

CASE REPORT

Four canals in the mesial root of a mandibular first molar. A case report under the operating microscope

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Abstract

In this era of microscope-assisted endodontics, finding variations in root canal system anatomy is not uncommon. Operating microscopes combined with careful clinical examination and radiographic interpretation can aid the clinician to successfully treat cases with such internal anatomy. The understanding of this view enables the possible location of additional canals in any tooth requiring endodontic treatment. The present clinical article demonstrates a rare anatomical complexity in the mesial root of a mandibular first molar. Four independent root canal orifices were found in this root by clinical detection with the aid of a dental operating microscope. This case shows that additional canals can be located in any root undergoing endodontic treatment and clinicians should always be aware of aberrant internal anatomy.

Introduction

A major cause of failure in endodontic treatment is the incomplete debridement of the entire root canal system (1,2). It has been previously shown that pulp tissue remnants and their subsequent infection by the invasion of microorganisms can affect and compromise the treatment outcome (3–5). In some of these cases, organic tissue remains in the pulp cavity because the clinician could not detect any additional root canals.

The mandibular first molar, as the earliest permanent posterior tooth to erupt, is considered to be the one most frequently involved in endodontic procedures (6). Because of the great number of endodontic treatments involving this tooth the clinician may be confronted in many cases of mandibular first molars, with aberrant internal anatomy.

Numerous *in vitro* and *in vivo* studies about the morphology of mandibular first molars have provided new data relating to the presence of extra roots, additional root canals, lateral canals or transverse canal anastomoses between the two or three canals in the mesial root (1,7–12). These studies point out the need for careful inspection for the existence of possible additional canals. From the above studies, only one (radiographic) study has reported

an incidence of 3.3% of four canals in the mesial root of mandibular first molar but the sample size was too small for safe conclusions to be made (12).

Up till now, quite a few clinical reports have been presented in the literature describing more than two canals in the mesial root of mandibular first molars (13–19). Among these reports, only Reeh has described a retreatment case of four canals in the mesial root of a mandibular first molar (18). It is of prime importance for the clinician to distinguish clearly and to identify completely the topographic location of any additional canals orifices. This is probably best achieved with the aid of a dental operating microscope.

The aim of this clinical report is to present and describe the endodontic management, through an operating microscope, of a mandibular first molar with four canals in the mesial root.

Case report

A 30-year-old male patient with a non-contributory medical history presented at our private office with discomfort and pain in the left mandibular region. The patient reported that for the last week he had experienced a

spontaneous and constant pain in this area but he could not detect the tooth that was responsible.

Clinically, the left mandibular first molar was covered by a metal-ceramic crown and the left mandibular second molar had a large amalgam restoration. Clinical examination revealed that the patient was sensitive to percussion only on tooth 36. There was no mobility and probing did not reveal any periodontal pocketing. The surrounding teeth did not demonstrate any clinical signs or symptoms. Because of the inability (owing to the presence of the crown) to perform reliable vitality tests (electric pulp test – EPT), tooth 36 was isolated with rubber dam and a tooth bath was carried out with slightly hot water. The patient reported that the pain he felt became worse after the test. It was decided, with the consent of the patient, to remove the crown in order to do reliable cold and EPTs. Vitality tests (cold, EPT) on tooth 36 after the removal of the crown showed responses longer than normal indicating irreversible pulpitis.

A preoperative radiograph was taken before the removal of the crown (Fig. 1A). No radiographic evidence of apical periodontitis was observed. The radiograph did not reveal any unusual anatomy of the molar. Endodontic treatment was initiated immediately in order to alleviate the patient's symptoms. After achieving anesthesia (1.7 mL Ubistesin forte, articaine, 1:100 000 epinephrine), the tooth was isolated with a rubber dam and the access cavity preparation was performed using Endo access and Endo-z burs (Dentsply, Maillefer, Baillaigues, Switzerland).

Investigation of the root canal system was initially performed with the aid of an endodontic explorer and then with size 10 K-files (Dentsply). Five root canals were initially detected (three in the mesial root, two in the distal root) and an operative radiograph (Fig. 1B) was taken to estimate the separation of the canals. Coronal flaring of the root canal orifices was carried out with GT Accessories files No 35 12% taper (Dentsply) in order to enhance access and visualisation. Observation of the pulp chamber with the aid of an operating microscope (Global, Protégé plus) under magnification 12.8× revealed an additional fourth canal in the mesial root.

An apex locator (Bingo 1020 Forum Technologies, Rishon Lezion, Israel) was used to verify the working length in all six root canals. An additional operative radiograph was then taken to confirm the independent presence of the fourth canal in the mesial root (Fig. 1C). Individual canal instrumentation was performed with HERO 642 (Micro-Mega, Rue du Tunnel, France) rotary Ni-Ti files No 20, 25, 30, 6%, 4% and 2% taper and No 35 2% taper. All four canals in the mesial root were instrumented by HERO Ni-Ti rotary instruments using a crown-down pressureless technique to a master apical size 35. The two canals in the

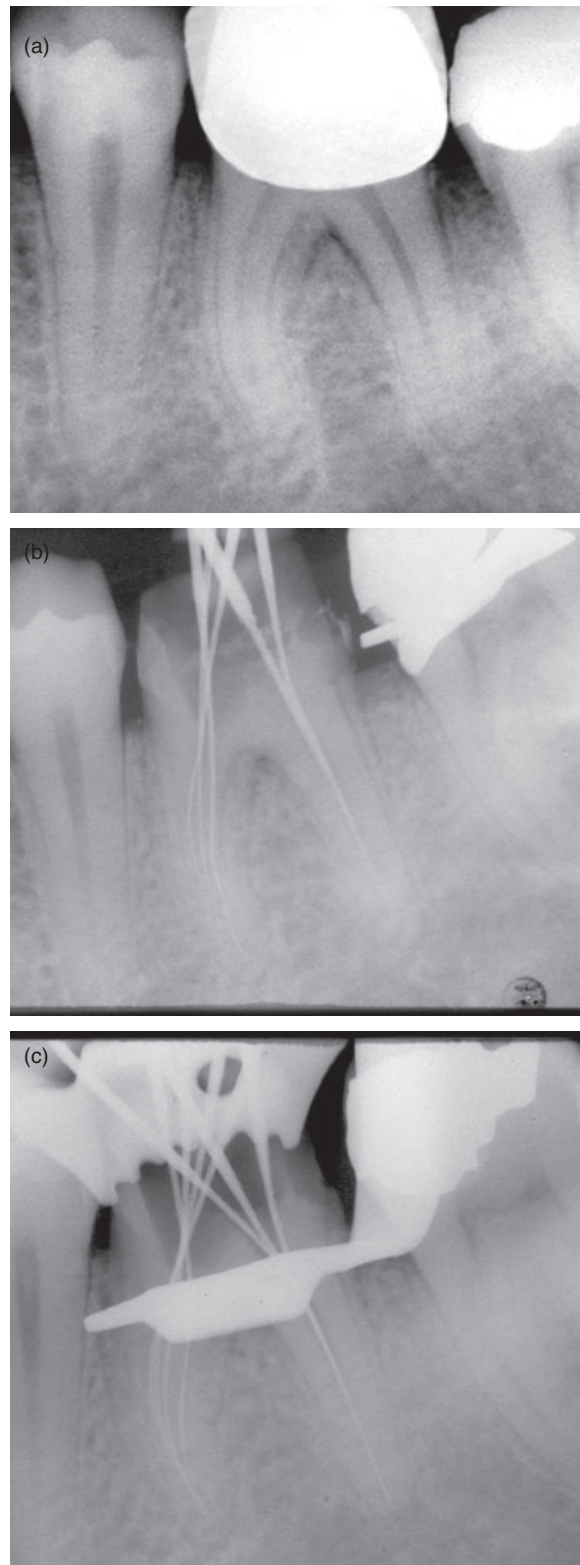


Figure 1 (a) Preoperative radiograph. (b) Initial working length radiograph with five endodontic files in place (three in the mesial root). (c) Second working length radiograph with seven endodontic files in place (four in the mesial root).

distal root were instrumented by hand. During mechanical instrumentation the distal canals were joined, creating a quite wide canal with master apical size 50. Copious chemical irrigation was performed with 2.5% sodium hypochlorite. After completion of the chemomechanical preparation, root canals were dried with sterile paper points. The pulp chamber was examined again under the operating microscope for any additional canals and photographs were taken under magnification 12.8 $\times$ and 19.1 $\times$ from different observation angles (Fig. 2).

Obturation was performed at the second appointment using cold lateral condensation of gutta-percha and AH-26 as a root canal sealer (Dentsply, De Trey, GmbH, Germany). Prior to obturation, EDTA (17%) was used to remove the smear layer and a final irrigation with 2.5% sodium hypochlorite followed. Each canal in the mesial root was obturated separately but the master gutta-percha

cones were in place for all four canals. This was done because it was previously established that all the canals joined near the apex. Excess gutta-percha cones were cut at the level of the root canal orifices and vertical condensation was performed immediately with ISO size 40 finger pluggers. A temporary filling (Cavit G, 3M ESPE) was placed and two postoperative radiographs were taken from different horizontal angles in order to assess the quality of obturation in all canals (Fig. 3). The patient was recalled 1 year postoperatively (Fig. 4). At the recall appointment, the patient was symptom free and the tooth had been recrowned.

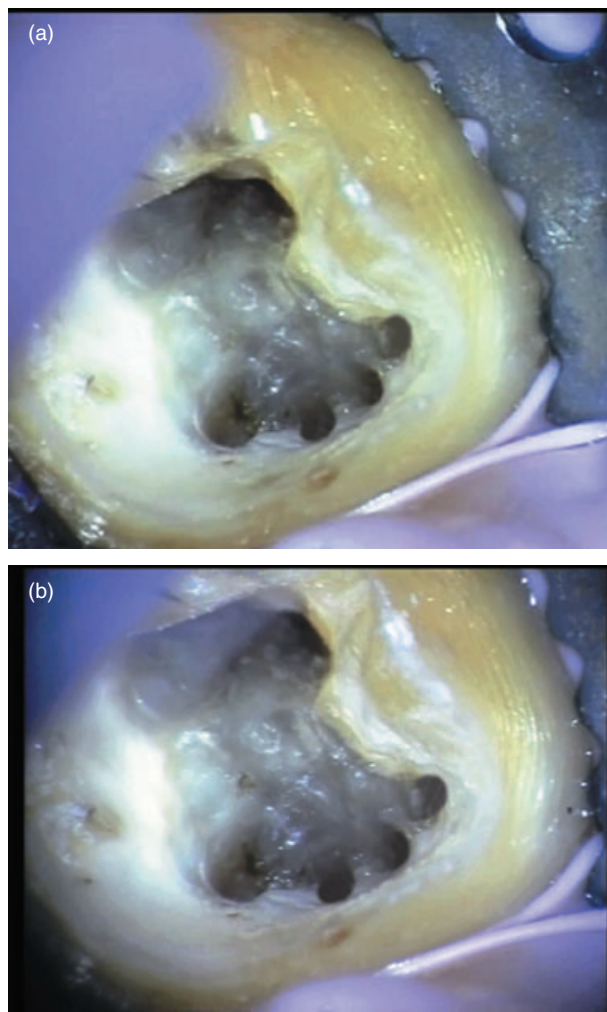


Figure 2 Clinical view of the four separate canal orifices in the mesial root, under magnifications (a) 12.8 $\times$, (b) 19.1 $\times$.

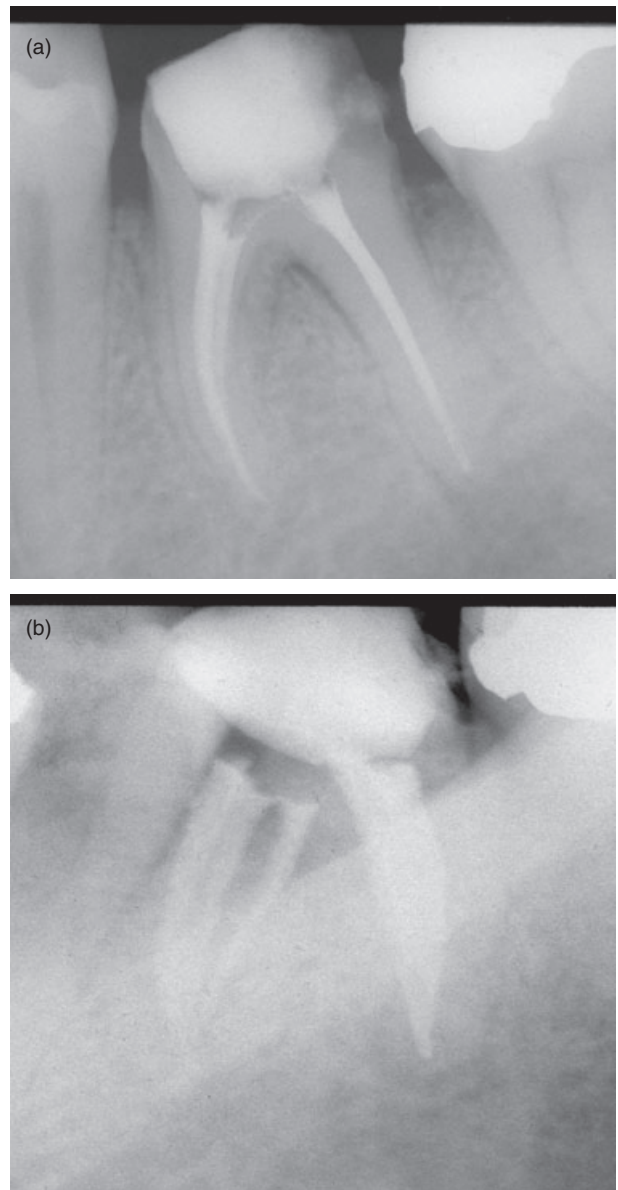


Figure 3 (a) Ortho-radial postoperative radiograph. (b) Postoperative radiograph taken from distal aspect.

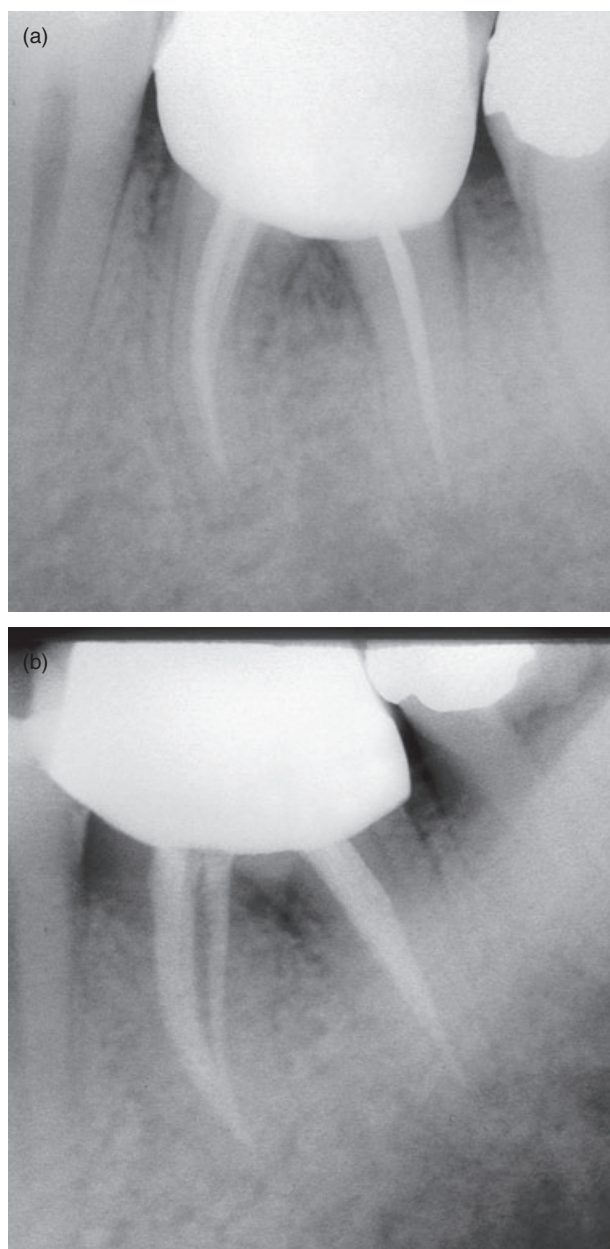


Figure 4 (a) Recall radiograph 1 year after the completion of the treatment. (b) Second recall radiograph taken with distal angle.

Discussion

Morphological variations in root canal system anatomy should always be considered at the beginning of treatment. Each case, independently of the type of tooth, should be examined cautiously, clinically and radiographically in order to detect possible anatomical aberrations. Once endodontic treatment has been initiated, proper access cavity preparation is a basic prerequisite for the investigation and successful detection of all root canal ori-

fices (20). An operating microscope can help the clinician to identify morphological deviations and to understand thoroughly the topographic anatomy of the pulp chamber floor and the exact location of canals orifices. It is evident from many studies, as well as from clinical practice in endodontics, that the use of magnification is considered helpful for the successful completion of endodontic treatment (21,22).

The mesial root of mandibular first molars has been investigated for many years. Sometimes, it is very wide in the buccolingual direction so that more than two canals can be located. According to endodontic literature, the middle mesial canal can be found in 1–7% of the cases (1,7–11). In most of the cases, this canal is hidden by a dentinal projection of the mesial aspect of pulp chamber walls. In all cases of mandibular molars, this dentinal growth is usually located between the two main canals (mesiobuccal-mesiolingual) and should be removed carefully in order to detect the additional canal or canals. Ultrasound technology is a very useful tool for the clinician to clean such an area efficiently. In the present case, the two middle mesial canals seem to originate as separate orifices but joined other canals before exiting (7).

The fact that initially a third (middle mesial) canal and later a fourth canal was located in the mesial root of this mandibular first molar underscores the necessity for thorough investigation of root canal system anatomy during endodontic treatment. Endodontists should always have in mind that additional canals may exist and ensure that all root canal orifices have been located.

In the past, many studies have reached the conclusion that failure to locate and clean extra canals in any root decreases the long-term prognosis of endodontic treatment (23,24). All these extra canals, if any, should be found if possible.

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