

The Outlier Premolar: Rare Anatomy in Maxillary Second Premolar"- A Case Report

Abstract:

Successful root canal therapy depends on the clinician's understanding of root canal anatomy, which often shows considerable variation, particularly in multirrooted teeth. The maxillary second premolar usually has a single root with one or two canals; however, the presence of three separate canals in distinct roots is exceedingly rare and presents diagnostic and therapeutic challenges.

This paper reviews anatomical variations in maxillary second premolars, highlighting the uncommon occurrence of three canals. Although their prevalence is minimal, undetected canals are a major cause of endodontic failure. Radiographic assessment remains the primary diagnostic tool, yet its two-dimensional limitations can obscure complex anatomy. Multi-angled periapical radiographs, CBCT imaging, and magnification through dental operating microscopes improve detection and management.

Proper access cavity design, meticulous exploration of the pulp chamber, and negotiation of fine canals using small hand files are crucial. Rotary systems like ProTaper Gold, used with a crown-down technique, facilitate effective shaping of intricate canal systems. Obturation with matching-taper gutta-percha cones and bioceramic sealers ensures a three-dimensional seal.

Geographic and ethnic factors may influence canal morphology, as suggested by reports from Brazil, Saudi Arabia, and East Asia. Clinicians should remain alert to such rare variations and modify their approach accordingly. Ultimately, a thorough understanding of anatomy, coupled with advanced diagnostic tools and refined clinical skills, is essential for successful management of maxillary second premolars with three canals.

Key-words: Anatomical variations, root anatomy, Maxillary second premolar, three root canals, endodontic procedure.

Introduction:

Successful root canal therapy largely depends on the clinician's understanding of root canal anatomy, which can often present with considerable variation. Even seemingly routine cases involving multirrooted teeth can become complicated without detailed knowledge of typical anatomical patterns and their possible deviations. Inadequate understanding of pulpal morphology leads to endodontic treatment failures.[1]

The maxillary second premolar typically presents with a single root containing one or two root canals. According to Vertucci, a single canal with one apical foramen occurs in approximately 75% of cases, while two canals converging at the apex are seen in about 24% of cases. The presence of three canals terminating at the apex is rare, occurring in only about 1% of instances.[2]

In single-rooted, single-canaled variants, the canal typically displays a broad bucco-palatal orientation, tapering sharply near the apical third. When two canals are present, they are usually divided by a dentinal septum. The presence of three canals in maxillary second premolars is extremely rare.[3]

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Received : 18 Dec., 2025, **Published :** 31 March, 2026

Access this article online

Website:
www.ujds.in

DOI:
<https://doi.org/10.21276/ujds.2026.12.1.12>

How to cite this article: Vookanti, Venkat Ramana Eddy, Mital, D. P., Raisingani, D. D., & Gurdasani, D. K. (2026). The Outlier Premolar: Rare Anatomy in Maxillary Second Premolar"- A Case Report. UNIVERSITY JOURNAL OF DENTAL SCIENCES, 12(1).

Research by Vertucci and Gegauff reported that 5% of 400 maxillary first premolars exhibited three canals, with configurations including: three canals within a single root (0.5%), two canals in one root and one in a second (0.5%), and three separate canals in three distinct roots (4%).[4]

In the Indian population, the maxillary second premolar exhibits a relatively higher prevalence of Type II canal configuration, occurring in approximately 33.6% of cases.[5]

Similarly, Carns and Skidmore documented 6 out of 100 maxillary first premolars with three separate canals in three roots.[6]

In a related study, Vertucci et al found three canals in only 2 out of 200 maxillary second premolars.[7]

Detecting the presence of three canals radiographically can be challenging. Meticulous evaluation of preoperative radiographs, combined with a solid understanding of internal tooth anatomy, is vital for endodontic success.

Sieraski et al observed that if the mesiodistal width at the mid-root level appears equal to or wider than the crown's width on a straight-on radiograph, the tooth likely has three roots.

Nonetheless, it is important to acknowledge the limitations of radiographs, which offer only two-dimensional representations of complex three-dimensional structures.

The term “radiculous” or “small molars” is sometimes used to describe maxillary premolars with three canals due to their resemblance to molar anatomy.[8]

A thorough radiographic assessment using horizontal angulation changes can significantly improve detection of additional roots and canals. Moreover, careful inspection of the pulp chamber during access preparation, along with sufficient removal of coronal dentin, is crucial for the accurate identification of canal orifices.[3]

Case Report:

A 28-year-old male presented to the Department of Conservative Dentistry and Endodontics at Mahatma Gandhi Dental College and Hospital with the chief complaint of pain in the upper right posterior region for the past two weeks. His medical and dental history were non-contributory.

Clinical examination revealed distoproximal caries in tooth #15(right maxillary second premolar) (FIG -1), which was tender on percussion. Vitality testing was done which elicited a negative response, suggesting non-vital pulp. A periapical radiograph showed distoproximal caries associated with

periodontal ligament space widening and a periapical radiolucency (FIG-2). An unusual root canal morphology was suspected, and cone-beam computed tomography (CBCT) was advised for further evaluation. CBCT imaging confirmed the presence of three root canals within a single root(1 Buccal & 2 palatal) with vertucci type VIII – 3 separate canals(3-3) canal configuration were identified(FIG-3).

Based on the clinical and radiographic findings, a diagnosis of Asymptomatic irreversible pulpitis with symptomatic apical periodontitis was made for tooth #15. Non-surgical root canal therapy was planned. Informed consent was obtained from the patient prior to the procedure.

Local anesthesia was administered using 2% lignocaine with 1:80,000 adrenaline via middle superior alveolar and greater palatine nerve block . The tooth was isolated using a rubber dam (Hygenic, Coltene, Switzerland), and all procedures were performed under magnification using a dental operating microscope (LEICA Microsystems, Wetzlar, Germany).

Following caries excavation with round diamond bur and spoon excavator, a pre-endodontic buildup was completed. Under magnification oval access cavity was created using an Endo Access bur and Endo Z bur(Dentsply, Maillefer, Switzerland) with a high-speed handpiece. Upon pulp chamber exploration, three distinct canal orifices (1 Buccal & 2 palatal)were identified (FIG-4).

The following instrumentation steps were carried out:

- Working length determination was done using both an electronic apex locator (J Morita Root ZX Mini, USA) and periapical radiographs with a #10 no K-file(FIG-5).
- Coronal flaring was achieved using a Pro-Taper Gold #SX orifice opener(Dentsply Maillefer, Ballaigues, Switzerland).
- Glide path preparation was done in all three canals with Proglider glide path file (Dentsply Maillefer, Ballaigues, Switzerland).
- Shaping and cleaning were carried out using Pro-Taper Gold Rotary files till F1 (Dentsply Maillefer, Ballaigues, Switzerland).

Irrigation was performed throughout the procedure using:

- 5.25% sodium hypochlorite (NaOCl) (SafeEndo Dental India Pvt. Ltd) for organic tissue dissolution followed by normal saline.
- 2.5% sodium hypochlorite (NaOCl) (SafeEndo Dental India Pvt. Ltd) irrigation During Instrumentation.

- Followed by 17% EDTA (SafeEndo Dental India Pvt. Ltd) for smear layer removal after Cleaning & Shaping.
- Normal saline followed by last Chlorhexidine (CHX)(SafeEndo Dental India Pvt. Ltd) rinse for antibacterial action.

Irrigation was activated using an ultrasonic activator to enhance debridement efficacy. After proper shaping and cleaning calcium hydroxide was placed as an intracanal medicament and the patient was recalled after one week.

At the follow-up visit, the tooth was asymptomatic, and obturation was performed using matching-taper gutta-percha cones and bioceramic sealer (Angelus Bio-C Sealer, Brazil) (FIG-6,7). The single cone technique was employed in all canals.

The canal orifices were sealed with a flowable composite, and the entire access cavity was restored with a bulk-fill composite material(FIG-8). The complete treatment was successfully performed in two sessions.

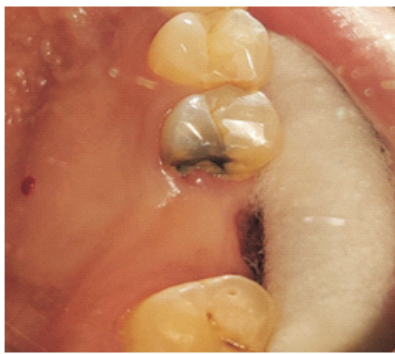


Fig. -1

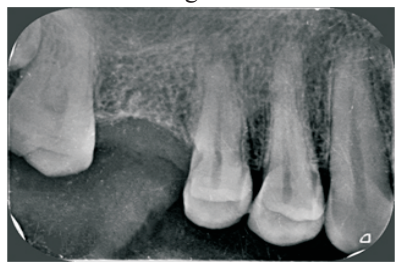


Fig-2



Fig. -3



FIG. - 4

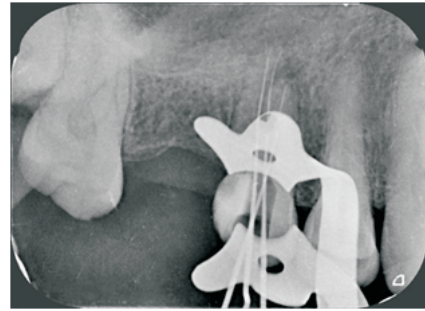


FIG. - 5

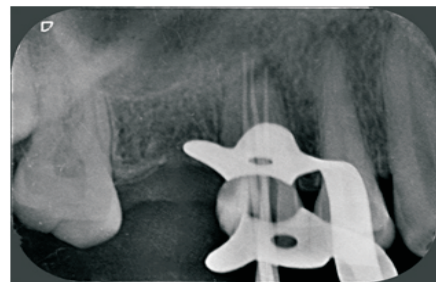


FIG. - 6



FIG. - 7



FIG. - 8

Discussion:

The endodontic management of maxillary premolars poses unique challenges due to the diverse variations in root number and canal configurations. As emphasized by Leonardo, failure to detect, locate, instrument, and properly treat all root canals can be a critical factor in endodontic treatment failure.[9]

Challenges faced during the treatment include identifying extra canals, access cavity preparation, canal negotiation, cleaning & shaping, and finally obturation.

Accurate identification of the extra root canals depends on radiographic interpretation. Periapical radiographs remain a primary diagnostic tool for assessing root and canal morphology. However, they provide only a two-dimensional view of a complex three-dimensional structure, which can result in missed canals, particularly when anatomical variations are present. To mitigate this limitation, radiographs taken at multiple horizontal angles (mesial and distal angulations) can enhance diagnostic accuracy by revealing additional canals that may not be visible in straight-on views.

Evaluate the width of the mid-root in radiographs if it is equal to or greater than the crown width, the presence of multiple roots or canals is likely

Cone-beam computed tomography (CBCT) has emerged as a valuable adjunct in complex cases, offering three-dimensional visualization of dental structures. Its use significantly improves the clinician's ability to detect unusual canal configurations such as presence of extra canals.

During clinical access preparation unusual pulp chamber anatomy or eccentric canal orifices may suggest extra canals.

Utilizing magnification through a dental operating microscope further enhances the clinician's ability to locate additional canal orifices. Improved illumination and magnification not only increase the accuracy of diagnosis and instrumentation but also contribute to better ergonomics and treatment efficiency.[10]

Create a modified oval access cavity to fully explore the pulp chamber floor and remove secondary or accessory dentin carefully to uncover canal orifices.

Canal negotiation in fine canals is difficult and should always start with small hand files (#6, #8, #10 K-files) to establish patency and glide path should be established using Proglider glide path file.

Due to the unusual root morphology and multiple canals, effective debridement and shaping of the entire canal system

can be difficult. To overcome this, use rotary file systems (e.g., Dentsply Pro-taper Gold rotary files) in a crown-down technique to allow for safe and controlled canal shaping.

Use of irrigant's with ultrasonic activation enhances cleaning of debris after shaping.

Obturation of three separate canals in a single root requires precision to avoid voids or overextension. To overcome this, use matching-taper gutta-percha cones that correspond with the final apical preparation size and use bio-ceramic sealers that offer excellent flow and bioactivity for sealing irregular canal spaces.

A review of the literature shows that cases of three-canal maxillary second premolars have been reported in specific geographic regions, including Brazil, Saudi Arabia, Turkey, Hong Kong, and Taiwan. This raises the possibility that genetic or ethnic factors may contribute to these anatomical differences, although further research would be required to confirm such associations.

Ultimately, the key to successful endodontic therapy lies in an accurate diagnosis, careful clinical inspection, and thorough radiographic evaluation. While familiarity with common root canal configurations is essential, the clinician must always remain alert to the possibility of deviations from the norm and adjust the treatment approach accordingly.[11]

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