ABSTRACT

Background: Root canal anatomy is a complex entity. The main objective of root canal treatment is to get rid of the infection and have a good apical and coronal seal with an appropriate filling. Inability to achieve thorough cleaning and shaping followed by three-dimensional obturation of the root canal system usually causes root canal treatment failure. For this reason, clinicians should be aware of these anatomical variations to achieve successful treatment.

Aim: The aim of this article is to report on the successful treatment and follow-up of mandibular first molar with additional middle mesial (MM) and middle distal (MD) canals.

Case report: A 29-year-old white male patient reported with a complaint of pain in relation with tooth #19. On clinical examination, diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis and condensing osteitis was made and nonsurgical root canal treatment was planned. Initially, two mesial and two distal canals were located, and the patient was planned for the obturation in the second visit. The complaint of mild persistent symptoms gave a possibility of additional canals. Under the dental operating microscope and selective troughing on the floor of the pulp chamber with ultrasonic tips, additional canals were located as MM and MD canals.

Conclusion: Leaving some area of the root canal system untreated is found to be one of the main reasons for root canal treatment failure. Dentists should take advantage of new tools, such as dental operating microscope and ultrasonic tips to be able to locate and treat the hidden and unusual anatomy.

Clinical significance: Mandibular first molar with six canals is very rare to encounter. Clinician should have a thorough knowledge of these unusual anatomy to avoid treatment failure due to incomplete disinfection of the root canal system.

Keywords: Additional canals, Mandibular first molar, Middle distal, Middle mesial, Root canal morphology.

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BACKGROUND

The main objective of root canal treatment is thorough shaping and cleaning of the entire pulp space and its complete obturation with an inert filling material.1 The main reason for the failure of root canal treatment is the inadequate removal of pulp tissue and microorganisms from the root canal system.2 Therefore, it is imperative that the clinician must have a thorough knowledge of root canal morphology and its possible variations to achieve a high level of success.

The root canal system has anatomic complexities in the form of additional canals, intercanal communications, lateral canals, and multiple foramina. Usually, mandibular first molar has two roots; mesial and distal with two canals in mesial and one canal in the distal root.3,4 The mesial root of mandibular molars often shows an additional canal in the form of MM canal.5-12 Clinical studies have investigated the incidence of MM canals in mandibular molars. Before the introduction of cone beam computed tomography (CBCT), the incidence of MM canal ranged between 1 and 15%,5,10,13 whereas a recent study7 has reported a much higher incidence of 46.2% in mandibular first and second molars. Use of CBCT to identify root canal system has been supported by Matherne et al.14 A micro-CT study by Harris et al11 reported 36% of mandibular first molars with more than two canals in the mesial root. Troughing in the floor of the pulp chamber and visualization through the dental operating microscope...
microscope have been proposed by many authors as an effective and safe approach to examine the mesial root for the potential MM canal. In addition to the MM canal, very few cases have reported a third canal located in the distal root. The incidence of the MD canal is very rare and found to be 0.2 to 3% of the reported cases. The purpose of this article is to report the successful treatment and follow-up of mandibular first molar with three mesial and three distal canals.

**CASE REPORT**

A 29-year-old white male patient presented to the clinic with a complaint of intermittent pain on the lower left side of the face since 2 months, getting worse with cold drinks. The medical history was noncontributory, and the patient reported a history of multiple fillings. Clinical examinations revealed composite restoration on tooth #19 and pain on percussion. The cold test was positive with an exaggerated response. Periapical X-ray film (Fig. 1A) showed widened periodontal ligament space and radiopaque lesions around both mesial and distal roots of tooth #19. The diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis and condensing osteitis was made. Nonsurgical root canal treatment was planned, and informed consent was obtained.

One carpule of lidocaine local anesthesia, 0.036 mg of epinephrine was administered, and rubber dam isolation was done. Under dental operating microscope (Zeiss OPMI pico, Carl Zeiss Surgical, Germany) at ×8 magnification, the pulp chamber was accessed using a sterile round bur and ultrasonic tips. Initially, four canal orifices were identified as mesiobuccal (MB), mesiolingual (ML), distobuccal (DB), and distolingual (DL). The patency of canals was confirmed with #10 K-file and orifices of all four canals were opened using Gates Glidden drills #2 and #3. Working length was determined, and canals were instrumented with Protaper Next (Dentsply maillefer, Switzerland) rotary files number X1 and X2. Canals were irrigated with 3% sodium hypochlorite after each instrument. The canals were dried; calcium hydroxide was applied in cavity as a temporary restoration, and the occlusion was checked. Postoperative radiograph (Fig. 2C) showed homogenous obturation in all six canals, and lesser bone densities around mesial and distal roots compared with 5 months old preoperative radiograph. Postoperative instructions were given; the patient was referred back to his dentist for final restoration, and a 12-month follow-up appointment was scheduled.

The patient came for the recall visit after 1 year and 9 months since completion of root canal treatment. His medical history was unchanged, he had no symptoms, and tooth #19 responded within normal limits. The IRM was still in the access cavity and had not been replaced with the final restoration. Radiograph showed normal periapical tissues and normal trabecular pattern (Fig. 2D). Importance of final restoration was discussed with the patient and he had been advised to get it restored as early as possible.

**DISCUSSION**

Numerous cases are reported in the literature regarding the unusual anatomy of mandibular first molar. The detection of additional canals requires thorough knowledge of root canal morphology and its frequent variations. Careful examination of the pulpal floor, selective troughing, and better visualization through a dental operating microscope are essential for the detection of additional canals in a mandibular first molar. In a study by Azim et al, the MM canal was found in 46.2% cases, out of which 6.6% were located after conventional access preparation and 39.6% after standardized troughing. They also reported significantly higher incidence of an MM canal in the younger patient age group. In the present
Figs 1A to D: (A) Preoperative radiograph of mandibular first molar showing occlusal restoration, widened periodontal ligament space, and radiopaque lesions around both mesial and distal roots; (B) access cavity showing three mesial canals; (C) access cavity showing three distal canals; and (D) master cone radiograph showing gutta-percha in six separated canals.

Figs 2A to D: (A) Access cavity showing three mesial canals obturated with gutta-percha and epoxy resin sealer up to the level of the orifices; (B) three distal orifices obturated up to the level of the orifices; (C) postoperative radiograph showing homogeneous obturation of all the six canals; and (D) follow-up radiograph showing normal periapical tissues and normal trabecular pattern.
case, the patient reported with lesser symptoms and the cold test gave positive response after initial cleaning and shaping, which gave possibilities of additional canals. The selective troughing in both mesial and distal roots and better visualization through a dental operating microscope helped to locate additional MM and DM canals. Wallance and Baugh\textsuperscript{22} reported a case of MM canal in the mandibular first molar, where MM canal originated as a separate orifice, but joined in the apical third of the canal. Izaz et al\textsuperscript{20} reported a case of MD canal that joined the main canal in the apical third. However, in this case, both MM and DM canals originated as separate orifices and remained separated throughout the entire length of the canal.

CONCLUSION

Ability to disinfect the root canal system is of paramount importance in endodontic treatment. Achieving a complete sterilized environment is not always possible due to the presence of additional canals, lateral canals, ramifications, and intracanal connections. Careful interpretation of symptoms combined with thorough examination of access cavity under the dental operating microscope significantly decreases the chance of missing these hidden anatomies.

CLINICAL SIGNIFICANCE

Although the anatomy of the tooth in this report is not usual and can be found rarely, clinicians should be aware of this variability of the root canal morphology to avoid treatment failures. All possible attempts should be made to locate and treat the additional canals in the mandibular first molar to achieve a higher level of success.

REFERENCES