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Case Report

Endodontic management of a maxillary first molar with seven root canals using a dental operating microscope: A case report

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CLINICAL SIGNIFICANCE

Clinicians must have knowledge of the anatomical variations during all phases of endodontic diagnosis and treatment and should use advanced magnification or diagnostic techniques to help in the detection of such abnormalities and the eventual success of endodontic therapy.

ABSTRACT

The main objective of root canal treatment is the thorough cleaning and shaping of the entire root canal system. For this, the detection of all canals is of significant clinical importance. Maxillary first molars (Mx1M) commonly present with three roots and three canals, with a second mesiobuccal canal (MB2) also present. With the advent of improved diagnostic systems, it has been reported that Mx1M can have different anatomical variations. This varying number of configurations presents a challenge to the endodontist in detecting and treating through the root canal. This problem can be avoided by using magnification systems or advanced diagnostic techniques. Although four canals were detected at the beginning of the treatment, a rare morphology and three additional canals were detected with the contribution of a dental operating microscope (DOM). This case report presents the endodontic management of an Mx1M with pulpal necrosis and symptomatic apical periodontitis. Nonsurgical endodontic therapy of a left Mx1M with three roots and seven root canals was successfully performed under a DOM.

1. Introduction

The primary goals of conventional endodontic treatment are removing pulp tissue and irritants from root canals and hermetically sealing the canal system. Accurate diagnosis and detection of all root canals are crucial for success; otherwise, the root canal system cannot be fully cleaned and filled, leading to treatment failure.[1] Human maxillary first molars (Mx1M) typically have four or five cusps, three roots (mesiobuccal, distobuccal, and palatal), and four canals.[2] However, studies and case reports have revealed anatomical variations, including Mx1M with one, two, or five roots[3-6] and three-rooted versions with multiple canals.[7-9]

This case report presents a rare Mx1M configuration with seven root canals: two mesiobuccal, three palatal, and two distobuccal, diagnosed during treatment. A thorough understanding of root canal morphology, proper clinical and radiographic examination, and the use of dental loupes or dental operating microscopes (DOM) are essential for success. This article highlights Mx1M morphological variations and additional canal management.

2. Case Presentation

An 18-year-old male patient presented to the Endodontics Department at Recep Tayyip Erdoğan University Faculty of Dentistry, Rize, Turkey, with a ten-day history of spontaneous and mastication-induced pain in the maxillary right posterior region. His medical history was unremarkable. He reported intermittent pain for two months, worsening in recent days. Clinical examination revealed a deep mesio-occlusal carious lesion, tender on percussion. Cold testing with Endo-Frost (Coltene, Switzerland) on tooth Mx1M was negative. Buccal and palatal palpation showed no tenderness, but vertical percussion was painful. Periodontal probing and mobility were within physiological limits. A preoperative periapical radiograph showed a mesio-occlusal carious lesion close to the pulp and widening of the periodontal ligament space near the mesiobuccal root (Fig. 1A). Based on clinical and radiographic findings, pulpal necrosis with symptomatic apical periodontitis was diagnosed, and nonsurgical endodontic treatment was planned. After obtaining informed consent, root canal treatment was initiated.

Local anesthesia was administered using 1.8 mL of 2% articaine with 1:200,000 epinephrine (Haver Pharma; Septodont, Istanbul, Turkey). An access cavity was prepared under rubber dam isolation. After access, the mesiobuccal 1 (MB1), distobuccal 1 (DB1), and mesiopalatal (MP1) canal orifices were located. Upon detecting the second mesiobuccal (MB2) canal, additional canals were suspected. The procedure continued under a dental operating microscope (DOM) (Extaro 3000, Carl Zeiss Meditec, Germany) at 2.5× magnification (Fig. 2). Examination with the DOM revealed a second palatal canal (MP2) and a third palatal orifice (DP). A dentin aberrancy between DB and DP orifices suggested an extra canal, leading to the discovery of the second distobuccal (DB2) canal 3 mm buccally to DP with an ultrasonic tip (E4D, Woodpecker, China). Three additional canals (MP2, DP, DB2) were identified, necessitating modification of the traditional triangular access to a trapezoidal shape. Due to calcification, MB2 and DB2 required multiple attempts for exploration using ethylenediaminetetraacetic acid (EDTA) and ISO #8 K-files (Mani, Japan). Patency was confirmed with ISO #10 K-files. Orifices were shaped using ProTaper Gold SX (Dentsply Maillefer, Switzerland) (Fig. 3). Working length was determined with an apex locator

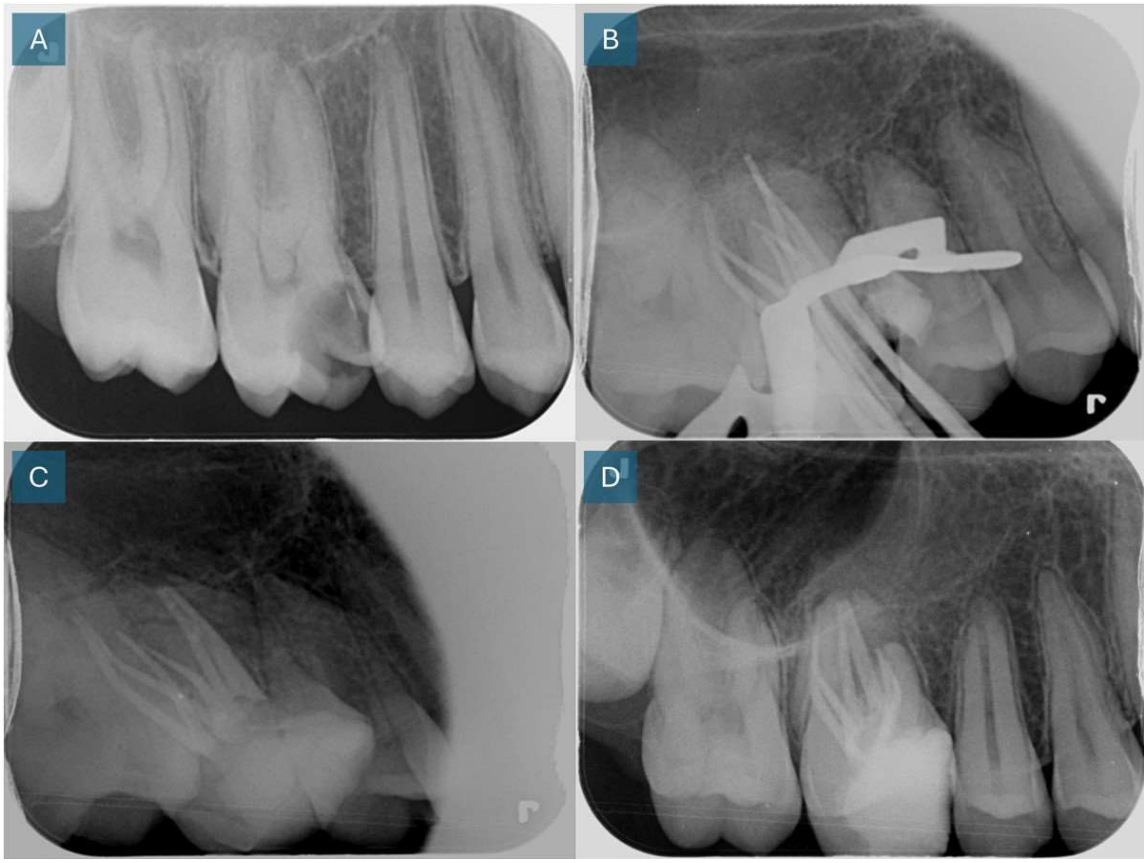

Fig. 1. (A) Periapical radiograph of the right maxillary first molar, (B) Master cone radiograph, (C) Post-obturation radiograph, (D) 2 months follow up

(Root ZX Mini, Morita, Japan). Cleaning and shaping were performed with ProTaper Universal files using the crown-down technique. Palatal canals were prepared to size 40.04, others to 30.04, with nickel-titanium rotary instruments. Irrigation was done with 2.5% sodium hypochlorite (NaOCl). After a master cone radiograph (Fig. 1B), final irrigation was performed. NaOCl was ultrasonically activated (DTE S6, Woodpecker, China), followed by 17% EDTA for 1 min per canal. The canals were dried with absorbent paper points (Dentsply Maillefer, Switzerland). Obturation was completed with cold lateral compaction of gutta-percha and AH Plus resin sealer (Dentsply Maillefer, Switzerland). A final radiograph was taken to assess obturation quality (Fig. 1C). The tooth was restored with a posterior composite filling (Z100; 3M ESPE, USA). The patient reported no post-treatment discomfort and remained asymptomatic at the 2-month follow-up (Fig. 1D).

Fig. 2. Dental operating microscope (DOM) (Extaro 3000, Carl Zeiss Meditec, Germany) that was used in the study

3. Discussion

A thorough understanding of Mx1M root canal morphology is crucial for endodontic success. Variations, especially in multi-rooted teeth, pose challenges, as removing pulp remnants, microorganisms, and toxins is essential. Extensive isthmuses, anastomoses, and inaccessible areas exist in all multi-rooted teeth.[10] Numerous studies have investigated Mx1M morphology.[3, 11-13] Typically, it has three roots and four canals, with MB2 reported in over 50% of cases.[14-16] Case reports have documented the presence of three canals in the mesial root of Mx1M as well.[17-19] Mx1M commonly has a broad buccolingual mesiobuccal root and a rounded or ovoid distobuccal root [20], explaining the higher incidence of multiple MB canals.[3] In the study by Sert and Bayırlı, the prevalence of Mx1M DB2 canal in the Turkish population was reported as 1.6–9.5%.[21] Mx1M with the DB3 canal has also been reported in the literature.[8,19,22,23] The incidence of five and six canals is 2.25–2.4% and 0.319–0.88%, respectively.[24,25] Cases with three canals in the palatal root are also uncommon.[26,27]

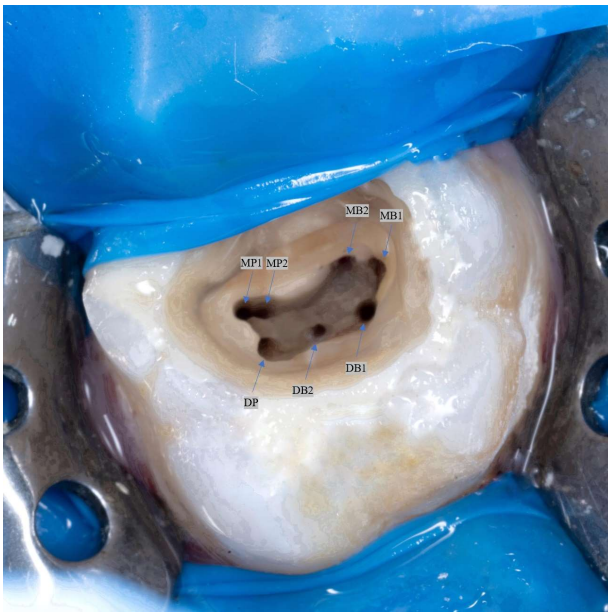

Fig. 3. Canal orifices after coronal shaping

Root canal complexity is a major challenge in endodontics. Magnification is key in overcoming this, with the endodontic microscope revolutionizing the field by offering 3x–30x magnification and superior illumination. It has significantly improved both surgical and conventional endodontic outcomes. Key advantages of magnification include enhanced visualization, improved ergonomics, and increased referral rates.[27] Buhrley et al. found MB2 detection rates of 71.1% with a microscope, 62.5% with dental loupes, and 17.2% without magnification.[28] In our case, three initially invisible canals were detected using a microscope. Periapical radiographs and DOM-assisted treatment helped determine root canal anatomy, though they may not always suffice.

In the past decade, micro-CT has emerged as the gold standard for studying root canal morphology due to its high-resolution imaging. While it provides more detail than CBCT, it is not clinically applicable.[29] CBCT aids in identifying complex root canals but was not used in this study, a potential limitation. However, DOM enabled a detailed examination, adhering to the ALARA principle, though CBCT use may be justified in some cases.

4. Conclusion

This report serves to present to the dental practitioners the complexities in root canal morphologies that the maxillary first molars can exhibit. A clinician should have a thorough knowledge of all the diversities and should perform a careful examination of the floor of the pulp chamber with a DOM. Lack of knowledge about accurate anatomical configurations of the root canals may lead dentists to leave remaining necrotic tissue, toxic products, and microorganisms in untreated missing canals, resulting in unsuccessful endodontic treatment.

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Conflict of Interest

The authors declare no conflict of interest.

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