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Case Report

Utilizing Cone-Beam Computed Tomography for Identifying and Managing Multiple Canals: A Case Report

Gyanendra Pratap Singh[1], Shruthi H Attavar[2]*, Sivaji Kavuri[3]

[1] Conservative Dentistry and Endodontics, Private Practioner, Ghaziabad, India.
[2] Conservative Dentistry and Endodontics, A B Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangalore, India.
[3] Conservative Dentistry and Endodontics, Anil Neerukonda Institute of Dental Sciences, Andhra Pradesh, India.

***E-mail** ✉ drshruthiattavar@yahoo.in

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ABSTRACT

The primary goal of root canal therapy is to locate all canals, achieve thorough debridement, and ensure a three-dimensional obturation of the canal system. Understanding the internal anatomy of the root canal structure is a critical aspect of successful endodontic treatment. Typically, the mandibular first molars present with two roots and 3 or 4 canals; however, the occurrence of additional canals, particularly the middle mesial canal, has been documented in various studies. This case report highlights the role of CBCT in the diagnosis and management of a mandibular 1st molar with an unusual presentation of 7 root canals. A dental operating microscope was used for clinical identification of the canals, and the findings were confirmed by CBCT imaging. This case emphasizes the importance of recognizing anatomical changes and the potential for additional canals during endodontic treatment. A comprehensive diagnosis is essential to ensure the long-term success of the procedure.

Keywords: Root canal morphology, Mandibular first molar, CBCT, Dental operating microscope

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Introduction

The success of endodontic treatment largely depends on thorough debridement of the root canal system [1]. The primary objective of the therapy of root canals is to eliminate all pulp tissue remnants and adequately fill the cleaned space with an inert material. One of the main reasons for treatment failure is the inability to fully navigate, clean, and achieve a three-dimensional seal of the root canal system [2]. While accurate diagnosis and proper treatment planning are essential, a deep understanding of root canal morphology and its variations is equally critical for successful outcomes [3].

Among all teeth, mandibular first molars exhibit some of the most complex internal canal configurations, as reported in numerous studies. Typically, they present with two roots, each containing multiple canals—usually two mesial and either 1 or 2 distal canals. However, in approximately 1-15% of cases, an additional middle mesial canal is found, making it one of the most commonly observed anatomical variations in these teeth [4]. Other notable modifications in root canal anatomy include the presence of an isolated root canal in a single root [5], additional roots such as radix paramolaris and radix entomolaris, a middle distal canal, and a C-shaped canal configuration [6]. Cases where a mandibular first molar presents with seven canals are exceptionally rare, as highlighted in various studies [7].

This case report emphasizes the crucial role of CBCT imaging and a surgical microscope in the comprehensive diagnosis and treatment of a mandibular first molar with seven root canals.

Materials and Methods

Case report

A 35-year-old male patient with no relevant medical history visited the dental hospital with persistent pain in the lower left tooth region for one week. Despite undergoing root canal treatment three days earlier, he continued to experience severe discomfort. Clinical examination revealed that the access cavity was missing a temporary restoration, and the patient reported pain on vertical percussion in tooth #36. Radiographic evaluation showed a mandibular molar with an access cavity and an expanded periodontal ligament space around the mesial root **(Figure 1a)**. Based on the clinical and radiographic findings, symptomatic apical periodontitis was diagnosed, and a conventional root canal treatment was planned.

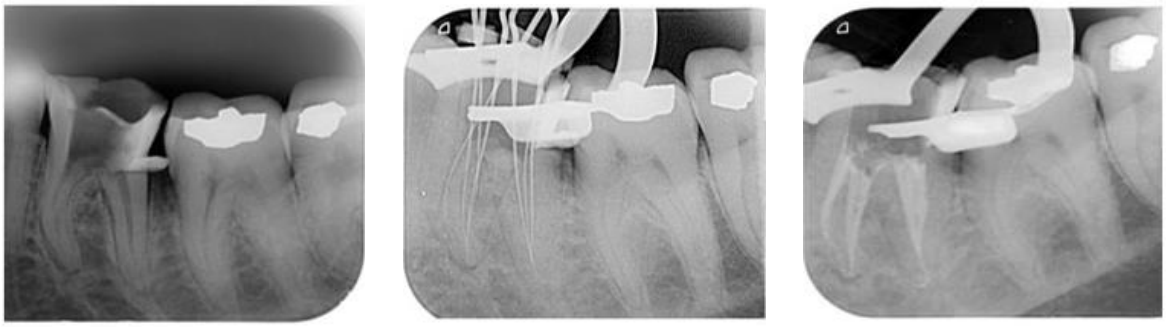
Treatment protocol

Local anesthesia was administered using 1.8 ml of 2% lidocaine with 1:200,000 adrenaline (Xylocaine; AstraZeneca). The tooth was isolated with a rubber dam, and an endo access bur was used to create an access cavity, which was further refined with an Endo Z bur (Dentsply Tulsa). Examination with a DG-16 endodontic explorer revealed four canals, two in the mesial and two in the distal (Hu-Friedy, Chicago, IL). A connection was observed between the distobuccal and distolingual canals, as well as between the mesiobuccal and mesiolingual canals. The presence of a large space between the mesial and distal orifices raised suspicion of additional canals, prompting further investigation.

Methods

After evaluating the canals, a ProTaper SX rotary file (Dentsply Maillefer) was used to widen the coronal portion. The working length was determined electronically with a third-generation apex locator and later confirmed through radiographic imaging. To gain a more precise understanding of the canal morphology, multiple radiographs were taken from different angles **(Figure 1b)**. Given the unusual canal configuration, CBCT imaging was recommended for further assessment. The endodontic cavity was sealed with IRM cement, and a CBCT scan was performed, providing both coronal and axial views that confirmed the presence of seven root canals **(Figures 2a and 2c).** Axial CBCT images revealed four distinct canals in both the coronal and middle sections. However, in the apical portion, only two mesial canals were visible, aligning with Sert and Bayirli's Type XIV canal pattern. Similarly, axial views of the distal root showed three separate canals in the coronal and middle sections, while only one was present in the apical third, also corresponding to Sert and Bayirli's Type XIV classification [8-10].

During the second session, local anesthesia with 2% lignocaine was administered. The canals were shaped using Hyflex (VDW, Munich, Germany) rotary files following the crown-down technique. The mesial canals were prepared to a taper of 25%, while the distal canals were enlarged to 30%. Throughout the instrumentation process, saline, 5.25% sodium hypochlorite (Prime dental product), and 17% EDTA (Pulpdent Corporation) were used for irrigation, followed by a final rinse with 2% chlorhexidine. The canals were then sealed using a single-cone obturation method with AH Plus sealer **(Figure 1c)**. Finally, the access cavity was restored with a composite resin core (P60; 3M dental products). The patient remained symptom-free over a 24-month follow-up period and later received a full-coverage porcelain crown [11].



a) b) c)

Figure 1. a) preoperative radiograph, b) working length radiograph, and c) post obturation.

Results and Discussion

Identifying and managing additional roots or canals in mandibular first molars presents a significant challenge for clinicians. The long-term effectiveness of endodontic therapy relies on a thorough understanding of typical root canal morphology and its variations. If extra canals remain undetected and untreated, the

overall success of the procedure may be compromised [12].

Traditional intraoral periapical and digital radiographs are commonly used to determine root canal anatomy in clinical settings. However, standard radiographic techniques generate only a two-dimensional representation of a three-dimensional structure. As a result, their effectiveness is often limited when dealing with complex anatomical variations. Recent advancements in imaging, particularly CBCT, have enhanced the ability to visualize root canal configurations in three dimensions. CBCT scanning provides a comprehensive assessment of internal root and canal anatomy from multiple perspectives [13], increasing the likelihood of identifying complex canal variations that may not be apparent on conventional radiographs.

In this case, CBCT was utilized to gain a clearer understanding of the intricate root canal system. The presence of 2 roots and 7 distinct canals in the left mandibular molar was confirmed through both a dental operating microscope and CBCT imaging. The analysis revealed a mesial root with four canals and a distal root with three. Albuquerque et al. proposed a classification system that systematically categorizes root and canal configurations in mandibular molars, considering both their exact positions and structural relationships [14].

Peiris *et al.* [15] suggest that such intricate root canal morphology arises due to the deposition of secondary dentin, leading to multiple partitions that create a network-like structure with several vertical canals. Mortman and Ahn [16] propose that additional canals in the mesial root may develop as a result of instrumentation between the mesiobuccal and mesiolingual canals. Navarro *et al.* [17] state that canal preparation within the isthmus is beneficial as it facilitates the division of the isthmus, allowing disinfectants to reach areas that are otherwise difficult to access with endodontic instruments. This approach enables effective cleaning and shaping without compromising the root structure. Furthermore, the perception of a well-obturated canal can vary based on the angulation of the X-ray beam and the positioning of the tooth [18]. To ensure a thorough evaluation of the root canal filling's integrity, a post-obturation CBCT scan, including coronal and axial views, was conducted in this case **(Figures 2b and 2d)**.

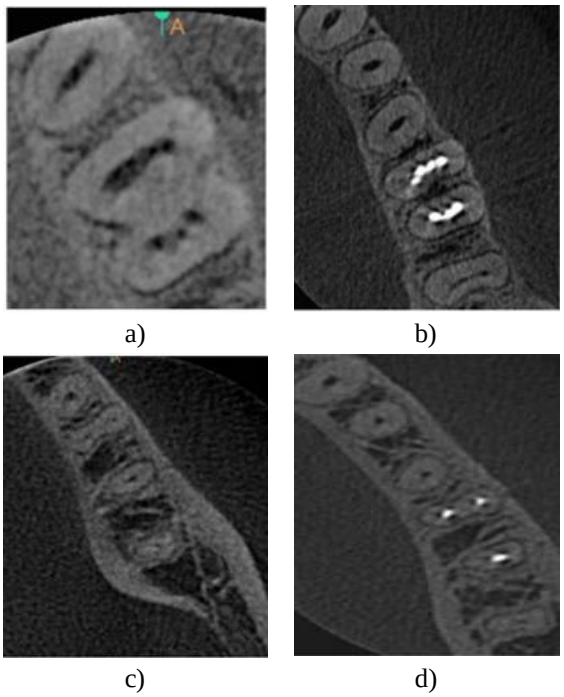


Figure 2. a) pre-operative coronal CBCT image showing the presence of seven canals, b) post-operative coronal CBCT image showing the presence of seven canals, c) pre-operative axial CBCT image showing the presence of seven canals, and d) postoperative axial CBCT image showing the presence of seven canals.

Conclusion

This case study emphasizes the importance of a thorough understanding of anatomical variations within the canal system when performing endodontic treatment. The occurrence of multiple canals in mandibular molars is uncommon; however, documenting such cases can aid in the identification and management of similar conditions in future endodontic procedures. Additionally, this report underscores the significance of advanced diagnostic tools, such as CBCT imaging and a dental operating microscope, in accurately detecting complex canal morphology and ensuring the success of endodontic treatment.

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