"Unveiling Complexity: Six-Canaled Maxillary Molar Managed with Magnification"

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INTRODUCTION

The maxillary first molar is one of the most commonly treated teeth in endodontic due to its complex anatomy, which has intrigued clinicians for a long time. The primary goal of endodontic therapy is the accurate identification, thorough cleaning and shaping, and three-dimensional obturation of the entire root canal system.(1) Failure to detect additional roots or canals can lead to endodontic treatment failure.(2)

Typically, maxillary molars are described as having three roots and three canals, with one canal in each root. However, studies have shown considerable variation in the number and configuration of root canals in these teeth. The occurrence of a third canal in the mesiobuccal root (MB3) of the maxillary first molar is rare, with a reported incidence ranging from 1.1% to 1.6%.(3,4) Similarly, the presence of a second canal in the distobuccal root (DB2) has been reported in 1.7% of cases.(5)

This clinical report presents a rare case of a maxillary first molar with six root canals. Successful identification and treatment of all root canals in this patient were confirmed through the use of 20-degree horizontally angulated radiographs, aided by magnification with loupes.

CASE HISTORY/EXAMINATION

A 28-year-old male reported to the Department of Conservative Dentistry and Endodontics at our Institute with a chief complaint of spontaneous tooth pain in the left posterior maxillary region for the past five days. He informed that the pain worsened during sleep. The patient had experienced intermittent pain in the upper left maxillary first molar over the previous two months, triggered by hot and cold stimuli. Six days prior, a general dentist had initiated root canal treatment on the tooth, but the patient experienced no relief.

The patient's medical history was insignificant. His Intraoral examination revealed a temporary restoration in the upper left first molar with tenderness on percussion. Periodontal probing showed that the tooth was non-mobile and exhibited normal physiological function. The vitality tests performed using heated gutta-percha (Dentsply Maillefer, Ballaigues, Switzerland) and Endo-Frost (Coltene, USA), elicited severe pain that lasted for over a minute. Adjacent teeth responded normally to these tests.

A preoperative intraoral periapical radiograph (IOPA) revealed a restoration involving the pulp and periodontal ligament widening in both the mesiobuccal and distobuccal roots (Fig. 1a). The IOPA did not show any unusual canal morphology. Based on clinical and radiographic findings, a diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made.

METHODS

The clinician informed the patient of the diagnosis and recommended root canal treatment. After obtaining consent, local anesthesia was administered using 1.8 ml of 2% lidocaine with 1:100,000 epinephrine. A rubber

dam was placed to ensure isolation of the operative field. All subsequent procedures were performed under magnification using loupes. The existing restoration was removed, the endodontic access cavity was refined, and a pre-endodontic buildup was completed using composite.

During the clinical examination, four root canals were initially identified: mesiobuccal (MB), mesiobuccal 2 (MB2), distobuccal (DB), and palatal (P). Under magnification and with the aid of a DG 16 endodontic explorer (Hu-Friedy), two small hemorrhagic pinpoints were detected in the grooves extending from the MB to P and DB to P directions. Further exploration led to the identification of additional canals, namely MB3 and DB2, which were successfully negotiated using a #8 K-file (MANI, Dentsply) (Fig. 1b).Top of Form

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The initial access design for the canals was triangular but was modified to enhance accessibility to the additional canals. An electronic apex locator (AirPex, Eighteeth, Changzhou Sifary Medical Technology, China) was used to determine the working lengths of all six canals, and the measurements were confirmed with a digital radiograph (Fig. 2a). The first distobuccal canal was found to merge with the second distobuccal canal in the middle third, continuing as a single canal.

Digital radiovisiographs (Kodak RVG system) taken at a 20-degree angle revealed the convergence of the MB1 and MB2 canals in the apical third (Fig. 2b). Initial instrumentation of the canals was performed using #15 stainless steel K-files (Mani Inc, Tochigi, Japan) with 5% sodium hypochlorite (Septodont, Saint-Maur-des-Fossés, France) as the irrigant. The canals were then cleaned and shaped using Protaper rotary nickel-titanium files (Dentsply Maillefer) with a crown-down technique. To promote healing, calcium hydroxide (Prime Dental Products, Thane) was placed as an intracanal medicament, and the access cavity was temporarily sealed with Cavit-Temp (Ammdent, Mohali, Punjab).

After one week, the tooth was asymptomatic. The final obturation was completed using Bioceramic sealer (SafeEndo, Vadodara, India) and Guttapercha (Dentsply Maillefer) (Fig. 3a, 3b). Post-obturation radiographs were taken to confirm the successful completion of the procedure (Fig. 4a, 4b). Two weeks after obturation, prosthetic rehabilitation was carried out with a zirconia crown (Fig. 5a, 5b). At the six-month follow-up, the patient remained asymptomatic, and radiographs showed evidence of periapical healing (Fig. 5c).

CONCLUSION and RESULTS

A thorough understanding of the complexity and variations in the root canal system, combined with increased operator experience and extended appointment time, along with proper illumination, greatly aids in the identification and treatment of additional canals.

DISCUSSION

Special attention to root canal anatomy is crucial during root canal therapy due to its significant variability and complexity. A thorough understanding of the internal morphology of root canals is essential for achieving successful endodontic outcomes. Studies have documented a wide range of variations in the number of roots and root canals in the maxillary first molar. According to Lee et al., the mesiobuccal root canal of maxillary first molars presents a particular challenge in endodontics due to its marked morphological variability.(6)

Research on maxillary first molars has consistently shown that the second mesiobuccal canal (MB2) is the most frequently encountered, with incidence rates ranging from 18.6% to 96.1%. The third mesiobuccal canal (MB3) is less common, with an incidence of 1.3% to 2.4%.(7) The mesiopalatal canal is reported in 56.8% of cases, followed by the second distobuccal canal (DB2), found in 1.6% to 9.5% of cases. The distopalatal canal has the lowest frequency, observed in only 1.7% of cases.(8) Therefore, meticulous attention is required during endodontic treatment to prevent complications from untreated or missed canals. Allan et al. reported that approximately 8.8% of endodontic failures requiring retreatment were due to untreated missed canals.(9)

Various traditional methods have been used to locate additional canals, including techniques such as the "champagne or bubble test" with sodium hypochlorite, 1% methylene blue staining, sharp explorer canal

exploration, identification of bleeding points, the red line test, the white line test, and obtaining oblique preoperative radiographs. In this case, radiographs taken from different angles, combined with a thorough examination of the pulp chamber floor, effectively revealed the variable anatomy, making advanced imaging techniques such as spiral computed tomography (SCT) and cone-beam computed tomography (CBCT) unnecessary. Although these imaging modalities provide detailed insights into root and canal anatomy, they also pose a risk of increased radiation exposure for the patient.

The operator's experience plays a critical role in successfully locating and negotiating complex canals in the mesiobuccal root of maxillary molars. Experienced clinicians demonstrate a higher success rate in identifying these challenging canals.(10) It is essential for the operator to allocate adequate time during the procedure to thoroughly search for additional canals. Clinically, the appearance of off-center files during exploration or in the working length radiograph may indicate the presence of extra canals within the root.(11,12) Since the primary goal for both patients and clinicians is the long-term retention of natural teeth, endodontic therapy remains the preferred treatment approach for addressing pulpal and periradicular pathology.

AUTHOR CONTRIBUTIONS

Promila Verma: writing original draft , Review and editing

Ankita Agarwal : Investigation; writing original draft.

Dr Rhythm: Formal analysis; writing – original draft.

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CONFLICT OF INTEREST Authors have no potential conflict of interest

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