International Journal Dental and Medical Sciences Research
Volume 7, Issue 5, Sept – Oct 2025 pp 200-203 www.ijdmsrjournal.com ISSN: 2582-6018

Endodontic Management of a Maxillary First Molar with Six Distinct Canals Identified Using Dental Loupes and Digital Radiography: A Rare Anatomical Variation

Dr. SINCY Z K[1], Dr. REJULA F[2], Dr. VARNIKA PARUPALLI[3]
[1]*Junior Resident, Department of Conservative Dentistry & Endodontics, Government Dental College, Trivandrum*
[2]*Professor(CAP), Department of Conservative Dentistry & Endodontics, Government Dental College, Trivandrum*
[3]*Junior Resident, Department of Conservative Dentistry & Endodontics, Government Dental College, Trivandrum*
CorrespondingAuthor: Dr. SINCY Z K

Date of Submission: 15-09-2025 Date of Acceptance: 25-09-2025

ABSTRACT:
The maxillary first molar is known for its anatomical complexity, particularly in the mesiobuccal root. While the presence of a second mesiobuccal canal is well-documented, the occurrence of a third mesiobuccal canal and an additional canal in the distobuccal root is extremely rare. This case report presents the successful nonsurgical endodontic management of a maxillary left first molar with six separate canals: MB1, MB2, MB3, DB1, DB2, and P. Diagnosis and treatment were completed without cone-beam computed tomography (CBCT), relying solely on careful inspection under 5× dental loupes and multiple angled digital radiographs. This case highlights the effectiveness of enhanced magnification and conventional diagnostic tools in identifying rare root canal configurations.

Keywords: Maxillary first molar, six canals, MB3, root canal morphology, 5× dental loupes, digital radiography

I. INTRODUCTION

Root canal morphology of the maxillary first molar is among the most variable in the dentition, particularly in the mesiobuccal (MB) root. The existence of a second MB canal (MB2) is common; however, a third MB canal (MB3), as well as a second distobuccal (DB) canal, is exceedingly rare (1,2). Failure to locate and treat such canals can result in endodontic failure (3).

Although cone-beam computed tomography (CBCT) offers excellent diagnostic clarity, it is not always readily accessible and is associated with a relatively higher radiation dose compared to conventional radiography, which may limit its use in routine cases. This case report presents the nonsurgical endodontic treatment of a maxillary first molar with six separate canals, identified and managed using 5× dental loupes and digital radiography alone.

II. CASE REPORT

A 36-year-old female reported with pain while chewing in the upper left back region for one week. The pain was intermittent and aggravated during mastication.

Clinical and Radiographic Findings

- Tooth #26 was tender to percussion, with no swelling or sinus tract.
- Thermal and electric pulp testing produced a lingering response.
- Periodontal examination was within normal limits.
- Radiographic evaluation (intraoral periapical radiograph using RVG) showed deep caries encroaching upon the pulp with signs of periapical ligament space widening.

A diagnosis of **symptomatic irreversible pulpitis with symptomatic apical periodontitis** was made, and nonsurgical root canal treatment was planned.The diagnosis, treatment procedure, potential risks, and expected outcomes were explained to the patient in detail, and informed consent was obtained prior to starting the treatment.

Access and Canal Location

Following local anesthesia(2% lidocaine with 1:100,000 epinephrine, Lignospan Special, Septodont, France) and rubber dam isolation, an access cavity was preparedusing an EndoAccess bur (Dentsply Maillefer, Ballaigues, Switzerland) and refined with an Endo-Z bur (Dentsply Maillefer, Ballaigues, Switzerland). Ultrasonic tips(Woodpecker, Guilin Woodpecker Medical Instrument Co. Ltd., Guilin, China) and a DG-16

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explorer(Medesy S.p.A., Maniago, Italy)were used to refine the access and carefully trough the pulp chamber floor, aiding in canal location.

Exploration under 5× magnification dental loupes(Admetec Ergo, Admetec Ltd., Haifa, Israel)) and illumination (Orchid- F, Admetec Ltd., Haifa, Israel) enabled identification of:

- Three distinct canals in the MB root: MB1, MB2 (palatal to MB1), and MB3 (distal to MB2).
- Two separate canals in the DB root: DB1 and DB2.
- A single palatal canal (P).

Working Length and Canal Preparation

Working lengths were established using an apex locator(Eighteeth AirPex electronic apex locator, Changzhou Sifary Medical Technology Co., Ltd., China) and confirmed using angled RVG images (20° mesial and distal). All canals were negotiated with #10 K-files (Mani Inc., Tochigi, Japan) and prepared with VDW.ROTATE system (VDW GmbH, Munich, Germany), with canal preparation completed up to 25/.04 in the MB canals and DB canals and up to 25/.06 in the palatal canal. Irrigation was performed following the recommendations of the American Association of Endodontists (AAE) to ensure effective disinfection and smear layer removal. The protocol was as follows:

- Initial irrigation with 5.25% sodium hypochlorite (Prime Dental Products Pvt. Ltd., India) after each instrument change, using a side-vented needle, with a total contact time of approximately 20–30 minutes during the procedure.
- Each sodium hypochlorite rinse was followed by a flush with normal saline (Abaris Healthcare Pvt. Ltd., India) to neutralize its activity and prevent interactions with other irrigants.
- After completion of instrumentation, canals were rinsed with 17% EDTA solution (RC Help, Prime Dental Products Pvt. Ltd., India) for 1 minute to remove the smear layer.
- A final rinse with normal saline was performed to eliminate residual EDTA and prevent prolonged dentin erosion.
- To enhance irrigant penetration and effectiveness, sonic activation was performed using the EndoActivator system (Dentsply Sirona, USA) for 30 seconds per canal after the final NaOCl and EDTA rinses.

III. OBTURATION AND FINAL RESTORATION

The canals were dried with sterile paper points and obturation was performed using the single cone technique with matching VDW.ROTATE gutta-percha points25/.04 in the MB canals and DB canals and 25/.06 in the palatal canal(VDW GmbH, Munich, Germany)and AH Seal resin-based sealer (Dentsply Sirona, USA). Access was sealed with resin modified glass ionomer cement (RMGIC, Prevest DenPro Ltd., India)and final restoration given with resin composites(Palfique Omnichroma, Tokuyama Dental Corp., Japan). Post-obturation radiographs confirmed dense three-dimensional fills in all six canals.

Follow-Up

At 6-month follow up, the patient remained asymptomatic. Radiographic examination showed normal periapical healing and integrity of the obturation.

Figure 1. Preoperative periapical radiograph of tooth #26 showing deep caries involving the pulp with widening of the periodontal ligament space.

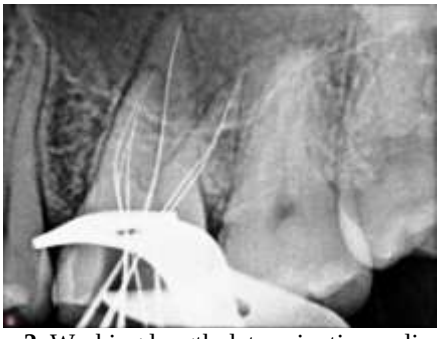

Figure 2. Working length determination radiograph confirming six canals: MB1, MB2, MB3, DB1, DB2, and palatal (P).

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Figure 3. Master cone fit radiograph demonstrating well-fitted gutta-percha cones corresponding to all six prepared canals.

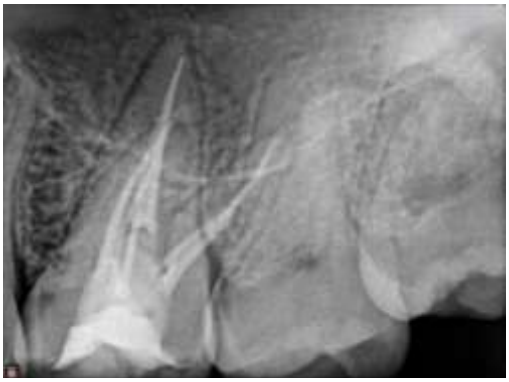

Figure 4. Immediate postoperative radiograph showing dense three-dimensional obturation of six canals with single cone technique and AH Seal.

Figure 5. Follow-up radiograph at 6 months revealing satisfactory periapical healing and maintained obturation quality.

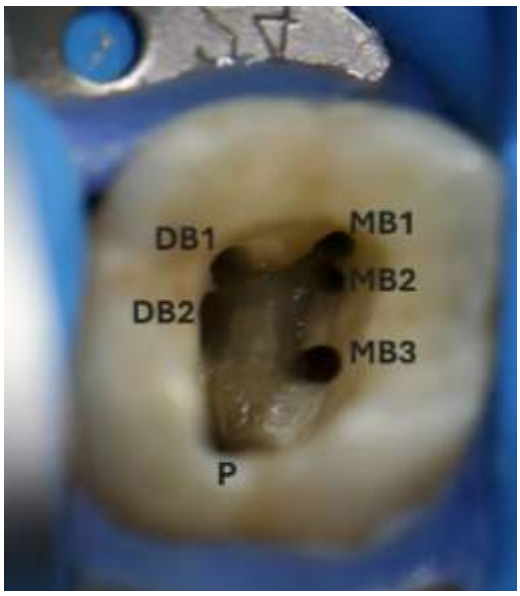

Figure 6. Intraoperative photograph showing canal orifice location under 5× dental loupes (Admetec, Ergo), revealing MB3 and DB2.

IV. DISCUSSION

The maxillary first molar is among the most anatomically complex teeth, frequently presenting with additional canals in the mesiobuccal (MB) root. While the presence of a second MB canal (MB2) is relatively common, the occurrence of a third MB canal (MB3) and a second distobuccal (DB) canal is exceedingly rare. The failure to locate and treat these additional canals has been associated with persistent symptoms and endodontic failure (1–3).

In the present case, six distinct canals were successfully identified and managed in tooth #26 using 5× magnification dental loupes (Admetec, Ergo) and digital radiography (RVG) alone. Despite the absence of cone-beam computed tomography (CBCT), a meticulous approach, aided by high-quality magnification and illumination, facilitated the detection of all canal orifices. This aligns with clinical reports emphasizing that even in the absence of advanced imaging, improved visualization through loupes or microscopes can significantly increase the detection rate of complex canal anatomies (4,5).

The MB3 canal was located distal to the MB2 and confirmed radiographically. Though uncommon, the presence of a third canal in the MB root has been documented in rare cases (2,6). Similarly, the identification of two separate canals in the DB root is unusual and requires a high index of suspicion. In this case, proper access cavity modification and targeted troughing allowed for the

successful negotiation and treatment of both DB canals.

Root canal shaping was performed using the VDW.ROTATE rotary NiTi system, which offers controlled flexibility and centering ability, particularly beneficial in anatomically complex cases. Obturation was performed using the single cone technique with matching gutta-percha cones and AH Seal sealer, a biocompatible resin-based material with excellent sealing properties.

This case reinforces the principle that with careful technique and proper magnification, even rare anatomical variants can be effectively managed without reliance on CBCT. Although three-dimensional imaging improves diagnostic capability, it should not be viewed as an absolute necessity in every case, particularly when skilled clinical methods and enhanced visualization tools are used appropriately.

Clinical Implications

High magnification with loupes enables improved visualization of accessory canal orifices, particularly when CBCT is not available or indicated.

Careful access refinement and canal orifice exploration remain fundamental to successful endodontic treatment.

Single cone obturation, when matched with the correct preparation system and sealer, can achieve a predictable and hermetic seal.

Literature Context:

- Vertucci's classification does not account for a third MB canal, underlining the rarity of such morphology (1).
- Studies by Kulid and Peters and others suggest that missed MB2 canals are a major cause of endodontic retreatment—underscoring the importance of magnification and tactile exploration (2,3).

V. CONCLUSION

This report illustrates that successful identification and treatment of six canals in a maxillary first molar can be achieved using **5× dental loupes and conventional RVG imaging**, without relying on CBCT. This reinforces the value of enhanced magnification, careful access refinement, and multiple radiographic views in detecting uncommon anatomical configurations and ensuring long-term clinical success (3,5,6).

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. The patient has given consent for her images and clinical data to be used for academic publication, with the understanding that confidentiality will be maintained.

Financial Support and Sponsorship

Nil.

Acknowledgments

None.

Conflict of Interest

The authors declare no conflict of interest.

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