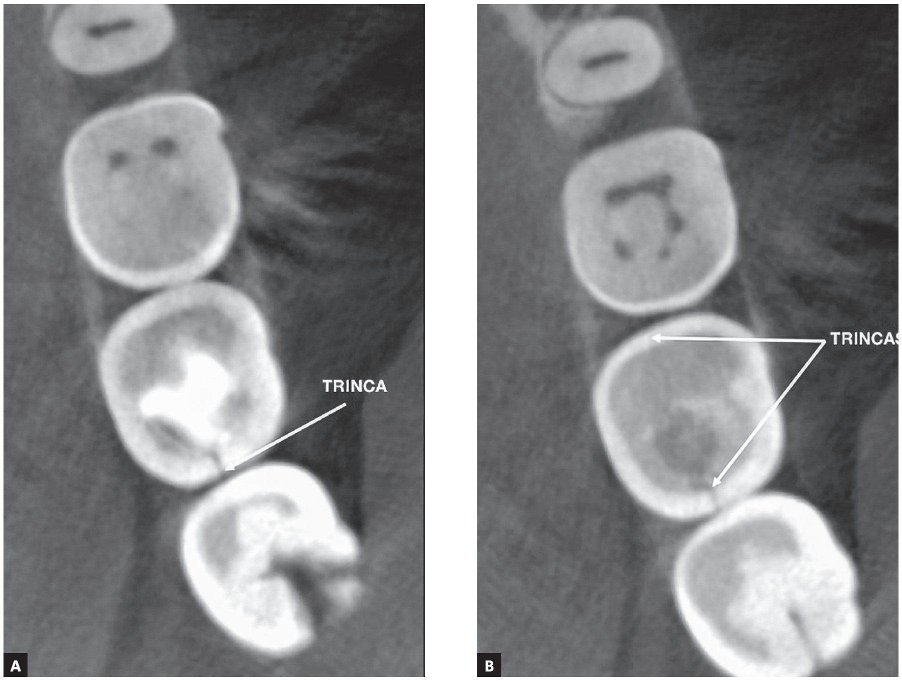

Figure 4. Axial sections showing a hypodense line, suggestive of crack without root involvement **(A** and **B)**.

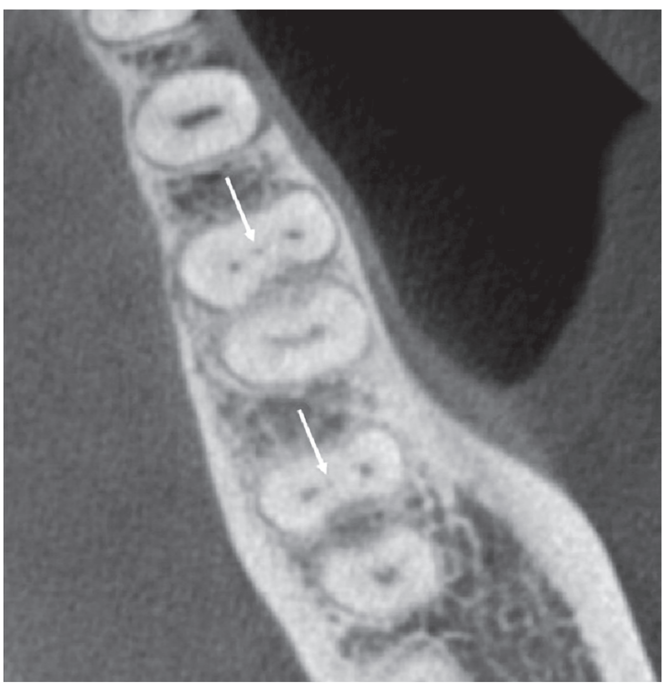

Figure 5. Axial section showing the presence of MMC in teeth #36 and #3.

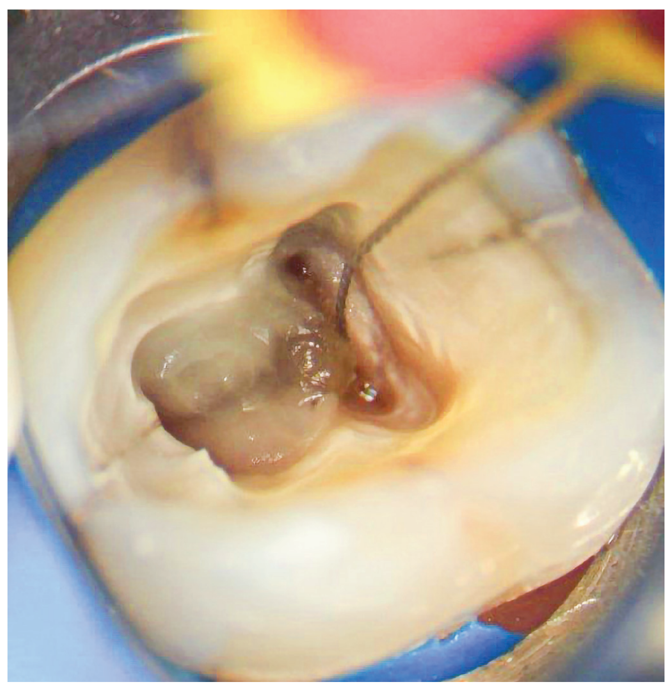

Figure 6. MMC located with #06 K file.

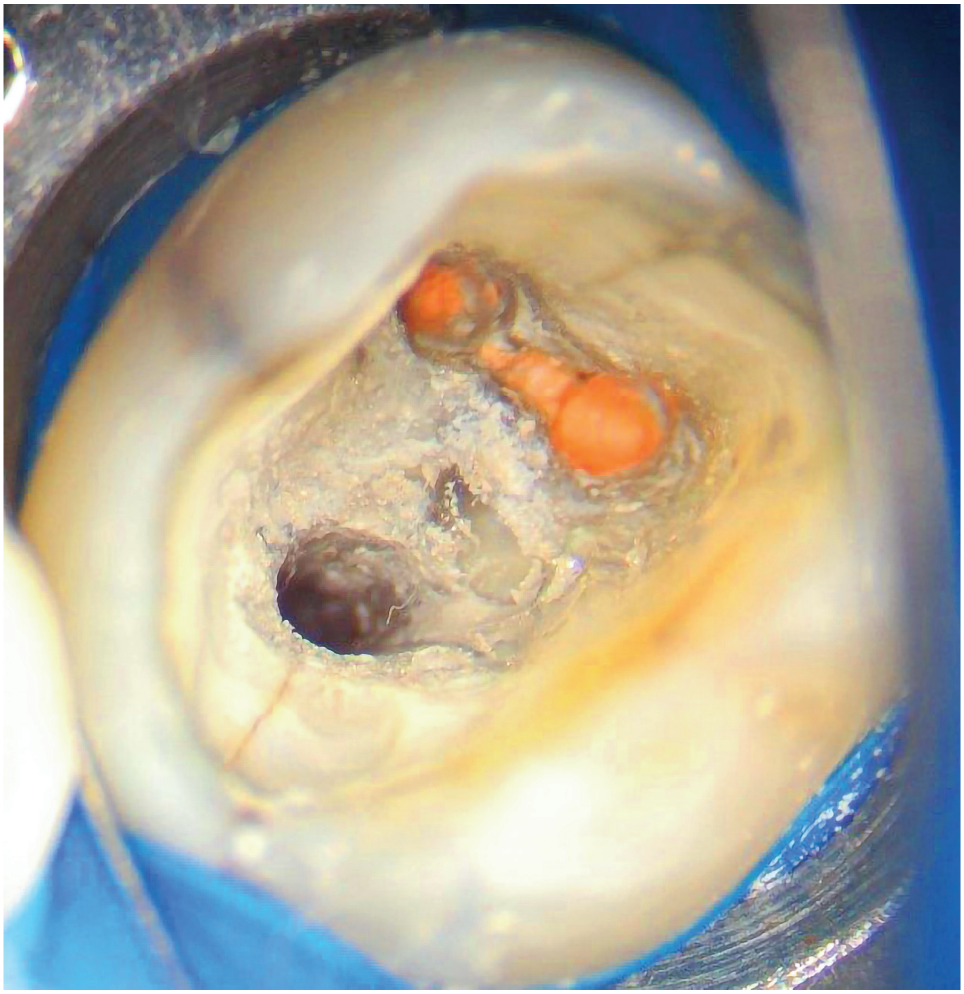

Figure 7. Root canal filling and post space prepared in the distal root.

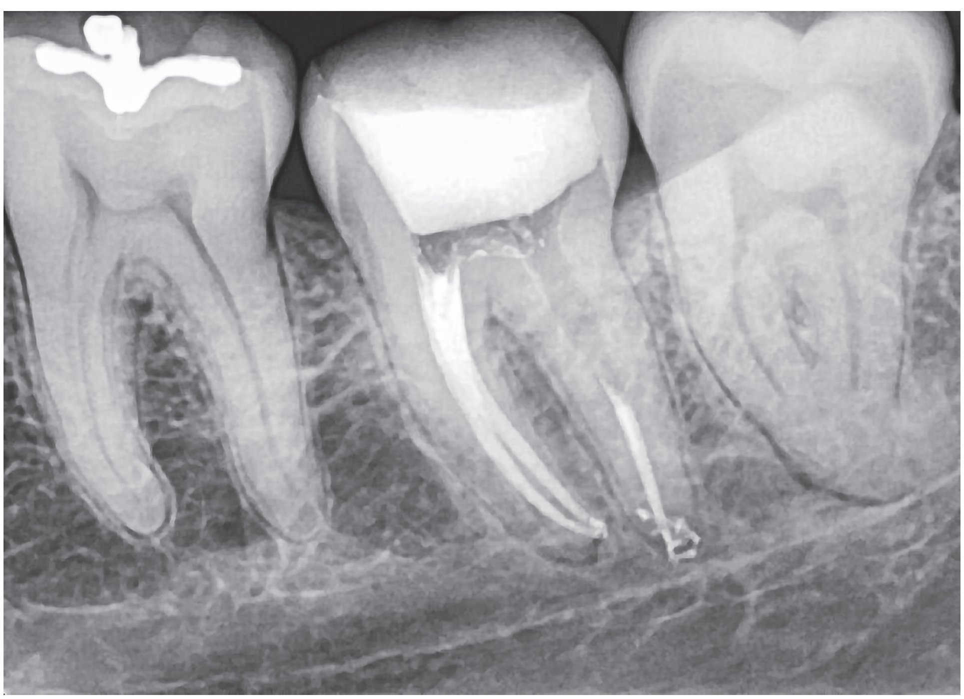

Figure 8. Final radiograph after root canal filling and post space preparation in the distal root.

Discussion

The literature reports on several methods used in advanced studies to expose the complexities of the root canal system anatomy, and underscores that careful clinical examination is required during and after coronal access.[12] The association of auxiliary methods, such as high-quality periapical radiographs taken at different angles, CBCT, ultrasonic inserts and DOM, are of vital importance for resolving cases of teeth with complex anatomy[22]. De Toubes et al. (2012)[6] evaluated four diagnostic methods (DOM, CBCT, digital radiographs at different angles, and clinical examination) to identify the MMC in the lower first molars. There was a statistical difference among the diagnostic methods used. The operating microscope alone was able to identify all the middle mesial canals that could be instrumented. CBCT was the second most effective method. This case report confirmed the importance of DOM and CBCT in locating and exploring the MMC.

Many studies have investigated molar morphology, but the prevalence of MMC in the mesial root of mandibular molars remains a controversial issue. The literature does not detail the difference between a true MMC and an isthmus between the mesiobuccal and mesiolingual canals. Tahmasbi et al. (2017)[23] carried out a study to identify the prevalence of a clearly distinguished MMC and an isthmus in the mesial root of the mandibular molars, using CBCT images with a smaller field of view (FOV), to analyze the configurations of the MMC and the isthmus.

Of the 122 teeth examined, a total of 20 (16.4%) had a true MMC. The prevalence of MMC was 26% in lower first molars and 8% in second molars. The frequency of the isthmus in the mesial root was 69.6%, and was more common in the second molars, with no statistical difference. The study showed a high prevalence of mandibular molars with MMC or isthmus; this led us to conclude that the location and chemical-mechanical preparation of these areas must be performed carefully.

Digitization and image reconstruction factors, including FOV, voxel size, number of acquisitions used for reconstruction and image artifacts, have a significant influence on image quality in CBCT. This variation can make it challenging to interpret the exam. The tomographic device used in this case report had a lower FOV, an essential factor to consider when a high resolution is required, especially in endodontics, unlike other dental specialties that cover areas of greater volume for analysis[24]. De Freitas et al. (2017)[25] evaluated the effectiveness of different computed tomography scanners in identifying mesiobuccal canals in upper molars. They subjected 35 extracted maxillary first molars to 4 image acquisition protocols: i-CAT Classic (ICC group; 120 kV, 3-8 mA, 0.25 mm isotropic voxel, 6 cm x 13 cm FOV and 40 seconds acquisition time), i-CAT Next Generation (ICN group; 120 kV, 3-8 mA, 0.125 mm isotropic voxel, 8 cm x 8 cm FOV and 26.9 seconds acquisition time), PreXion 3D (PX1 group; 90 kV, 4 mA, 0.09 mm isotropic voxel, 5.6 cm x 5.6 cm FOV and 16.8 seconds of acquisition time) and PreXion 3D (PX2 group; 90 kV, 4 mA, 0.09 mm of isotropic voxel, 5.6 cm x 5.6 cm FOV and 33.5 seconds of acquisition time). Two calibrated endodontists evaluated the images. Micro-CT images of the teeth were used as a control group. Anatomical variations of vestibular mesial roots were identified correctly in 54.3% (n = 19) of the ICC group, 65.7% (n = 23) of the ICN group, and 80.0% (n = 28) of the PX1 and PX2 groups. The PX1 and PX2 groups proved more effective in diagnosing the mesial vestibular canals, in that PX1 was more appropriate, since it resulted in a shorter radiation time and had diagnostic imaging similar to PX2. Single-channel anatomy was the most prevalent in the study.

The CBCT is a reliable resource for locating the root canals; however, depending on the spatial resolution and thickness of the cuts, the identification of anatomical variations may be difficult. On the other hand, micro-CT provides a better evaluation of anatomical structures, because it uses a longer exposure time and smaller voxel sizes than CBCT in digitizing images. Versiani et al. (2016)[4] evaluated the morphological aspects of MMCs in lower first molars collected from Brazilian and Turkish populations (n = 48). The incidence of MMC was 18.6% (48 out of 258 molars) and was significantly higher in the Brazilian population (n = 30, 22.1%) than in the Turkish population (n = 18, 14.8%).

The MMC occurs predominantly in lower first molars.[9,14,16] However, a study evaluated the prevalence of MMC after performing standardized conservative access to the entrance of the mesiobuccal and mesiolingual canals in 91 lower molars of 87 patients. Standardized access and location of the canals were performed with DOM. MMC was located in 42 of the 91 lower molars (46.2%) – 21 first molars and 21 second molars. Six MMC canals were located by conventional access (6.6%), and the other 36, by standardized access (39.6%). There was a greater tendency to locate the MMC in second molars (60%) compared with first molars (37.5%).[27]

In the present case report, a lower second molar (tooth #37) needed endodontic treatment, which revealed a third canal in the mesial root, detected with the supplementary use of CBCT and DOM. Additionally, the examination showed the presence of MMC in tooth #36.

Conclusion

Knowledge of internal anatomy and its variations is essential for better prognosis of endodontic therapy. Anatomical variations in lower molars, such as the presence of the middle mesial canal, should always be investigated. In this case report, cone-beam computed tomography and the dental operating microscope were crucial for the correct planning of the case, as regards the presence of cracks and the detection of the middle mesial canal.

References

1. Hull TE, Robertson PB, Steiner JC, Del Aguila MA. Patterns of endodontic care for a Washington state population. J Endod. 2003;29(9):553-6.
2. Villas-Bôas MH, Bernardineli N, Cavenago BC, Marciano M, Del Carpio-Perochena A, de Moraes IG, et al. Micro-computed tomography study of the internal anatomy of mesial root canals of mandibular molars. J Endod. 2011;37(12):1682-6.
3. Wolf TG, Paqué F, Zeller M, Willershausen B, Briseño-Marroquín B. Root canal morphology and configuration of 118 mandibular first molars by means of micro-computed tomography: an ex vivo Study. J Endod. 2016;42(4): 610-4.
4. Versiani MA, Ordinola-Zapata R, Keles A, Alcin H, Bramante CM, Pécora JD, et al. Middle mesial canals in mandibular first molars: a micro-CT study in different populations. Arch Oral Biol. 2016;61:130-7.
5. De Pablo ÓV, Estevez R, Sánchez MP, Heilborn C, Cohenca N. Root anatomy and canal configuration of the permanent mandibular first molar: a systematic review. J Endod. 2010;36(12):1919-31.
6. De Toubes KM, Cortes MI, Valadares MA, Fonseca LC, Nunes E, Silveira FF. Comparative analysis of accessory mesial canal identification in mandibular first molars by using four different diagnostic methods. J Endod. 2012;38(4):436-41.
7. Karapinar-Kazandag M, Basrani BR, Friedman S. The operating microscope enhances detection and negotiation of accessory mesial canals in mandibular molars. J Endod. 2010;36(8):1289-94.
8. Pomeranz HH, Eidelman DL, Goldberg MG. Treatment considerations of the middle mesial canal of mandibular first and second molars. J Endod. 1981;7(12):565-8.
9. Carvalho MC, Zuolo ML. Orifice locating with a microscope. J Endod. 2000; 26(9):532-4.
10. Teixeira FB, Sano CL, Gomes BP, Zaia AA, Ferraz CC, Souza-Filho FJ. A preliminary in vitro study of the incidence and position of the root canal isthmus in maxillary and mandibular first molars. Int Endod J. 2003;36(4):276-80.
11. Von Arx T. Frequency and type of canal isthmuses in first molars detected by endoscopic inspection during periradicular surgery. Int Endod J. 2005;38(3):160-8.
12. Baugh D, Wallace J. Middle mesial canal of the mandibular first molar: a case report and literature review. J Endod. 2004;30(3):185-6.
13. Skidmore AE, Bjorndal AM. Root canal morphology of the human mandibular first molar. Oral Surg Oral Med Oral Pathol. 1971;32(5):778-84.
14. Gulabivala K, Aung TH, Alavi A, Ng YL. Root and canal morphology of Burmese mandibular molars. Int Endod J. 2001;34(5):359-70.
15. Navarro LF, Luzi A, Garcia AA, Garcia AH. Third canal in the mesial root of permanent mandibular first molars: review of the literature and presentation of 3 clinical reports and 2 in vitro studies. Med Oral Patol Oral Cir Bucal. 2007;12(8):E605-9.
16. Harris SP, Bowles WR, Fok A, McClanahan SB. An anatomic investigation of the mandibular first molar using micro-computed tomography. J Endod. 2013;39(11): 1374-8.
17. Karapinar-Kazandag M, Basrani BR, Friedman S. The operating microscope enhances detection and negotiation of accessory mesial canals in mandibular molars. J Endod. 2010;36(8):1289-94.
18. La SH, Jung DH, Kim EC, Min KS. Identification of independent middle mesial canal in mandibular first molar using cone-beam computed tomography imaging. J Endod. 2010; 36(3):542-5.
19. Reeh ES. Seven canals in a lower first molar. J Endod. 1998;24(7):497-9.
20. Blattner TC, George N, Lee CC, Kumar V, Yelton CD. Efficacy of cone-beam computed tomography as a modality to accurately identify the presence of second mesiobuccal canals in maxillary first and second molars: a pilot study. J Endod. 2010; 36(5):867-70.
21. Buchanan LS. The continuous wave condensation technique: a convergence conceptual and procedural advances in obturation. Dent Today. 199413(10):80, 82, 84-5.
22. Patel S, Dawood A, Ford TP, Whaites E. The potential applications of cone beam computed tomography in the management of endodontic problems. Int Endod J. 2007;40(10): 818-30.
23. Tahmasbi M, Jalali P, Nair MK, Barghan S, Nair UP. Prevalence of middle mesial canals and isthmi in the mesial root of mandibular molars: an in vivo cone-beam computed tomographic study. J Endod. 2017;43(7):1080-3.
24. Costa FF, Gaia BF, Umetsubo OS, Pinheiro LR, Tortamano IP, Cavalcanti MGP. Use of large-volume cone-beam computed tomography in identification and localization of horizontal root fracture in the presence and absence of intracanal metallic post. J Endod. 2015;38(6), 856-9.
25. Freitas JV, Baratto-Filho F, Coelho BS, Tomazinho FSF, Crozeta BM, Sousa Neto MD, et al. Efficacy of different cone-beam computed tomographic protocols in the identification of mesiobuccal canals of maxillary first molars: a tomographic and ex vivo study. J Endod. 2017;43(5):810-5.
26. Nosrat A, Deschenes RJ, Tordik PA, Hicks ML, Fouad AF. Middle mesial canals in mandibular molars: Incidence and related factors. J Endod. 2015;41:28-32.
27. Azim AA, Deutsch AS, Solomon CS. Prevalence of middle mesial canals in mandibular molars after guided troughing under high magnification: an in vivo investigation. J Endod. 2015;41:164-8.