



Case Report

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Diagnosis and Endodontic Management of a Maxillary First Premolar With Three Root Canals: A Case Report

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Abstract

Maxillary first premolars typically exhibit one or two canals, but variations such as three canals can significantly impact treatment success. This case report describes the clinical identification and successful endodontic management of a maxillary first premolar with three distinct canals. The use of multiple radiographic angulations and careful tactile exploration facilitated the diagnosis and management, resulting in a positive clinical outcome.

Keywords: Maxillary first premolar, Three canals, Anatomical variation, Endodontic treatment.

INTRODUCTION

Endodontic success fundamentally depends on thorough debridement, disinfection, and three-dimensional obturation of the entire root canal system. Inadequate understanding of root canal morphology remains one of the principal causes of missed canals, incomplete treatment, and subsequent failure of endodontic therapy ^[1]. Among posterior teeth, maxillary first premolars are particularly known for their anatomical variability. While they typically present with one or two canals, the occurrence of three canals or three roots, although rare, poses a unique diagnostic and treatment challenge that requires heightened clinical vigilance and skill ^[2, 3].

Several studies have reported variations in root canal anatomy across different ethnic and population groups, emphasizing the importance of considering demographic factors during diagnosis ^[4]. While the presence of two canals is frequently observed, three-rooted or three-canal maxillary first premolars have been reported with an incidence ranging from 0% to 6% in the literature ^[5]. Accurate detection of these additional canals necessitates a modified approach to access preparation, optimal illumination, magnification tools such as loupes or dental microscopes, and careful radiographic evaluation, often requiring angled radiographs or advanced imaging modalities like cone-beam computed tomography (CBCT).

This case report aims to present the successful diagnosis and management of a maxillary first premolar with three distinct canals, highlighting the significance of meticulous clinical and radiographic assessment in ensuring favorable treatment outcomes.

CASE REPORT

Patient Information

A 22-year-old male presented to the Department of Conservative Dentistry and Endodontics at Pacific Dental College and Research Centre, Udaipur, reporting sharp, spontaneous pain and sensitivity in the upper right posterior region for the past week. He denied any significant medical conditions, medication use, allergies, or prior dental trauma. His family history and psychosocial background were unremarkable, with no relevant genetic concerns or use of tobacco, alcohol, or recreational substances. The patient also reported no previous interventions on the affected tooth.

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Clinical Findings

On intraoral examination, deep disto-proximal carious involvement was observed in the maxillary right first premolar (tooth #14). The tooth exhibited tenderness to percussion, suggesting pulpal inflammation. Initial periapical radiographs showed no periapical pathology but indicated a possible variation in the root anatomy (Figure 1). The clinical and radiographic evaluation raised suspicion of an additional canal in the affected tooth.



Figure 1: Pre-operative radiograph

Diagnostic Assessment

Further diagnostic work included multiple angulated periapical radiographs, which confirmed the presence of three separate root canals in tooth #14. This anatomical variation was identified without the need for CBCT, as conventional imaging provided sufficient clarity (Figure 2). Based on the combined clinical signs and radiographic evidence, a diagnosis of symptomatic irreversible pulpitis was established, warranting endodontic intervention. No laboratory tests or other diagnostic procedures were required.



Figure 2: Determination of the working lengths, 3 root canals radiographical confirmation

Therapeutic Intervention

Endodontic treatment was initiated under local anesthesia (2% lidocaine with 1:80,000 epinephrine). Following rubber dam isolation, access to the pulp chamber was achieved. Exploration with nickel-titanium hand files (sizes 10, 15, and 20) confirmed the presence of three distinct canals: palatal, mesiobuccal, and distobuccal. Canal patency was established and maintained with a size 15 K-file.

Biomechanical preparation was performed using a rotary ProTaper Gold system (Dentsply Sirona) employing a crown-down technique. Irrigation was carried out with 2.5% sodium hypochlorite (NaOCl) after each file change to ensure disinfection. Ethylenediaminetetraacetic acid (EDTA) was used intermittently to remove the smear layer, followed by a final rinse with sterile saline. A master cone fit was verified radiographically (Figure 3).

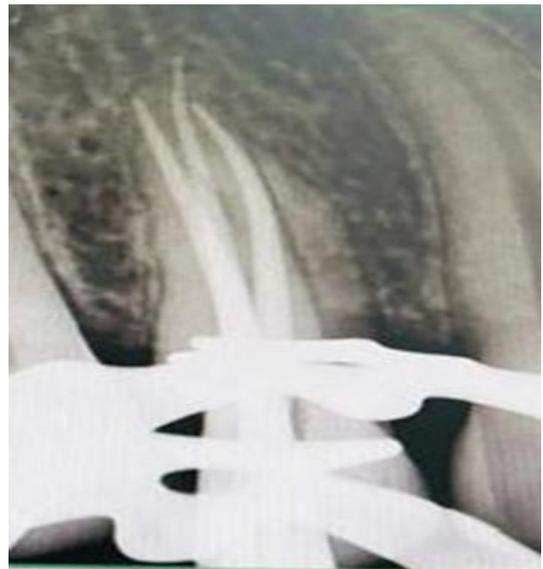


Figure 3: Master cone

The canals were dried with absorbent paper points, and obturation was completed using the single-cone technique with AH Plus resin-based sealer and gutta-percha cones. A post-endodontic restoration was placed immediately using Miracle Mix (GC Corporation), reinforcing the tooth structure and sealing the access cavity. No changes in the treatment protocol were necessary during the procedure.

Follow-up and Outcomes

The patient reported resolution of pain and sensitivity at the one-week follow-up visit. Clinical examination revealed no tenderness on percussion or palpation, and the post-endodontic restoration was intact (Figure 4). No adverse events or complications were observed during or after treatment. Radiographic follow-up showed proper obturation with no signs of periapical pathology (Figure 5).

Therapy adherence was confirmed through direct follow-up visits and patient self-reporting. The patient tolerated the intervention well, with no reported discomfort beyond the expected mild post-operative sensitivity, which subsided within a few days without medication. No unanticipated events occurred during the treatment or follow-up period.



Figure 4: Final periapical radiograph after the obturation of tooth #14



Figure 5: Post endodontic restoration

DISCUSSION

The successful management of this case highlights both the strengths and limitations of the clinical approach undertaken. A key strength was the thorough preoperative assessment, including the use of multiple angulated radiographs, which enabled the detection of an uncommon three-canal configuration in the maxillary first premolar. Careful tactile exploration using fine K-files and the use of magnification further supported accurate canal identification. The procedural steps, including crown-down preparation, effective irrigation protocols, and obturation with a reliable sealing technique, contributed to the positive clinical outcome.

However, the case was managed without the use of cone-beam computed tomography (CBCT), which is considered the gold standard for detailed root canal morphology assessment. Although multiple radiographs provided sufficient diagnostic information, CBCT could have offered a more precise three-dimensional evaluation^[6], particularly in cases with overlapping anatomic structures. This represents a limitation in the diagnostic phase of treatment.

The occurrence of three distinct canals in maxillary first premolars, though rare, is well documented in the endodontic literature. Cleghorn et al. reported that up to 5.6% of such teeth may present with this

variation, emphasizing the need for heightened clinical vigilance^[7]. Similarly, studies by Pécora and Sert have underscored population-based variability, indicating that clinicians should be prepared to encounter such anatomical deviations^[8, 9]. Typically, the presence of two buccal canals and one palatal canal mirrors the canal configuration seen in maxillary molars, requiring modified access cavity designs, often T-shaped, to effectively locate and instrument all canals^[10].

In this case, the identification of the third canal was facilitated by both radiographic interpretation and meticulous tactile exploration. The use of magnification and maintenance of a dry operating field were additional factors that enhanced visualization and treatment precision. Ultimately, adherence to sound endodontic principles, including complete debridement, disinfection, and three-dimensional obturation, ensured the successful resolution of symptoms and favorable healing outcomes.

CONCLUSION

This case underscores the importance of recognizing anatomical variations in maxillary first premolars, as missed canals can compromise endodontic success. Thorough radiographic evaluation, careful tactile exploration, and the use of magnification are critical in detecting additional canals. By adapting access design and following meticulous treatment protocols, clinicians can effectively manage such complexities and achieve predictable clinical outcomes.

Patient Perspective

The patient expressed satisfaction with the treatment received and reported significant relief from the spontaneous pain and sensitivity that initially brought him to the clinic. He noted that the procedure was comfortable and that the dental team kept him well informed at every stage of the treatment. The patient appreciated the explanation provided about the unusual root canal anatomy and was reassured by the careful approach taken to ensure all canals were treated. He reported no post-operative complications and expressed confidence in the outcome, mentioning that he would recommend similar care to others if needed.

Conflicts of Interest

The author reports no conflicts of interest.

Funding

None declared.

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