

CASE REPORT

Endodontic management of a four-canal mandibular second premolar; using an operative microscope: A case report

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Key Clinical Message

Due to the complexities and variations of the root canal system's anatomy, mandibular premolars are among the most difficult teeth for endodontic treatment. The lack of clinician knowledge ultimately leads to treatment failure.

Abstract

Mandibular premolars are the most complicated teeth for endodontic treatment because of the variations in root canal anatomy. On the other hand, missing root canals can subsequently lead to failure of endodontic treatment, which causes the patient to become symptomatic. Therefore, the clinician's knowledge of the different types of root canal anatomy and the skill of using new equipment for proper root canal treatment improve the outcome. This study reported the successful endodontic treatment of a mandibular second premolar with four root canals by using an operative microscope.

KEYWORDS

endodontics, premolar, root canal preparation, root canals

1 | INTRODUCTION

Missing root canals is one of the main causes of failure. In 98% of cases, missing at least one of the root canals subsequently caused apical periodontitis.¹ Also, based on a CBCT investigation study, previously treated teeth with missed root canals are 4.3 times more likely to be associated with periapical lesions.²

Since locating all root canals, removing tissues and microorganisms by preparing and completely cleaning the root canal system, followed by three-dimensional obturation account for the long-term success of root canal

treatment, the clinician's sufficient knowledge about anatomical variations in addition to the normal anatomy of the root canal is a necessity to obtain a suitable outcome.³ Due to the complexities and variations of the anatomy of the root canal system, mandibular premolars are one of the most challenging teeth for endodontic treatment. The lack of knowledge of the clinician in these cases causes root canal missing and incomplete root canal preparation, ultimately leading to the failure of the treatment in these cases.^{4,5} The incidence of anatomical variations in the mandibular premolar is less common than in the first mandibular premolar. In most

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cases, the mandibular second premolar has a single root and a single canal, but cases with multiple roots and canals have also been reported. Past studies indicate that the prevalence of these anatomical variations is different by race.⁶ According to Vertucci's study, mandibular premolars are single-canal at apex in 97.5% of cases and double-canal in only 2.5%.⁷ Zillich and Dawson, after examining 938 mandibular premolars, reported an incidence of three root canals in 0.4% of cases.⁶ According to Thomas Gerhard Wolf's systematic review, in which 17,839 mandibular premolar teeth were examined, 85%–100% of the teeth had single roots, less than 8% had two roots, and only 0.1% to 3.5% had three roots. Vertucci Type I is the most common root canal configuration, followed by Vertucci Type V.⁸ Rare cases of mandibular second premolar teeth with four root canals have also been reported.^{9–12}

Various techniques have been used to examine the anatomy of the root canal in studies, including micro-CT, CBCT, clearing, and two-dimensional radiographic examination. Micro-CT is considered the gold standard due to its high resolution, but its use is limited to *in vitro*.^{8,13} This case report describes the diagnosis and successful non-surgical endodontic treatment of a mandibular second premolar with four canals.

2 | CASE HISTORY/ EXAMINATION

A 26-year-old male patient with a non-contributory medical history visited his general dentist complaining of spontaneous pain in the lower left second premolar tooth. The dentist had referred the patient after preparing the access cavity because of the inability to locate the root canals. In the intraoral examination, swelling and sinus tract were not seen, there was no sensitivity to palpation and percussion, and no periodontal pocket was observed. Due to previous incomplete treatment and coronal pulp removal, the response to the pulp sensitivity test was negative. The periapical radiograph showed a sudden disappearance of the canal in the middle area; also, the radiograph represents that the periapical tissue was intact (**Figure 1A**).

3 | METHODS (DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT)

After anesthetizing the tooth with 1.8 mL of 2% lidocaine and 1/100,000 epinephrine using an infra-alveolar nerve block, it was isolated with a rubber dam.

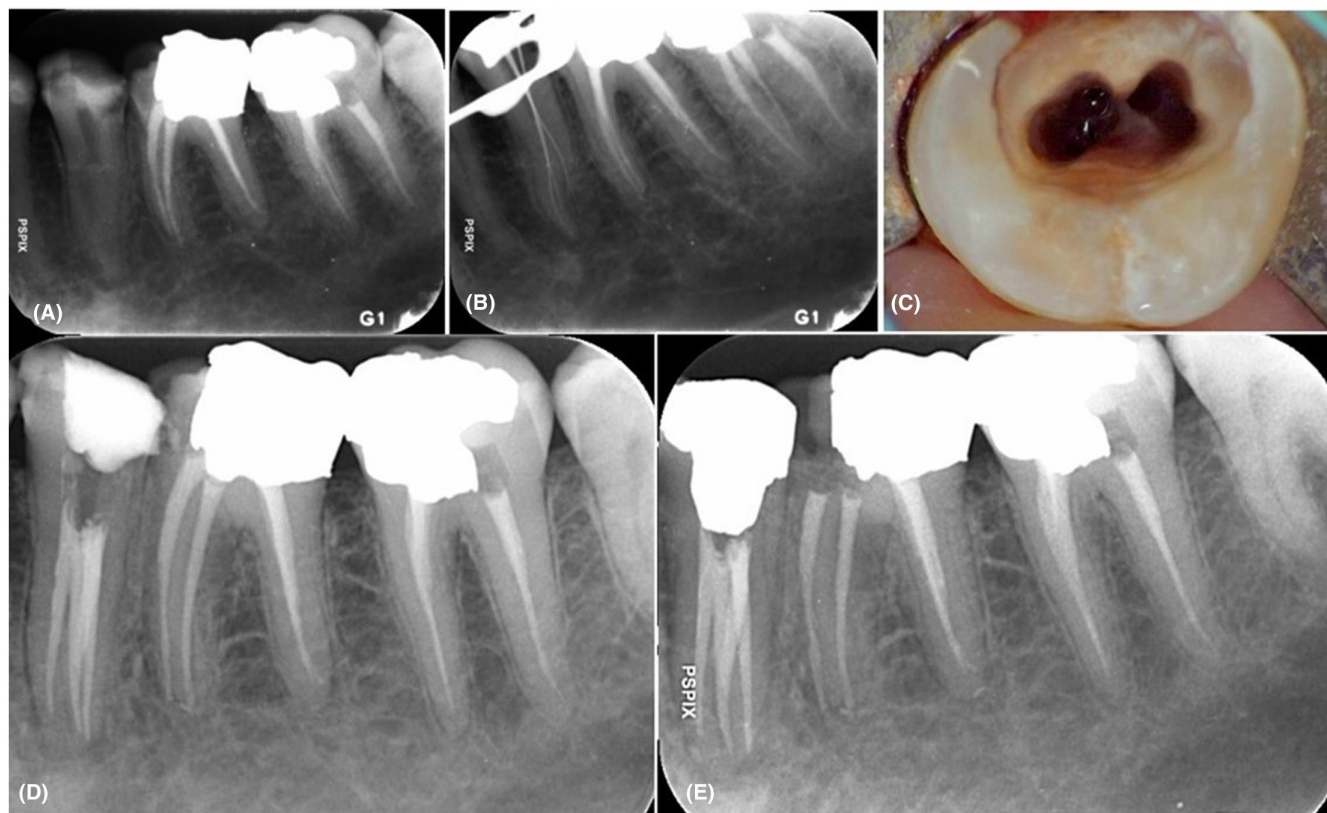


FIGURE 1 (A) Preoperative periapical radiograph. (B) Working length determination. (C) Four orifices were located in the middle third of the root. (D) Postoperative radiograph immediately after obturation (two canals are superimposed). (E) Six-month follow-up.

Temporary restoration and remaining caries were removed. For proper access to all canals, the access cavity was extended. After preparing the access cavity, the first three root canals were negotiated with a K-file #10 (Mani, Tochigi, Japan). Working length was determined with an electronic apex locator (Endo-radar plus; Woodpecker Medical Instrument Co, Guilin, China) and confirmed with a radiograph (Figure 1B). Then floor of the pulp chamber was carefully inspected using an operating microscope (OPMI Pico Dental Microscope; Zeiss, Oberkochen, Germany) at 10× magnification and subsequently, the fourth root canal was located: two canals in the distal and two canals in the mesial in the shape of a trapezoid which the base was located in the mesial (Figure 1C). The distolingual canal joined to the mesiolingual canal in the apical third.

The pulp chamber was filled with 5.25% sodium hypochlorite (Nikdarman, Tehran, Iran), and K-files #10 and #15 (Mani, Tochigi, Japan) reached working length, respectively. Rotary files (Shenzhen Denco Medical Co, Shenzhen, China) up to F2 were used by an electric endomotor (Endo-radar plus; Woodpecker Medical Instrument Co, Guilin, China) for root canal preparation. 2.5% sodium hypochlorite was used as an irrigant between each instrument; due to the complexity of the treatment, the obturation was postponed to the second visit. Hydraulic calcium hydroxide was used as an intracanal medicament, and the tooth was coronally sealed with the Cavisol (Golchai, Tehran, Iran); in the second visit, after removing the temporary restoration and removing calcium hydroxide from the root canals, the canals were irrigated with 2.5% sodium hypochlorite, and after rinsing with saline, final irrigation performed with 17% EDTA (Nikdarman, Tehran, Iran) for 1 min: After rinsing the canals with saline, the canals were dried and obturated with gutta-percha and EndoSeal MTA sealer (Maruchi, Wonju, South Korea). The tooth was coronally sealed with the cavisol (Golchai, Tehran, Iran), and the final radiograph was taken (Figure 1D). Finally, he was referred to the restorative department for a permanent restoration.

4 | CONCLUSION AND RESULTS (OUTCOME AND FOLLOW-UP)

The tooth was completely asymptomatic at the 6-month follow-up, and the PDL was normal on the radiograph (Figure 1E).

5 | DISCUSSION

Mandibular premolars have unique variations and complexities in the root canal system, which makes them one

of the most challenging teeth for root canal treatment.³ The second mandibular premolar is usually single-canal. Also, the occurrence of two canals ranges from 1.2% to 11.7%, and for three canals, it is 0.4%. Rare cases of four and five canals have also been reported in previous studies.¹⁴ Due to the high anatomical variation of mandibular premolar teeth, these teeth are susceptible to missing root canals in endodontic treatment.

In 42% of cases that lead to retreatment, there is an untreated canal.¹⁵ Since missing root canals are considered one of the main causes of endodontic treatment failure, the clinician's awareness of the anatomical variations of root canals is crucial.

Failure of Endodontic treatment occurs with typical signs and symptoms such as pain and swelling in the sinus tract or atypical, which, as reported, missed root canal in mandibular premolars can cause paraesthesia in the mental area and induce dull pain in the region, which may mimic symptoms of non-odontogenic problems can deceive clinicians in diagnosis. In addition, Sachdeva et al. reported a case of sensitivity to hot and cold due to missing a root canal in a previously treated mandibular premolar.^{15,16} Due to the high incidence of aberrations in these teeth, if an endodontically treated mandibular premolar reveals symptoms, the clinician should consider the possibility of missing the root canal as the cause of the problem.

The disappearance pathway of the root canal in periapical radiographs usually indicates the presence of an additional canal. Fast break is a term used for this purpose, which is a sign of the branching of the root canal. Also, the wider mesiodistal dimensions of the root indicate the presence of additional canals. Therefore, by using these criteria, it is possible to predict the degree of difficulty before initiating the treatment.¹⁷

Detection, instrumentation, and obturation of multiple canals originating from a small pulp chamber, especially when the canals are deeply located, is a dilemma for the clinician. Tactile examination using a small pre-curved K-file as well as magnification are used to find the orifices. Furthermore, various tools and methods are recommended for the detection of root canal orifices, including magnification and illumination for inspection of the pulp chamber floor and staining the pulp chamber floor with dye to increase the color contrast to facilitate locating the orifice of additional canals. After locating canals, the access cavity should be extended to improve vision and facilitate instrumentation. Due to the proximity of the orifices, instrumentation, and obturation are challenging, and magnification is required. A copious irrigation eliminates dentin chips and prevents loss of working length and blockage. Endodontic sealers with higher flow are suitable for spreading in the

narrow parts of the canal in mandibular premolar with multiple root canals.^{18,19}

Endodontic treatment of four-canal mandibular second premolar requires appropriate tools and equipment, especially an operating microscope and illumination, making treatment more predictable and enabling clinicians to find all the canals and do suitable preparation and obturation.^{9,10}

AUTHOR CONTRIBUTIONS

Sholeh Ghabraei: Conceptualization; investigation; writing – review and editing. **Reza MahjourianQomi:** Conceptualization; project administration; writing – original draft; writing – review and editing. **Parisa Bagheri:** Conceptualization; supervision.

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CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted without any commercial or financial relationships construed as a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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