

Unveiling Anatomical Variation in Root Canal Anatomy: A Case Report of a Maxillary Molar with Seven Canals

Aayush Bhatt¹, Roshan Samuel¹, Priyanka Zinge¹, Sakshi Lawande¹

¹Department of Conservative Dentistry and Endodontics, School of Dental Sciences, Karad, India

Corresponding Author: Aayush Bhatt

DOI: <https://doi.org/10.52403/ijrr.20250657>

ABSTRACT

Root canal anatomy is complex, and understanding anatomical variations is essential for successful treatment. This case report highlights a maxillary first molar with a rare anatomical variation consisting of seven canals: three in the mesiobuccal (MB1, MB2, MB3), two in the distobuccal (DB1 and DB2), and two in the palatal (P1 and P2) roots. Cone beam computed tomography (CBCT) examination was performed to confirm the presence of these seven canals. Diagnosing and managing such complex canal configurations presents significant challenges in endodontics. The patient was treated with the lateral compaction technique for obturation. A thorough understanding of root canal morphology and its potential variations is crucial for achieving effective access, cleaning, and obturation. Reporting rare cases like this helps expand clinical knowledge and improve the management of complex root canal systems in endodontic practice.

Keywords: Anatomy, Cone-Beam Computed Tomography, Maxillary molar, Root canal therapy, Tooth abnormality

INTRODUCTION

An in-depth understanding of root canal anatomy and its variations is essential for success of non-surgical root canal therapy

(RCT).^[1] It may be challenging to diagnose and treat pulp cavities accurately due to anatomical variations, especially in teeth that have numerous roots.^[2] One of the important causes of unsuccessful treatment outcome is the failure to identify or address additional canals beyond expected number.^[1] Studies have shown that these anatomical complexities, particularly the presence of additional canals may be responsible for significant proportion of treatment failures.^[3,4]

Maxillary molars exhibit the highest incidence of non-surgical RCT failures among all permanent teeth, attributable to their intricate anatomy.^[5] The maxillary molars typically have three roots and three corresponding canals, with the second mesiobuccal canal (MB2) occurring in 50.4% to 91.1% of cases, while the third mesiobuccal canal (MB3) is an uncommon finding, present in only 0.2% to 4.2% of cases.^[6,7] Although extra canals in the palatal and distobuccal roots are relatively rare, the occurrence of a second distobuccal canal (DB2) varies between 1.6% and 9.5%, while two canals in the palatal root have been observed in 0.2% to 7.0% of cases.^[8,9] Despite previous studies reporting unusual cases of maxillary molars with up to 7 canals,^[10-13] the present case adds further insight into these rare anatomical variations. This case report describes a maxillary first molar with 7 root canals, underscoring the

importance of documenting such exceptional cases to enhance clinician awareness and preparedness for similar clinical scenarios. The current case report is prepared according to CARE guidelines of reporting case reports.^[14]

CASE REPORT

A 35-year-old male presented to the Department of Conservative Dentistry and Endodontics with moderate pain in the upper right posterior region, which had been lasting for two weeks. Upon clinical examination, the upper right maxillary first molar had deep proximal caries. The tooth exhibited moderate pain upon palpation and percussion. However, it showed a healthy periodontium, normal mobility, and

no signs of other abnormalities. The preliminary periapical radiograph showed a deep Class I carious lesion in tooth #16 with involvement of the pulp (Figure 1). An early painful response was initially elicited by vitality testing using a cold test (Endo Frost, Roeko, Langenau, Germany), followed by an electric pulp test (Parkel Electronics Division, Farmingdale, NY, USA). Considering both the clinical and radiographic findings, a diagnosis of Acute Irreversible Pulpitis with Apical Periodontitis was established. After discussing the tooth's condition and the full treatment plan with the patient and obtaining their consent, RCT for the affected tooth was scheduled.

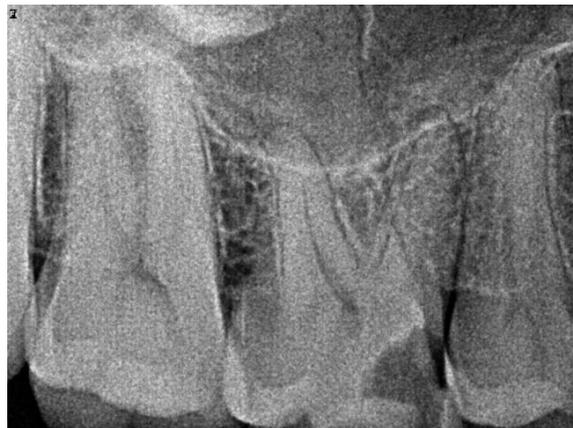


Figure 1: Pre-operative radiograph of the upper right first molar

The preoperative radiograph did not show any anatomical variations in the number of root canals present in the tooth. After administering local anaesthesia (1.8ml of 2% lignocaine with 1:100,000 epinephrine), rubber dam isolation was established. Following the removal of caries with a #2 round bur using a slow-speed handpiece, the pulp chamber was deroofed. During the access preparation, the mesiobuccal (MB1), distobuccal (DB2), and palatal (P1) canal orifices were initially identified. Troughing with ultrasonic tips revealed additional canals—MB2, MB3, and DB2—facilitating straight-line access. Further modification of the access preparation also uncovered a

second P canal (P2). (Figure 2).

Cone-beam computed tomography (CBCT) imaging was carried out on the patient to confirm the presence of seven canals (Figure 3). A DG-16 explorer was used to determine the canal orifices under magnification, and Orodeka orifice openers were employed for coronal flaring to enhance accessibility. An electronic apex locator (Root ZX; Morita, Tokyo, Japan) was used to establish the working length, and K-files were employed to maintain canal patency. The working length was verified radiographically after initial hand filing up to size #20 was performed in all canals (Figure. 4).



Figure 2: Intra-oral photograph of the upper right first molar

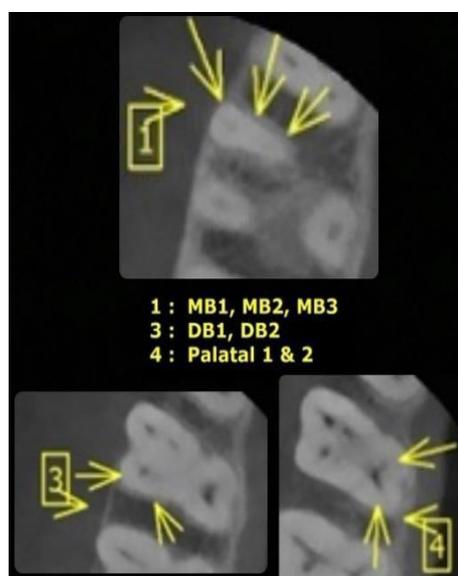


Figure 3: CBCT Axial view to confirm the presence of seven canals



Figure 4: Periapical radiograph of working length confirmation

Calcium hydroxide placed as an intracanal medicament, and canals were sealed with a temporary intermediate restoration (Cavit, ESPE, Seefeld, Germany). A follow-up appointment was scheduled for the patient one week later. On a subsequent visit, canal preparation was completed using Coltene Hyflex CM rotary files. The MB1, MB2, and MB3 canals were instrumented up to size 20.04, while the DB1 and DB2 canals up to size 25.04, and the P1 and P2 canals up to size 25.06.

Sodium hypochlorite (Prime Dental Products, Thane) was utilized extensively

for irrigation during treatment, and 17% EDTA (Premier Dental Products) was administered for the final rinse. After the canals were dried with paper points (Dentsply Maillefer), a master cone radiograph was then taken to confirm the fit (Figure 5). Obturation was carried using the lateral compaction method with gutta-percha (Dentsply Maillefer) (Figure 6). Finally, the access cavity was closed with a bonded reinforced composite resin restoration, and the patient was provided with post-treatment instructions before being dismissed. (Figure 7).

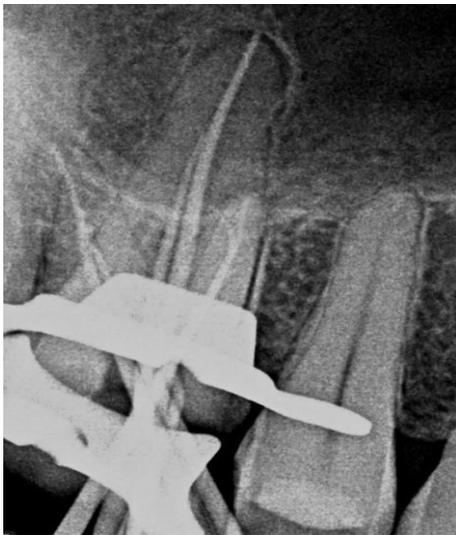


Figure 5: Master cone fit check with the upper right first molar



Figure 6: Post-obturation radiograph of the upper first molar



Figure 7: Post-endodontic restoration radiograph of the upper first molar

DISCUSSION

As reported in most of the dental literature, the maxillary first molar typically features three roots and generally has four root canals with MB2 canal present in 18.6-96.1% of the cases.^[1] This case, however, highlights a rare variation- a maxillary first molar with seven root canals. Documenting such unusual cases is highly valuable for educational purposes, as it enhances clinicians' ability to recognize and manage similar anatomical complexities during endodontic treatment. Due to the complex and variable nature of root canal anatomy, mastering these differences is crucial for determining apical limits, performing cleaning and shaping, and achieving successful treatment outcomes.^[5,9,15]

Identifying and disinfecting additional canals can be challenging, as it depends on various factors. Locating these additional canal orifices requires the use of advanced equipment and techniques, including magnifying loupes, dental operating microscopes with improved illumination, and ultrasonic tips for troughing.^[16] Additionally, methods such as utilizing the DG-16 explorer to examine the chamber floor and the Champagne bubble test-which employs sodium hypochlorite or 1% methylene blue dye-can help identify hidden canals.^[17,18] Moreover, ultrasonic tips, thin tapered finishing burs, and specific round burs are valuable for removing calcifications, minor tooth structures, and troughing the line angles of the pulpal floor.^[12]

To identify the root and canal configuration, periapical radiographs taken at various angles are a crucial component of endodontic treatment. However, periapical radiographs are compressed 2-dimensional images of 3-dimensional objects, which limit the amount of information that can be obtained from them. This might explain why the radiographic study of the tooth did not reveal any abnormalities in the canal structure. In this case, after a clinical evaluation suggested atypical anatomy, the patient underwent a CBCT examination,

which revealed a more accurate representation.

CBCT has become an essential tool in various dental fields due to its ability to provide high contrast, detailed structural images, and a three-dimensional view of dental anatomy.^[13] In the present case, CBCT confirmed the presence of three mesiobuccal canals, two distobuccal and two palatal canals, which is imperative to the success of the treatment. However, the use of CBCT is generally restricted to teeth with suspected complex anatomical or morphological issues to minimize exposure to ionizing radiation, even though the exposure is minimal.^[13] Proper access cavity design is crucial for identifying and negotiating complex canal anatomy. In this case, to enhance accessibility to additional canals, traditional triangular access shape has been modified to trapezoidal shape. Palatal root demonstrated Vertucci's Type-II configuration, where two distinct canals merged into one at the apex. Notably, this case featured both MB2 and MB3 canals. It is quite rare for all three of maxillary first molar's roots to have dual canal systems simultaneously.

Ultimately, to prevent endodontic failures caused by missed canals or incomplete preparation and obturation, it is crucial to have a thorough understanding of root canal morphology and a heightened awareness of potential anatomical variations. The application of appropriate diagnostic techniques, along with adjustments to access cavity design, can significantly improve the identification and management of complex cases. By integrating these strategies into clinical practice, the success rate of endodontic treatments can be greatly enhanced.

CONCLUSION

This case presentation underscores the importance of developing a comprehensive understanding of anatomical variations in all teeth, particularly in maxillary posterior teeth, to ensure successful RCT. Clinicians must remain vigilant, as both external and

internal tooth anatomy can deviate from the norm. While the occurrence of maxillary first molars with seven root canals is exceptionally rare, each case requires a meticulous clinical and radiographic evaluation to accurately identify any anatomical anomalies. By remaining thorough in these assessments, clinicians can improve treatment outcomes and reduce the risk of endodontic failure.

Declaration by Authors

Acknowledgement: None Source of

Funding: None

Conflict of Interest: No conflicts of interest declared.

REFERENCES

1. Zhang ZH, Yao HL, Zhang Y, Wang X. Endodontic management of the maxillary first molar with special root canals: A case report and review of the literature. *World J Clin Cases*. 2020 Jun 26;8(12):2590-2596. doi: 10.12998/wjcc. v8.i12.2590.
2. Malagnino V, Gallottini L, Passariello P. Some unusual clinical cases on root anatomy of permanent maxillary molars. *J Endod*. 1997 Feb;23(2):127-8. doi: 10.1016/S0099-2399(97)80260-9.
3. Vertucci FJ. Root canal anatomy of the human permanent teeth. *Oral Surg Oral Med Oral Pathol*. 1984 Nov;58(5):589-99. doi: 10.1016/0030-4220(84)90085-9.
4. DeGroot ME, Cunningham CJ. Mandibular molar with 5 canals: report of a case. *J Endod*. 1997 Jan;23(1):60-2. doi: 10.1016/S0099-2399(97)80211-7
5. Karobari MI, Arshad S, Noorani TY, Ahmed N, Basheer SN, Peeran SW, Marya A, Marya CM, Messina P, Scardina GA. Root and Root Canal Configuration Characterization Using Microcomputed Tomography: A Systematic Review. *J Clin Med*. 2022 Apr 20;11(9):2287. doi: 10.3390/jcm11092287.
6. Kaushik M, Mehra N. Maxillary first molars with six canals diagnosed with the aid of cone beam computed tomography: a report of two cases. *Case Rep Dent*. 2013; 2013:406923. doi: 10.1155/2013/406923.
7. Liu H, Hao J, Shen Y. Endodontic Treatment of a Maxillary Second Molar With Five Canals: A Case Report and a Literature Review. *Cureus*. 2024 Apr 27;16(4):e59179. doi: 10.7759/cureus.59179
8. Sert S, Bayirli GS. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. *J Endod*. 2004 Jun;30(6):391-8. doi: 10.1097/00004770-200406000-00004
9. Nayak G, Singh KK, Shekhar R. Endodontic management of a maxillary first molar with three roots and seven root canals with the aid of cone-beam computed tomography. *Restor Dent Endod*. 2015 Aug;40(3):241-8. doi: 10.5395/rde.2015.40.3.241
10. Beatty RG. A five-canal maxillary first molar. *J Endod*. 1984 Apr;10(4):156-7. doi: 10.1016/S0099-2399(84)80119-3.
11. Bond JL, Hartwell G, Portell FR. Maxillary first molar with six canals. *J Endod*. 1988 May;14(5):258-60. doi: 10.1016/S0099-2399(88)80180-8.
12. Yadav HK, Saini GK, Chhabra HS, Panwar PS. Endodontic management of a maxillary first molar with seven root canals using spiral computed tomography. *J Dent (Shiraz)*.2017;18(1):65-69
13. Rodrigues E, Brait AH, Galvão BF, da Silva EJ. Maxillary first molar with 7 root canals diagnosed using cone-beam computed tomography. *Restor Dent Endod*. 2017 Feb;42(1):60-64. doi: 10.5395/rde.2017.42.1.60.
14. Riley DS, Barber MS, Kienle GS, Aronson JK, von Schoen-Angerer T, Tugwell P, et al. CARE guidelines for case reports: explanation and elaboration document. *J Clin Epidemiol*.2017;89:218-235. doi: 10.1016/j.jclinepi.2017.04.026.
15. Hasan M, Rahman M, Saad N. Mandibular first molar with six root canals: a rare entity. *BMJ Case Rep*.2014: bcr2014205253. doi: 10.1136/bcr-2014-205253
16. Sujith R, Dhananjaya K, Chaurasia VR, Kasigari D, Veerabhadrappe AC, Naik S. Microscope magnification and ultrasonic precision guidance for location and negotiation of second mesiobuccal canal:

- An in vivo study. J Int Soc Prev Community Dent.2014;4:S209-12. doi: 10.4103/2231-0762.149045.
17. Bello MD, Tibúrcio-Machado C, Londero CD, Barletta FB, Moreira CH, Pagliarin CM. Diagnostic efficacy of four methods for locating the second mesiobuccal canal in maxillary molars. Iran Endod J. 2018;13(2):204. doi: 10.22037/iej.v13i2.16564.
18. Jain S, Mandke LP. The hunt for the hidden-Methods of locating root canals. Int. J. Oral Health Dent. 2022; 8:18-22. doi:10.18231/ j. ijohd.2022.005
- How to cite this article: Aayush Bhatt, Roshan Samuel, Priyanka Zinge, Sakshi Lawande. Unveiling anatomical variation in root canal anatomy: a case report of a maxillary molar with seven canals. *International Journal of Research and Review*. 2025; 12(6): 499-505. DOI: <https://doi.org/10.52403/ijrr.20250657>
